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# Late Trading in Mutual Fund Shares – The Sequel?

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**Abstract** This paper provides new evidence of late trading activities in the mutual fund markets of France, Germany and the UK. We find that investors who are allowed to trade late can earn substantial returns between 18% and 35% annually. Late trading accounts for up to 0.6% of daily flow. Evidence of such illicit and abusive trading practices was uncovered in 2003 during a large scandal in the US fund industry. Our findings suggest that late trading may still persist in European markets. However, we do not find evidence of late trading in the UK.

**Keywords** Mutual funds · Fund flows · Late trading

**JEL Classification** G10 · G23 · G28

## 1 Introduction

The tip-off from a whistle blower in 2003 unfolded what became the largest scandal in mutual fund history. Several major asset management companies, hedge funds and brokerage firms in the US engaged in abusive trading activities including market timing, mispricing, insider trading and late trading. The latter allows some investors to trade mutual fund shares after market close, resulting in profitable opportunities at the expense of other investors. This practice evolved from the way mutual funds are priced. For example, US-based funds calculate their net asset value per share (NAV) once a day usually at the close of the stock exchange at 4 pm Eastern Standard Time (EST). This is the price at which investors can purchase and redeem fund shares. US

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statutory law requires trades in open-ended mutual fund shares to be processed at a price following the order (forward pricing).[1] Accordingly, orders received before 4 pm are executed at current day's NAV, while orders received after 4 pm must be executed at next day's NAV. However, some investors were allowed to place orders after 4 pm at current day's price (backward pricing). By doing so, these investors could place orders after market close and profit by exploiting the likely direction of the price movement the following day based on information revealed after market close. Thus, the exercise of stale price arbitrage provides an opportunity to some investors to reap short-term gains at almost no extra risk to the detriment of long-term (mainly small) investors.[2] The additional expenses incurred by these trades are shared by all investors at the fund level, while the profits are reserved for only those who actually trade late. Zitzewitz (2006) estimated losses due to late trading incurred by long term investors at about USD 400 m per annum.[3]

Late trading was often facilitated by brokerage firms or dealers which colluded with investors. But fund companies have also allowed this practice for a fee or in exchange for 'sticky assets', whereby investors engaging in late trading place additional funds into other high-fee investments under management. New York State Attorney General Eliot Spitzer, who led the investigation into the mutual fund trading scandal in 2003, compared such illegal trading schemes to "*betting on a horse race after the horses have crossed the finish line*".[4] By the end of 2004, numerous institutions had settled the alleged trading charges with payments totaling over USD 3bn.[5] Settlements included civil penalties, investor restitutions and lower future management fees. Among those institutions were firms like Janus Capital Group, Franklin Templeton, Bank of America, Bank One, Alliance Bernstein, Putnam, Old Mutual PLC, Sun Life Financial, Canary Capital Partner LLC and many more. Since then, the fund industry has grown from USD 16.2 trillion in assets under management in 2004 to USD 30.0 trillion in 2013, half of which is held by US funds.[6] Almost every second household in the US owns mutual funds either directly or indirectly.

In the wake of the US scandal, regulators in other countries became concerned about potential misconduct in the fund industry of their own jurisdiction. For example, the Committee of European Securities Regulators (CESR) conducted regulatory and supervisory investigative work during the latter part of 2003 and in 2004 to

[1] So called forward pricing rule 22c-1, adopted by SEC in 1968.

[2] Late trading was often practiced together with market timing or frequent trading of mutual fund shares in an attempt to exploit stale prices. The rules surrounding market timing vary from fund to fund and such practice is either prohibited or deemed unethical since it violates the fund's fiduciary duty to act in its shareholders' best interests. In the words of former New York State Attorney General Eliot Spitzer "Allowing timing is like a casino saying that it prohibits loaded dice, but then allowing favored gamblers to use loaded dice, in return for a piece of the action."

[3] Mutual fund trading "in disguise" is a serious issue of concern for investors and regulators. In a different context, Ortiz et al. (2015) using intra reporting data (monthly portfolio returns of domestic Spanish equity funds) shows how fund managers can manipulate returns around reporting dates, rebalancing their portfolios by increasing the weights of the return-winner stocks and decreasing the weights of the poor-return stocks, with non-disclosure months showing the opposite trend.

[4] Eliot Spitzer was New York State Attorney General from 1998 until the end of 2006. See also "State Investigation Reveals Mutual Fund Fraud: Secret Trading Schemes Harmed Long-Term Investors", Press Release Office of New York State Attorney General Eliot Spitzer, September 3, 2003. <http://www.oag.state.ny.us/press/2003/sep/sep03a_03.html>.

[5] See Houge and Wellman (2005) for more details on the charges and settlements.

[6] US equity mutual funds held USD 7.8 trillion in total net assets in 2013. See Investment Company Institute Fact Book 2014, < http://www.ici.org/pdf/2014_factbook.pdf>.

assess the state of affairs in the European fund industry.[7] The investigation was mainly done by sending out questionnaires to fund companies designed to detect possible malpractices related to late trading and market timing. In some instances, the investigation involved on-site inspections or special audits. The investigation concluded that there was no prima facie evidence of abusive trading practices in the member states, despite some alarming findings in their report. Among others, compliance with cutoff times used to determine whether an order gets processed at current or next day's price could not be verified in all cases, mainly due to inadequate record keeping.[8] And this regardless of the fact that the cutoff times are clearly defined in the prospectus of all investment funds according to the CESR report. Also, poor organisational structures lacking clarity in responsibilities and procedures were identified in a number of cases, with the ramification that can be prone to trading abuses and prejudicial business practices, e.g. favoring special clients. Some fund managers even reported they had been approached by hedge funds specifically asking for late trading or market timing facilities. Yet, the actions taken by European regulators were relatively meager. Policies to hinder late trading or market timing were largely implemented through self-regulatory codes of best practices in cooperation with national fund industry associations. The upshot of all this was that fund companies had to do not much more than to tighten their internal control mechanisms.

There are only a handful of academic studies addressing the alleged trading abuses and associated consequences related to the mutual funds scandal in the US. For example, Peterson (2010) and Frankel (2006-2007) evaluate the conditions and structures that led to such trading abuses, mainly the regulatory environment in general and lack of transparency. Houge and Wellman (2005) as well as Choi and Kahan (2007) examine investor reactions by measuring capital flows, assets under management and fund performance. Not surprisingly, funds that were involved in the investigation suffered substantial outflows and underperformed their peers in the period following the scandal. Shichor (2012) studies the scandal from a criminologist point of view and highlights the failure of US regulators and supervisors but also the funds' internal control mechanisms to prevent such kind of misconduct. Davis et al. (2007) assess the relationship between fund management fees and control structures and illegal activities. They show that higher levels of management fees decrease the likelihood of illegal behavior, most likely as a result of reduced financial incentives to engage in malpractices.

In this paper, we examine the incidence and extent of late trading in European markets. Our approach follows closely the methodology used by Zitzewitz (2006) with some notable differences. First, we include market return volatility as a general limit to this arbitrage strategy.[9] A model only accounting for potential gains while ignoring the risk involved in such arbitrage opportunities might lead to spurious results. Since our empirical tests to unravel late trading are based on the changes in futures prices, the volatility of these changes is a direct proxy for risk. Furthermore, Cao et al. (2008) document a negative contemporaneous response of flow to shocks in high frequency market-wide volatility. Hence, to the extent that market

[7] See the Committee of European Securities Regulators (CESR) Report "Investigations of Mis-Practises in the European Investment Fund Industry", CESR/40–407, November 2004. CESR was replaced by the European Securities and Market Authority (ESMA) in 2011.

[8] Such problems were identified as being somewhat alarming in France but not in Germany.

[9] Limits of arbitrage are discussed in Shleifer and Vishny (1997), Gromb and Vayanos (2002) and Barberis and Thaler (2003). A recent survey of the limits of arbitrage literature can be found in Gromb and Vayanos (2010).

volatility serves as a proxy for investor sentiment, a large drop in investor confidence might greatly constrain a fund manager's ability to engage in arbitrage trading on late information even if profitable opportunities exist. In addition, Busse (1999) showed that mutual funds time market volatility with funds decreasing their market exposure when volatility is high. Other limits to late trading are legal constraints and implementation costs. As late trading is prohibited by law, the legal constraints are obvious. The opportunity of stale price arbitrage in the form discussed here should not exist. As a result, the coefficients on the variables that capture late trading should all be zero. Implementation costs can be largely ignored because funds can be traded at virtually no costs and because late traders are unlikely to incur sales charges. Second, we address the question of who is more likely to trade late. We distinguish between different types of funds based on style, size and clientele types, in an attempt to identify likely investment vehicles that can be used to conceal late trading practices and hence gain a better understanding of how widespread late trading practices have been. In particular, we investigate the incidence of late trading across retail and institutional funds, small and large funds, and small-cap versus large-cap orientation funds. Third, we complement the literature by providing estimates of the amount of flow accounted for by late trading and the potential gains from this practice.

Europe, the second largest mutual fund industry in terms of assets under management after the US, provides an interesting case arising from the nature of the CESR investigation and, in particular, its findings that we believe warrant further scrutiny.[10] Because we require futures contracts to be traded long enough after the market close of equities and due to limited data availability for mutual funds, we focus our study on France, Germany and the UK.[11] None of our tests indicate late trading activities in the case of UK equity funds, suggesting that funds in the UK largely comply with order processing times.[12] However, despite a cutoff time of 12 pm for most funds in the sample for France, our results show that net flow of French mutual funds[13] is correlated with market movements after the market close of 5.30 pm Central European Time (CET).[14] Some of the trades are placed as late as between 8 pm and 10 pm. Similarly, net flow of German equity funds,[15] with a cutoff time of usually 3 pm, is correlated with changes in futures prices between 5.30 pm and 7 pm and during the last hour of futures trading between 9 pm and 10 pm. Moreover, we find this correlation pattern to hold for both retail and institutional funds.[16] Distinguishing between large and small funds based on assets under management reveals that it is the flow of larger funds that is more likely to be correlated with "after-hour" market movements. Based on investment style, we find evidence that the incidence of late trading is likely to be more prevalent among large-cap funds.

[10] Furthermore, Europe and in particular France represent an interesting case because the European mutual fund industry is dominated by banks (see Dieu 2015) and banks, as we know, were heavily involved in late trading in the past.

[11] According to the European Fund and Asset Management Association (EFAMA) these countries account for about two-thirds of the total assets under management in Europe (EFAMA, Asset Management in Europe, 8th Annual Review, April 2015).

[12] Mutual funds domiciled either in the UK, Ireland, Jersey, Isle of Man or Luxembourg that invest in UK equities.

[13] Mutual funds domiciled either in France or Luxembourg that invest in French equities.

[14] All time designations hereinafter refer to CET unless otherwise stated.

[15] Mutual funds domiciled either in Germany, Ireland or Luxembourg that invest in German equities.

[16] In the case of French mutual funds, we find a correlation for retail funds but not for institutional funds. In the case of German funds, the flow of both retail and institutional funds is correlated with price changes after the market close for trading in equities.

Overall, our evidence for French and German equity funds suggests that net flow is to some extent correlated with market movements after cutoff times with late trading accounting for approximately 0.2% and up to 0.6% of daily flow. We find that investors who are allowed to trade late can earn between 18% and 31% annually with a minimum number of trades following large market movements and as much as 35% per annum at the highest trading frequency. These returns come with lower risk compared to a buy-and-hold strategy. Our results demonstrate why late trading has been so widespread and why it is still likely to persist.

The remainder of this paper is organized as follows. Section 2 describes the data. Sections 3 and 4 present the empirical findings and we conclude in section 5.

## 2 Data

We use daily net flow and fund assets data from Morningstar. Net flow is estimated from a fund's prior day assets, current day assets and the daily return as:

$$\mathrm{FLOW}_{it} = TNA_{it} - TNA_{it-1}(1 + r_{it}) \tag{1}$$

$TNA_{it}$ is the fund's daily total net assets and $r_{it}$ is the fund's total return. Hence, eq. (1) is simply the difference between current and prior day's assets that is not accounted for by daily return. We obtain estimated share class flow and net assets by share class rather than fund-level data. As pointed out by Greene and Hodges (2002) there is no a priori reason to assume that flow into different share classes of a fund would be the same. Rather flow is affected by the different fee structures and purchase and redemption restrictions of the various share classes. Using share classes also allows us to distinguish between retail and institutional investors. Lastly, investors can only trade share classes of funds and hence share class flow directly resembles investor flow. Working with daily flow usually gives rise to questions about the timeliness of the data. For example, it has been found that some funds report assets pre- instead of post-flow.[17] For these funds, flow of day *t* is actually flow of day *t-1*. Since we do not have access to balance sheet data of European funds, we cannot test for this potential data issue, and hence we do not adjust flow. However, if some funds do report with a time lag this would bias the results against finding evidence of late trading, while making false corrections would bias the results in the opposite direction. The advice we received from the European Securities and Market Authority (ESMA) is that there is no unified practice at the European level with regards to lags in accounting and pricing. Rather depending on their own rules or instruments of incorporation as well as national regulation, funds might report with or without a lag.

To proxy for movements in the market we use changes in near-month futures contracts from Thomson Reuters Tick History (TRTH) obtained through Sirca. This enables us to compute intraday price changes throughout and, more importantly, after continuous trading in equities ends. Trading hours for futures contracts vary across European countries but these contracts are generally not traded over night. However, we require that futures are traded long enough after the market close of equities in

[17] See Edelen and Warner (2001), Greene and Hodges (2002) and Zitzewitz (2003) for a discussion.

order to capture sufficient post cutoff information. This ensures price changes in futures contracts can be used as a general predictor for next day's market return and trading signal by late traders. Because of this and due to limited data availability on assets and flow of mutual funds, we focus our analysis on France, Germany and the UK where trading in futures contracts ends at 9 pm and 10 pm, respectively. We use price changes of futures on the CAC 40 in the case of French funds, DAX 30 in the case of German mutual funds, and price changes on the FTSE index in the case of UK funds. These futures contracts are traded every week day from 8 am (CAC) and 9 am (DAX) until 10 pm CET, and from 8 am until 9 pm (FTSE) GMT.

For French and UK mutual funds data is available from June 2008 and for German funds from June 2006. All samples go through to the end of July 2014. Because of better data availability we restrict our sample to equity mutual funds. We delete a small number of observations that are related to the inception of a fund or obvious data entry errors. Table 1 reports summary statistics of aggregate mutual fund flow normalized by prior day's total net assets of all funds in each sample. We classify flow as inflow if it is positive on day $t$ and as outflow if it is negative.

Panel A reports the characteristics of aggregate net flow of French mutual funds. The mean net flow over the sample period is −2.52 basis points per day and the median daily net flow is −2.25 basis points. The standard deviation is 49.08 basis points. Average daily net flows of German and UK equity funds are also slightly negative, −2.43 and −2.71 basis points, respectively, with standard deviations around the mean of about 15 basis points. Average net fund flows are negative because these measures are influenced by large outflows occurring during the global financial crisis (GFC) and the sovereign debt crisis (SDC) which are part of the sample period. Investors withdrew more capital than they invested in equity mutual funds in over 60% of the sample trading days. Yet, average daily inflow is greater than outflow in the case of French mutual funds, 12.31 basis points compared to −9.30 basis points, respectively. But for German and UK mutual funds average daily inflow is smaller than average outflow.

**Table 1** Summary statistics of aggregate daily flow of French, German and UK Equity Funds. The table reports summary statistics of aggregate daily net flow for a sample of 351 French, 255 German and 1009 UK equity mutual funds that invest in domestic equities. The sample periods vary depending on data availability and start from June 2008 and June 2006, respectively, through to July 2014. Net flow, inflow and outflow are normalized by previous day's aggregate TNAs of the sample funds

| | N | Mean (bps) | Median (bps) | Std (bps) | Max (%) | Min (%) | t -statistic | p -value |
|---|---|---|---|---|---|---|---|---|
| Panel A: French equity funds | | | | | | | | |
| Net flow | 1563 | −2.49 | −2.21 | 49.08 | 8.51 | −8.03 | −2.01 | 0.04 |
| Inflow | 492 | 12.32 | 2.61 | 61.59 | 8.51 | 0.00 | 4.44 | 0.00 |
| Outflow | 1071 | −9.30 | −3.99 | 40.37 | 0.00 | −8.03 | −7.54 | 0.00 |
| Panel B: German equity funds | | | | | | | | |
| Net flow | 2080 | −2.43 | −1.95 | 15.23 | 1.78 | −3.35 | −7.29 | 0.00 |
| Inflow | 780 | 7.46 | 4.09 | 11.55 | 1.78 | 0.00 | 18.04 | 0.00 |
| Outflow | 1300 | −8.37 | −5.00 | 14.05 | 0.00 | −3.35 | −21.48 | 0.00 |
| Panel C: UK equity funds | | | | | | | | |
| Net flow | 1588 | −2.71 | −0.99 | 15.95 | 0.33 | −3.27 | −6.78 | 0.00 |
| Inflow | 648 | 4.18 | 2.58 | 4.44 | 0.33 | 0.00 | 23.93 | 0.00 |
| Outflow | 940 | −7.46 | −3.43 | 19.01 | 0.00 | −3.27 | −12.04 | 0.00 |

## 3 Methodology and empirical results

### 3.1 Methodology

This section describes the methodology we use in this paper to test for late trading. Equation (2) is an example of a regression model where the cutoff time for processing redemption and subscription orders is assumed to be 12 pm midday, while regular trading in stocks ends at 5.30 pm. This allows capturing the correlation of daily net flow with market movements after the cutoff time and after market close using a specification of the form:

$$\begin{aligned} \mathrm{FLOW}_{it} = {} & \alpha_{it} + \beta_1 \Delta FUT_t^{9am-12pm} + \beta_2 \Delta FUT_t^{12pm-5:30pm} + \beta_3 \Delta FUT_t^{5:30pm-10pm} \\ & + \sum_{k=1}^{K} \gamma_k F_{kt} + \Delta_1 \mathrm{Volatility}_t + \Delta_2 \mathrm{BondRe}t_t + \varepsilon_{it} \end{aligned} \tag{2}$$

$FLOW_{it}$ is the fund's net flow normalized by prior day net assets. The right-hand side variables of interest are log changes in the near-month futures contract price. The first term controls for market movements driven by information emerging before the cutoff or valuation point. The second and third terms capture post-cutoff information and hence late trading. Normal trading in futures ends at 10 pm. Most futures contracts in Europe are not traded over night.[18] $F$ is a vector that controls for lagged flow and lagged fund returns. The former is included to account for persistence in the time series of flow whereas the latter accounts for the return chasing behavior of investors. Since late trading is an arbitrage strategy, and risk represents one of the major limits to arbitrage, we also include volatility as a control variable. More specifically, we include the realized volatility of five minute intraday returns defined as:

$$\sigma_t = \sqrt{\sum_{j=1}^{N_t} \left(r_{t,j}\right)^2} \tag{3}$$

where $\sigma_t$ denotes daily market volatility based on five-minute interval observed squared returns on day $t$, and $r_{t,j}$ are log changes of the futures contracts on the market index over the five-minute interval ($j$). We calculate intraday returns including the time period after continuous trading in securities has stopped, i.e. after 5.30 pm. This is important since it is the post-cutoff and after market close price changes which are the main predictors of next day's market return and thus the main drivers of stale-price arbitrage.[19] This non-parametric measure is based on the high-frequency volatility estimator proposed by Andersen et al. (2001) who argue that a five minute interval is long enough to avoid measurement errors and short enough to avoid microstructure biases.[20] Conditioning on market volatility is also important to account for the market turmoil and swings in investor sentiment arising during the 2007–2008 global financial crisis and the deepening of the sovereign debt crisis in Europe at the end of

[18] Note that 9 pm was the latest trading time stated in the civil complaint brought in 2003 by the Attorney General of the State of New York to the State Supreme Court against Canary Capital Partners LLC, a hedge fund that collaborated with different brokers and asset management companies, including among others the Bank of America (Nations funds), to trade hundreds of funds late (after 4 pm).

[19] For example, consider there was a large increase in stock prices after the cutoff until market close, say between 12 pm (3 pm) and 5.30 pm in the case of French (German) funds. Buying a fund at the prevailing (stale) price would be profitable even if next day's return did not prove to be as high as expected.

[20] The results reported below are qualitatively the same if we use other volatility measures such as standard deviation or intervals of 15 min.

2011. Lastly, bond returns, *BondRet*, are included because investors might shift between shares and bonds, particularly during crises. We obtain the return series on 10-year government bonds from Thomson Reuters Datastream. Equation (2) is estimated by pooled OLS with double clustered standard errors in the fund ($i$) and time ($t$) dimensions. Hence, they are robust to both cross-sectional dependence and serial correlation in the residuals.

We first follow past literature (e.g. Zitzewitz 2006) and report in Table 2 results from a baseline model where the observations are aggregated across funds. The coefficients for the samples of French and German equity funds indicate that flow is correlated with market movements after market close (Panel A). Replacing the term $\Delta FUT^{5\,30pm\ \ to\ \ 10pm}$ with a finer decomposition (i.e. hourly changes) Panel B shows that flow is again correlated with post cutoff market movements for the samples of French and German funds. And these results are robust to the inclusion of control variables as shown in columns (2) and (4) of Panel B.[21] Overall, the coefficient estimates and R-square values are lower compared to those reported in Zitzewitz (2006) for US-based international and domestic equity funds.[22] The lower coefficients for French and German equity funds indicate that late trading, if present in our sample, is not of the same extent as it was in the US until 2003. None of the coefficients of changes in futures prices are statistically significant in the case of UK equity funds, with or without control variables.[23]

### 3.2 French mutual funds

Table 3 shows the results of different variants of eq. (2) estimated for French mutual funds that invest in domestic equities.[24] The legislation in France does not specify a particular time at which fund shares are to be priced; rather each fund company has to define a valuation point in its prospectus. That is, laws require fund companies to determine a valuation point and until when orders are processed at current day's price, but it is at the funds' discretion which point in time to choose. We have viewed numerous fund documents and unlike the US, where funds price their shares usually at 4 pm market close EST, cutoff time for most funds in France is 12 pm. Regular trading hours for equities at the Euronext Paris are from 9 am through 5.30 pm, while futures contracts on the CAC 40 are traded from 8 am through 10 pm. Therefore, our first regression specification follows the form given by eq. (2) above.

The coefficient estimates in column two of Table 3 show that flow is correlated with market movements after market close. This effect remains largely unnoticed in the regression in column one that includes intraday time intervals only for the morning, afternoon and evening

[21] The coefficients on the control variables are virtually the same across both panels, and hence are only included once.

[22] For example, Zitzewitz reports R-square values of 0.44 and 0.07 for US funds investing in international and domestic equities, respectively.

[23] This finding is consistent with the results of an investigation conducted by the UK Financial Services Authority (FSA) in 2003–2004, which found no evidence of late trading practices in the UK investment fund industry. The FSA report concluded this was "*in large part due to the industry framework in the United Kingdom, whereby deals are placed directly with the fund manager before valuation points, and an important control function is provided by the trustee in UK funds.*" This finding was also included in the 2004 CESR report.

[24] We include only funds that have more than 100 observations. Standard errors of estimated coefficients reported in Table 3 are clustered by fund and year in columns (1)–(3) and by fund and day in column (4).

**Table 2** Correlation of fund flow with market movements. The table reports regression estimates of equally-weighted flows of French, German and UK equity mutual funds on changes in the price of futures contracts on the CAC 40, DAX 30 and the FTSE index, $\Delta FUT$. In the case of French (German, UK) mutual funds, $\Delta FUT^{morning}$ are log changes in futures prices between 9 am and 12 pm (3 pm, 12 pm), $\Delta FUT^{afternoon}$ between 12 pm (3 pm, 12 pm) and 5.30 pm (UK funds: 4.30 pm), and $\Delta FUT^{evening}$ between 5.30 pm and 10 pm (UK funds: 4.30 pm and 9 pm). Columns 2, 4 and 6 also include lagged flow, $Flow_{t-i}$, lagged fund returns, $Ret_{t-i}$, realized volatility over 5-min intraday returns, *Volatility*, and the returns on 10-year government bonds, *Bond Ret*, as additional regressors. The coefficients on the control variables are virtually the same across both panels, and hence are only included once. Corresponding *t*-statistics, based on heteroskedasticity-robust standard errors, are reported in parentheses

| | | French equity funds | | | | German equity funds | | | | UK equity funds | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (1) | | (2) | | (3) | | (4) | | (5) | | (6) | |
| Panel A | | | | | | | | | | | | | |
| $R^2$ | | 0.01 | | 0.23 | | 0.01 | | 0.05 | | 0.00 | | 0.19 | |
| $\Delta FUT^{morning}$ | | −0.003 | (−0.94) | −0.006 | (−1.62) | 0.009 | (0.81) | 0.000 | (0.04) | −0.006 | (−0.78) | −0.005 | (−0.63) |
| $\Delta FUT^{afternoon}$ | | −0.001 | (−0.44) | 0.000 | (0.07) | −0.006 | (−0.50) | −0.007 | (−0.68) | 0.002 | (0.39) | −0.001 | (−0.25) |
| $\Delta FUT^{evening}$ | | **0.010** | **(2.64)** | **0.009** | **(2.30)** | **0.034** | **(2.27)** | **0.038** | **(2.98)** | 0.000 | (0.08) | 0.001 | (0.27) |
| Panel B | | | | | | | | | | | | | |
| $R^2$ | | 0.01 | | 0.23 | | 0.01 | | 0.05 | | 0.00 | | 0.18 | |
| $\Delta FUT^{morning}$ | | −0.003 | (−0.86) | −0.005 | (−1.49) | 0.010 | (0.91) | 0.001 | (0.12) | −0.006 | (−0.84) | −0.006 | (−0.77) |
| $\Delta FUT^{afternoon}$ | | −0.002 | (−0.78) | 0.000 | (0.12) | −0.006 | (−0.49) | −0.007 | (−0.69) | 0.002 | (0.33) | −0.003 | (−0.56) |
| ΔFUT | FR, DE: 5.30 pm to 6 pm<br>UK: 4.30 pm to 5 pm | **0.023** | **(1.85)** | **0.025** | **(2.04)** | **0.081** | **(2.38)** | **0.093** | **(2.72)** | −0.019 | (−1.26) | −0.016 | (−1.16) |
| ΔFUT | FR, DE: 6 pm to 7 pm<br>UK: 5 pm to 6 pm | 0.005 | (0.54) | 0.002 | (0.24) | 0.011 | (0.31) | 0.010 | (0.32) | −0.005 | (−0.40) | −0.015 | (−1.35) |
| ΔFUT | FR, DE 7 pm to 8 pm<br>UK: 6 pm to 7 pm | 0.004 | (0.48) | 0.006 | (0.71) | **0.071** | **(2.19)** | **0.051** | **(1.73)** | 0.012 | (0.94) | 0.007 | (0.57) |
| ΔFUT | FR, DE: 8 pm to 9 pm<br>UK: 7 pm to 8 pm | 0.027 | (3.28) | 0.020 | (2.32) | 0.049 | (1.88) | 0.035 | (1.50) | 0.000 | (−0.04) | −0.004 | (−0.34) |
| ΔFUT | FR, DE: 9 pm to 10 pm<br>8 pm to 9 pm | 0.001 | (0.11) | 0.001 | (0.10) | 0.000 | (−0.02) | 0.025 | (1.17) | 0.003 | (0.40) | 0.010 | (1.30) |
| $Flow_{t-1}$ | | | | **−0.249** | **(−2.36)** | | | **0.060** | **(2.47)** | | | **0.105** | **(2.36)** |
| $Flow_{t-2}$ | | | | **0.134** | **(3.57)** | | | **0.042** | **(2.14)** | | | **0.147** | **(4.93)** |
| $Flow_{t-3}$ | | | | **0.211** | **(6.41)** | | | **0.073** | **(3.74)** | | | **0.133** | **(4.89)** |
| $Flow_{t-4}$ | | | | **0.112** | **(5.31)** | | | **0.057** | **(1.97)** | | | **0.160** | **(4.55)** |
| $Ret_{t-1}$ | | | | 0.004 | (1.58) | | | **0.000** | **(2.98)** | | | 0.006 | (1.53) |
| $Ret_{t-2}$ | | | | **0.008** | **(3.21)** | | | **0.000** | **(3.19)** | | | 0.006 | (1.49) |
| $Ret_{t-3}$ | | | | 0.002 | (0.66) | | | **0.000** | **(−2.03)** | | | 0.002 | (0.41) |
| $Ret_{t-4}$ | | | | −0.001 | (−0.44) | | | 0.000 | (1.35) | | | −0.006 | (−1.50) |
| Volatility | | | | **−0.010** | **(−2.40)** | | | **−0.039** | **(−3.34)** | | | **−0.017** | **(−2.79)** |
| Bond Ret | | | | −0.001 | (−0.59) | | | 0.000 | (−2.00) | | | 0.000 | (0.01) |

Bold numbers indicate that coefficients are statistically significant on conventional levels

**Table 3** French mutual funds. The table reports regression estimates of different variants of eq. (2). The dependent variable is normalized daily net flow of 351 mutual funds domiciled either in France or Luxembourg that invest in French equities. All funds are registered and available for sale in France. The independent variables are log changes in the price of futures contracts on the CAC 40 index, $\Delta FUT$, lagged flow, $Flow_{t-i}$, and lagged fund returns, $Ret_{t-i}$, realized volatility over 5-min intraday returns, *Volatility*, and the returns on 10-year government bonds, *Bond Ret*. Columns one and two report results for the full sample, while columns three and four comprise trading days with post cutoff price changes in the futures market of 1% or more. Standard errors are clustered by funds and year in columns (1)–(3) and by funds and day in column (4). Corresponding *t*-statistics are reported in parentheses. The time period is June 2008 through July 2014

| | Full sample: | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Morning, afternoon and evening[a] | | Hourly price changes[a] | | Large price changes[a] | | Large price changes[b] | |
| | (1) | | (2) | | (3) | | (4) | |
| Intercept | 0.000 | (0.86) | 0.000 | (0.88) | 0.000 | (−1.44) | 0.000 | (−1.61) |
| $\Delta FUT^{9am\ to\ 12pm}$ | 0.005 | (0.78) | 0.006 | (0.84) | **0.008** | **(2.37)** | 0.008 | (1.02) |
| $AFuT^{12pm\ to\ 5.30pm}$ | 0.003 | (0.80) | 0.002 | (0.64) | **0.028** | **(2.01)** | **0.028** | **(2.10)** |
| $AFuT^{5.30pm\ to\ 1Opm}$ | 0.007 | (1.04) | | | | | | |
| $AFuT^{5.30pm\ to\ 6pm}$ | | | −0.001 | (−0.09) | 0.014 | (0.72) | 0.014 | (0.40) |
| $AFuT^{6pm\ to\ 7pm}$ | | | −0.001 | (−0.03) | **0.066** | **(2.11)** | **0.066** | **(2.67)** |
| $AFuT^{7pm\ to\ 8pm}$ | | | −0.003 | (−0.26) | 0.038 | (1.32) | 0.038 | (1.68) |
| $AFuT^{8pm\ to\ 9pm}$ | | | **0.019** | **(1.68)** | **0.039** | **(2.55)** | **0.039** | **(1.81)** |
| $AFuT^{9pm\ to\ 10pm}$ | | | 0.010 | (1.10) | **0.053** | **(2.42)** | **0.053** | **(2.74)** |
| $Flow_{t-1}$ | 0.015 | (1.38) | 0.015 | (1.37) | 0.023 | (1.37) | 0.023 | (1.37) |
| $Flow_{t-2}$ | **0.030** | **(5.40)** | **0.031** | **(5.42)** | 0.013 | (1.57) | 0.013 | (1.12) |
| $Flow_{t-3}$ | **0.026** | **(4.94)** | **0.026** | **(4.93)** | **0.058** | **(2.41)** | **0.058** | **(3.29)** |
| $Flow_{t-4}$ | **0.019** | **(4.59)** | **0.019** | **(4.64)** | 0.017 | (1.40) | 0.017 | (1.90) |
| $Ret_{t-1}$ | **0.010** | **(2.92)** | **0.010** | **(2.88)** | 0.019 | (1.44) | 0.019 | (2.82) |
| $Ret_{t-2}$ | 0.006 | (1.39) | 0.006 | (1.39) | **0.008** | **(2.65)** | 0.008 | (1.62) |
| $Ret_{t-3}$ | −0.003 | (−0.32) | −0.003 | (−0.34) | **0.019** | **(3.30)** | **0.019** | **(3.21)** |
| $Ret_{t-4}$ | −0.006 | (−1.55) | −0.006 | (−1.59) | 0.000 | (−0.11) | 0.000 | (−0.08) |
| Volatility | −0.027 | (−1.27) | −0.027 | (−1.30) | **−0.019** | **(−2.41)** | −0.019 | (−1.54) |
| Bond Ret | −0.001 | (−0.32) | −0.001 | (−0.37) | 0.001 | (0.26) | 0.001 | (0.22) |
| $R^2$ | 0.002 | | 0.002 | | 0.006 | | 0.006 | |
| N | 439,008 | | 437,394 | | 69,193 | | 69,193 | |

Bold numbers indicate that coefficients are statistically significant on conventional levels

[a] Standard errors are clustered by funds and year

[b] Standard errors are clustered by funds and day

rather than hourly price changes.[25] However as shown in column two, the coefficient on $\Delta FUT^{8pm–9pm}$, towards the end of futures trading, is positive and statistically significant.[26] Arguably late evening information is more important for late traders than futures price movements during the afternoon, because evening changes are naturally better predictors of next day's market returns. Most coefficient estimates on lagged flow are statistically significant, indicating persistence in the flow series.[27] There is also evidence of return chasing

[25] The main reason for this is that the regression includes both retail and institutional funds. However, we only find that flow of retail funds is correlated with post-cutoff market movements. We discuss separate results for both fund groups in detail below. If we only include retail funds for the regression in column one, the coefficient of $\Delta FUT^{5.30pm–10pm}$ is 0.01 with a *t*-statistic of 1.75.

[26] Following an anonymous referee's suggestion, we included changes in the S&P 500 futures index from 10 pm to 9 am (Central European Time) to examine if late trading may persist after 10 pm. We find no significant correlation between the S&P futures changes and mutual fund flow.

[27] We include four lags to cover one week of trading. However, our results are not affected by the number of lags.

behavior, with the previous day fund return coefficient being positive and statistically significant. The negative coefficient on volatility is in line with Cao et al. (2008) who document a negative relation between fund flow and market volatility. However, the estimated coefficient is not significant in statistical terms. Similarly, bond returns are negatively but insignificantly related to fund flow.

To account for the possibility that fund companies have become more careful after the scandal in the US, we assume they engage in or knowingly allow late trading, if at all, only when it appears to be most profitable. For this reason, the results shown in column three include observations only when the change in futures prices between 12 pm and 10 pm is equal to or larger than 1 %.[28] We do not find meaningful differences in the results if we condition on smaller or larger price changes (e.g. 0.5% or 1.5%). A comparison of the results in columns two and three highlights the impact of market information on net flow and by implication on the incidence of late trading. We find that flow is correlated with futures price changes after the 12 pm cutoff time and after market close and the magnitude of this effect is much stronger in comparison to the results shown in column two. In column four we report results with standard errors clustered by fund and day. Again we find that fund flow is correlated with market movements after the 12 pm cutoff. Besides confining late trading to days on which post cutoff price changes are large, it might be that such practices are as profitable during periods with a high degree of value-relevant information. To test this conjecture, we re-estimate eq. (2) around quarterly earnings announcement periods. We obtain similar results regardless of different time window lengths around the end of a calendar quarter.[29]

In summary, we find evidence suggestive of late trading in French mutual funds. Our results are robust when we explicitly control for the GFC and SDC by introducing intercept and interaction dummies capturing the respective periods of extreme market turmoil.[30] Our results are also broadly consistent with the report of the CESR investigation of French fund companies in 2004, stating:

"Despite the fact that the cutoff time is clearly defined in the prospectus of all investment funds, its enforcement is variable depending on the different parties involved in the processing of these subscriptions/redemptions."

Indeed, non-compliance with cutoff times is the core of late trading schemes and conflicting reports on enforcement practices during the CESR investigation should have raised questions requiring further scrutiny.

### 3.3 German mutual funds

Table 4 reports pooled regression results for German equity mutual funds. As before, no particular cutoff time is legally set, but according to the annotation of German

[28] Consistent with the view that late trading is primarily used for profit maximization rather than loss avoidance or minimization, the alternative condition of market movements equal to or less than minus 1% may not work as well. Saying that we recognize that 'stale price arbitrage' may involve both buying at the stale price while expecting a gain on the next day and selling when the market is expected to decline. For French mutual funds, the results are mixed when we test for the latter by conditioning on price changes in futures prices (after cutoff) of minus 0.5% or minus 1%.

[29] In order to conserve space, these results are not included in the paper but are available upon request from the authors.

[30] Again these results are not reported but are available upon request.

**Table 4** German mutual funds. The table reports regression estimates of different variants of eq. (2). The dependent variable is normalized daily net flow of 255 mutual funds domiciled either in Germany, Ireland or Luxembourg that invest in German equities. All funds are registered and available for sale in Germany. The independent variables are log changes in the price of futures contracts on the DAX 30 index, $\Delta FUT$, lagged flow, $Flow_{t-i}$, and lagged fund returns, $Ret_{t-i}$, realized volatility over 5-min intraday returns, *Volatility*, and the returns on 10-year government bonds, *Bond Ret*. Columns one and two report results for the full sample, while columns three and four comprise trading days with post cutoff price changes in the futures market of 1% or more. Standard errors are clustered by funds and year in columns (1)–(3) and by funds and day in column (4). Corresponding *t*-statistics are reported in parentheses. The time period is June 2006 through July 2014

| | Full Sample: | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Morning, afternoon and evening[a] | | Hourly price changes[a] | | Large price changes[a] | | Large price changes | |
| | (1) | | (2) | | ([3]) | | | |
| Intercept | **0.001** | **(2.13)** | **0.001** | **(2.15)** | **0.001** | **(1.69)** | 0.001 | (1.64) |
| $\Delta FUT^{9am\ to\ 3pm}$ | 0.002 | (0.33) | 0.001 | (0.30) | 0.000 | (0.05) | 0.000 | (0.03) |
| $\Delta FUT^{3pm\ to\ 5.30pm}$ | 0.001 | (0.20) | 0.000 | (0.09) | 0.001 | (0.13) | 0.001 | (0.05) |
| $\Delta FUT^{5.30pm\ to\ 10pm}$ | **0.016** | **(1.90)** | | | | | | |
| $\Delta FUT^{5.30pm\ to\ 6pm}$ | | | **0.024** | **(2.16)** | **0.144** | **(2.16)** | **0.144** | **(3.17)** |
| $\Delta FUT^{6pm\ to\ 7pm}$ | | | 0.019 | (1.64) | 0.038 | (1.19) | 0.038 | (0.85) |
| $\Delta FUT^{7pm\ to\ 8pm}$ | | | −0.001 | (−0.03) | −0.013 | (−0.66) | −0.013 | (−0.46) |
| $\Delta FUT^{8pm\ to\ 9pm}$ | | | **0.020** | **(2.91)** | −0.037 | (−1.14) | −0.037 | (−1.40) |
| $\Delta FUT^{9pm\ to\ 10pm}$ | | | 0.018 | (1.16) | −0.035 | (−1.43) | −0.035 | (−1.17) |
| $Flow_{t-1}$ | **0.062** | **(7.63)** | **0.062** | **(7.63)** | **0.045** | **(3.45)** | **0.045** | **(3.11)** |
| $Flow_{t-2}$ | **0.049** | **(7.34)** | **0.049** | **(7.34)** | **0.026** | **(2.05)** | **0.026** | **(1.66)** |
| $Flow_{t-3}$ | **0.035** | **(2.94)** | **0.035** | **(2.94)** | **0.022** | **(2.46)** | **0.022** | **(2.48)** |
| $Flow_{t-4}$ | **0.030** | **(4.86)** | **0.030** | **(4.86)** | **0.041** | **(4.59)** | **0.041** | **(2.36)** |
| $Ret_{t-1}$ | **0.016** | **(4.19)** | **0.016** | **(4.13)** | **0.019** | **(3.22)** | **0.019** | **(2.66)** |
| $Ret_{t-2}$ | **0.009** | **(1.89)** | **0.009** | **(1.90)** | 0.006 | (0.61) | 0.006 | (1.09) |
| $Ret_{t-3}$ | 0.002 | (0.60) | 0.002 | (0.61) | 0.007 | (1.30) | 0.007 | (1.33) |
| $Ret_{t-4}$ | **0.008** | **(1.93)** | **0.008** | **(1.89)** | **0.006** | **(1.65)** | 0.006 | (0.92) |
| Volatility | **−0.042** | **(−2.98)** | **−0.042** | **(−3.05)** | **−0.039** | **(−2.57)** | **−0.039** | **(−2.30)** |
| Bond Ret | −0.007 | (−1.55) | −0.007 | (−1.55) | −0.002 | (−0.46) | −0.002 | (−0.33) |
| $R^2$ | 0.011 | | 0.011 | | 0.008 | | 0.008 | |
| N | 242,617 | | 242,617 | | 25,957 | | 25,957 | |

Bold numbers indicate that coefficients are statistically significant on conventional levels

[a] Standard errors are clustered by funds and year

[b] Standard errors are clustered by funds and day

statutory law this should normally be 3 pm (general but non-binding rule).[31] The 3 pm cutoff also corresponds to the time stated in most prospectuses we have viewed.

The results in column one show that fund flow is correlated with market movements between 5.30 pm and 10 pm. The coefficients on price changes during the morning and afternoon are not statistically significant. Using the results in column one, we can estimate the amount of flow accounted for by presumed late trading. Since we include log changes in futures prices on the right-hand side of eq. (2), the effect of a change in $\Delta FUT^{5.30pm–10pm}$ can be calculated as $\beta_3 * ln(1 + \Delta)$, where $\beta_3$ is the coefficient estimate reported in column one and

[31] See German securities law, annotation to sec. 36 par. 1 InvG (Investmentgesetz), Berger, Steck and Luebbehuesen, C.H. Beck, Muenchen 2010, p. 351 marginal number 6. Note in the context of implementing a European Directive (so-called AIFM-Directive) the InvG was replaced by the KAGB (Kapitalanlagegesetzbuch) in July 2013, which takes over the regulations of the InvG and other acts.

Δ is the percentage change in $\Delta FUT^{5.30pm-10pm}$. Because the dependent variable is flow as percent of TNA, we can infer that for one standard deviation increase in $\Delta FUT^{5.30pm-10pm}$ about 1 basis points of TNA orders are traded late. Based on the squared correlation coefficient of 1%, compared to one standard deviation in daily flow this equates to approximately 0.6% of late trading flow.[32]

Column two provides more detailed information on the correlation between daily fund flow and market movements during the evening hours. The results show that these correlations are stronger right after the market close, between 5.30 pm and 6 pm, and later in the evening, between 8 pm and 9 pm. All coefficients on lagged flow are positive and significant at the 1 % level, again demonstrating persistence in daily fund flow. Three of the four coefficients on lagged fund returns are also positive and statistically significant indicative of return chasing behavior. Realized volatility on day $t$ is negatively correlated with flow and the effect is statistically significant even after controlling for past fund returns.[33] Bond returns are also negatively correlated with flow.

The results in column three are for the subsample that includes observations only when the futures return between 3 pm and 10 pm is 1 % or more. We cannot find as strong evidence of late trading here as in the case of French mutual funds. Only the coefficient on futures price change $\Delta FUT^{5.30pm-6pm}$ is statistically significant and its relatively large magnitude suggests that late orders tend to congregate around the close of the market for trading in equities. We obtain the same result if we use standard errors clustered by fund and day (see column four). There is no evidence of late trading activity used to exploit futures market information later in the evening. We interpret these findings as evidence consistent with limits to late trading arbitrage. Because most of the large post cutoff price movements in the German sample occurred around the collapse of Lehman Brothers in late 2008, the peak of the GFC, and during the deepening of the SDC in late 2011, any profitable opportunities arising may have been offset by constraints to arbitrage induced by large swings in investor sentiment, run-like behavior and liquidity shortages.[34] The coefficient on volatility is negative and statistically significant, consistent with a reduced investor appetite for risk.

### 3.4 UK mutual funds

Table 5 reports results of eq. (2) for UK equity mutual funds. The dealing cutoff time is again set by each fund company and disclosed in the prospectuses, which is 12 pm for most funds we have viewed. Consistent with the results in Table 2 above, all of the coefficients of changes in futures prices are statistically indistinguishable from

[32] The standard deviation of average flow is reported in Table 1 and is 15.23 basis points. In the case of French mutual funds late trading accounts for approximately 0.19% of daily flow. This is based on the coefficient estimate reported in footnote 23 and compared to one standard deviation in aggregate daily flow of French mutual funds as reported in Table 1.

[33] The coefficients on after hour price changes are largely unaffected by excluding volatility information post 5:30 pm or omitting volatility as an explanatory variable from the regression.

[34] In contrast for France, large price changes ($\Delta FUT^{12pm-10pm} \geq 1\%$) are evenly spread across the sample period.

**Table 5** UK mutual funds. The table reports regression estimates of different variants of eq. (2). The dependent variable is normalized daily net flow of 1009 mutual funds domiciled either in the UK, Ireland, Jersey, Isle of Man or Luxembourg that invest in UK equities. All funds are registered and available for sale in the UK. The independent variables are log changes in the price of futures contracts on the FTSE index, $\Delta FUT$, lagged flow, $Flow_{t-i}$, and lagged fund returns, $Ret_{t-i}$, realized volatility over 5-min intraday returns, *Volatility*, and the returns on 10-year government bonds, *Bond Ret*. Columns one and two report results for the full sample, while column three comprises trading days with post cutoff price changes in the futures market of 1% or more. Standard errors are clustered by fund and year. Changing the time dimension of the clustering to months or days, does not materially affect the results reported below. Corresponding *t*-statistics are reported in parentheses. The time period is June 2008 through July 2014

| | Full Sample: | | | | Large Price Changes | |
|---|---|---|---|---|---|---|
| | Morning, Afternoon and Evening | | Hourly Price Changes | | | |
| | (1) | | (2) | | (3) | |
| Intercept | **0.001** | **(2.05)** | **0.001** | **(2.10)** | **0.001** | **(2.88)** |
| $\Delta FUT^{8am\ to\ 12pm}$ | **−0.010** | **(−2.43)** | **−0.010** | **(−2.40)** | 0.004 | (1.25) |
| $\Delta FUT^{12pm\ to\ 4.30pm}$ | 0.005 | (−0.86) | −0.006 | (−0.90) | −0.020 | (−1.39) |
| $\Delta FUT^{4.30pm\ to\ 10pm}$ | 0.005 | (1.13) | | | | |
| $\Delta FUT^{4.30pm\ to\ 5pm}$ | | | −0.010 | (−1.32) | −0.026 | (−0.99) |
| $\Delta FUT^{5pm\ to\ 6pm}$ | | | −0.009 | (−0.42) | −0.011 | (−0.83) |
| $\Delta FUT^{6pm\ to\ 7pm}$ | | | 0.010 | (1.60) | 0.009 | (0.46) |
| $\Delta FUT^{7pm\ to\ 8pm}$ | | | −0.007 | (−0.94) | - 0.002 | (− 0.14) |
| $\Delta FUT^{8pm\ to\ 9pm}$ | | | 0.017 | (1.46) | 0.027 | (1.44) |
| $Flow_{t-1}$ | 0.034 | (1.40) | 0.033 | (1.39) | −0.014 | (−0.41) |
| $Flow_{t-2}$ | **0.048** | **(6.19)** | **0.048** | **(6.19)** | **0.043** | **(3.65)** |
| $Flow_{t-3}$ | **0.047** | **(9.91)** | **0.047** | **(9.93)** | **0.037** | **(4.25)** |
| $Flow_{t-4}$ | **0.035** | **(9.38)** | **0.035** | **(9.39)** | **0.036** | **(6.31)** |
| $Ret_{t-1}$ | **0.018** | **(2.63)** | **0.018** | **(2.65)** | 0.001 | (0.13) |
| $Ret_{t-2}$ | 0.003 | (1.20) | 0.003 | (1.21) | 0.002 | (0.35) |
| $Ret_{t-3}$ | 0.002 | (0.75) | 0.002 | (0.76) | −0.009 | (−2.04) |
| $Ret_{t-4}$ | −0.001 | (−0.24) | −0.001 | (−0.16) | −0.006 | (−0.95) |
| Volatility | −0.031 | (−2.05) | −0.033 | (−2.15) | −0.022 | (−1.78) |
| Bond Ret | 0.000 | (0.04) | 0.000 | (0.18) | −0.008 | (−1.44) |
| $R^2$ | 0.008 | | 0.008 | | 0.005 | |
| N | 948,088 | | 946,216 | | 89,827 | |

Bold numbers indicate that coefficients are statistically significant on conventional levels

zero. Therefore, changes in the market, before and after the cutoff, are not helpful in explaining same day fund flow. Put differently, we do not find evidence of late trading among equity funds in the UK. This is in line with the findings of the FSA investigation (see footnote 21).

## 3.5 Robustness

### *3.5.1 Institutional funds versus retail funds*

Because late trading appears not to be present in the UK, the subsequent analyses focus on French and German equity funds. To further investigate how widespread late trading practices may have been, we first distinguish between institutional and retail funds. Funds with a minimum investment of EUR 100,000 or more are usually classified as institutional and generally target corporations, pension funds,

endowments, foundations and other large, including high net-worth, investors. Retail funds focus on individual investors.

The results in Table 6 for French mutual funds show that only the flow of retail funds is correlated with market movements after the cutoff time. The coefficients on $\Delta FUT^{8pm-9pm}$ and $\Delta FUT^{9pm-10pm}$ are both positive and statistically significant. None of the coefficients on futures price changes are statistically significant in the case of institutional funds. This suggests the culprits may be hiding their illicit trades among the frequent subscription and redemption orders of retail investors. While retail fund managers may have more flexibility to exploit late trade opportunities compared to institutional fund managers acting on predetermined flow orders or having their practices being closely monitored, the evidence from the US is that prior to 2003 late trading was widespread among institutional investors favored by mutual fund companies. In the case of German mutual funds, the results show that the flow of both institutional and retail funds is correlated with after-hour market movements. The coefficients on $\Delta FUT^{5.30pm-6pm}$, $\Delta FUT^{9pm-10pm}$ (institutional funds) and on $\Delta FUT^{6pm-7pm}$ (retail funds) are all positive and statistically significant. In particular, judging by the magnitude of estimated coefficients, it appears the incidence of late trading is more prevalent among institutional investors favored by mutual fund companies. We also find that market volatility has a negative and significant effect on flow for

**Table 6** Institutional funds versus retail funds. This table reports regression estimates of eq. (2) for institutional and retail funds by country. Funds with a minimum investment of EUR 100,000 or more are classified as institutional, all other funds as retail funds. In case of French (German) mutual funds, $\Delta FUT^{morning}$ are log changes in futures prices between 9 am and 12 pm (3 pm). $\Delta FUT^{afternoon}$ are log changes in future prices between 12 pm (3 pm) and 5.30 pm. Standard errors are clustered by fund and year. Corresponding *t*-statistics are reported in parentheses. The time period for French mutual funds is June 2008 and for German mutual funds June 2006 through July 2014

| | Institutional Funds | | | | Retail Funds | | | |
|---|---|---|---|---|---|---|---|---|
| | France | | Germany | | France | | Germany | |
| Intercept | 0.001 | (0.82) | **0.002** | **(3.17)** | 0.001 | (1.17) | **0.001** | **(2.71)** |
| $\Delta FUT^{morning}$ | 0.007 | (0.23) | 0.012 | (0.53) | 0.009 | (1.17) | 0.005 | (0.62) |
| $\Delta FUT^{afternoon}$ | 0.021 | (0.76) | 0.003 | (0.16) | 0.003 | (0.63) | −0.005 | (−0.73) |
| $\Delta FUT^{5.30pm\ to\ 6pm}$ | −0.055 | (−1.61) | **0.040** | **(3.84)** | 0.007 | (0.51) | 0.006 | (0.29) |
| $\Delta FUT^{6pm\ to\ 7pm}$ | −0.244 | (−1.61) | 0.041 | (0.39) | 0.011 | (0.49) | **0.034** | **(2.09)** |
| $\Delta FUT^{7pm\ to\ 8pm}$ | 0.123 | (1.03) | 0.090 | (1.10) | −0.014 | (−1.34) | −0.016 | (−0.44) |
| $\Delta FUT^{8pm\ to\ 9pm}$ | −0.075 | (−0.63) | 0.123 | (1.47) | **0.031** | **(3.49)** | 0.009 | (0.45) |
| $\Delta FUT^{9pm\ to\ 10pm}$ | −0.008 | (−0.17) | **0.074** | **(5.21)** | **0.019** | **(1.90)** | 0.019 | (1.49) |
| $Flow_{t-1}$ | **0.048** | **(3.46)** | **0.036** | **(3.39)** | 0.014 | (1.12) | **0.049** | **(4.04)** |
| $Flow_{t-2}$ | **0.042** | **(2.05)** | **0.021** | **(2.55)** | **0.017** | **(2.22)** | **0.033** | **(6.22)** |
| $Flow_{t-3}$ | **0.018** | **(2.70)** | **0.023** | **(2.33)** | **0.019** | **(4.90)** | **0.025** | **(2.80)** |
| $Flow_{t-4}$ | 0.012 | (1.14) | 0.003 | (0.79) | **0.015** | **(3.04)** | **0.038** | **(2.70)** |
| $Ret_{t-1}$ | 0.014 | (0.60) | 0.016 | (0.59) | 0.006 | (1.35) | **0.022** | (2.89) |
| $Ret_{t-2}$ | −0.020 | (−0.86) | 0.010 | (0.37) | **0.008** | **(2.44)** | **0.020** | **(2.99)** |
| $Ret_{t-3}$ | 0.011 | (0.57) | −0.035 | (−1.47) | −0.008 | (−0.80) | 0.002 | (0.29) |
| $Ret_{t-4}$ | 0.019 | (0.83) | −0.027 | (−1.01) | −0.006 | (−1.44) | **0.014** | **(2.38)** |
| Volatility | −0.028 | (−0.60) | **−0.101** | **(−2.35)** | −0.029 | (−1.28) | **−0.043** | **(−3.42)** |
| Bond Ret | −0.006 | (−0.31) | −0.028 | (−1.35) | −0.005 | **(−1.91)** | −0.006 | (−1.34) |
| $R^2$ | 0.006 | | 0.003 | | 0.012 | | 0.007 | |
| N | 29,228 | | 24,677 | | 409,199 | | 222,140 | |

Bold numbers indicate that coefficients are statistically significant on conventional levels

German funds in line with the results of Table 4. Lagged returns appear to be significant for retail funds but not for institutional funds. This finding is consistent with prior research showing that portfolio choice, investor behaviour and the flow-performance relation across fund types are different. For example, clients of institutional funds tend to use more sophisticated performance measures such as risk-adjusted return measures or tracking error and do not chase returns in the same way as their retail counterparts (e.g. del Guercio and Tkac 2002; James and Karceski 2006; Salganik and Schreiber 2013).

### 3.5.2 Fund size and investment style

We turn next to examine whether differences in the incidence of late trading exist between small and large funds. Larger funds have generally more buy and sell orders per day than smaller funds, and hence, placing orders late unnoticed might be easier, particularly when fund managers are not directly involved. The classification into small and large funds is based on the average total net assets of each fund. The results in Table 7 show that it is mainly the flow of larger funds, which is correlated with post cutoff market movements.

In the case of (large) French mutual funds the coefficients on price changes during the afternoon and 8 pm and 9 pm are 0.01 and 0.05 with *t*-statistics of 2.09 and 6.81, respectively. In the case of (large) German mutual funds, the coefficient estimates on $\Delta FUT^{5.30pm-6pm}$, $\Delta FUT^{8pm-9pm}$ and $\Delta FUT^{9pm-10pm}$ are all of the same (positive)

**Table 7** Large funds versus small funds. This table reports regression estimates of eq. (2). The classification into small and large funds is based on the average total net assets of the sample funds. Standard errors are clustered by fund and year. Corresponding *t*-statistics are reported in parentheses. The time period for French mutual funds is June 2008 and for German mutual funds June 2006 through July 2014

| | Large funds | | | | Small funds | | | |
|---|---|---|---|---|---|---|---|---|
| | France | | Germany | | France | | Germany | |
| Intercept | 0.000 | (0.38) | **0.000** | **(1.99)** | **0.001** | **(1.79)** | **0.002** | **(3.13)** |
| $\Delta FUT^{morning}$ | 0.005 | (0.51) | −0.002 | (−0.23) | 0.011 | (1.47) | 0.017 | (0.82) |
| $\Delta FUT^{afternoon}$ | **0.010** | **(2.09)** | −0.013 | (−1.15) | −0.005 | (−0.61) | 0.008 | (0.57) |
| $\Delta FUT^{5.30pm\ to\ 6pm}$ | −0.005 | (−0.44) | **0.030** | **(1.66)** | 0.015 | (0.56) | **0.079** | **(1.77)** |
| $\Delta FUT^{6pm\ to\ 7pm}$ | 0.003 | (0.18) | 0.033 | (1.45) | −0.010 | (−0.32) | 0.032 | (1.02) |
| $\Delta FUT^{7pm\ to\ 8pm}$ | −0.009 | (−1.07) | 0.007 | (0.20) | −0.007 | (−0.30) | −0.022 | (−0.46) |
| $\Delta FUT^{8pm\ to\ 9pm}$ | **0.054** | **(6.81)** | **0.027** | **(1.73)** | −0.016 | (−0.59) | 0.013 | (0.29) |
| $\Delta FUT^{9pm\ to\ 10pm}$ | 0.012 | (1.08) | **0.029** | **(2.26)** | 0.023 | (1.50) | 0.017 | (0.82) |
| $Flow_{t-1}$ | 0.035 | (1.08) | **0.085** | **(3.06)** | 0.014 | (1.05) | **0.027** | **(4.41)** |
| $Flow_{t-2}$ | **0.053** | **(4.04)** | **0.027** | **(1.97)** | 0.008 | (1.06) | **0.029** | **(4.71)** |
| $Flow_{t-3}$ | **0.014** | **(1.81)** | **0.033** | **(2.87)** | **0.020** | **(4.27)** | **0.020** | **(1.89)** |
| $Flow_{t-4}$ | **0.013** | **(3.38)** | **0.017** | **(3.46)** | **0.015** | **(2.48)** | **0.034** | **(2.13)** |
| $Ret_{t-1}$ | **0.987** | **(2.32)** | **0.028** | **(4.11)** | 0.006 | (0.01) | 0.012 | (0.90) |
| $Ret_{t-2}$ | **0.928** | **(3.46)** | **0.017** | **(2.76)** | 0.139 | (0.20) | 0.019 | (1.37) |
| $Ret_{t-3}$ | −0.220 | (−0.25) | 0.002 | (0.37) | −1.600 | (−1.26) | −0.009 | (−0.69) |
| $Ret_{t-4}$ | −0.392 | (−1.35) | 0.006 | (1.13) | −0.481 | (−0.62) | 0.015 | (1.53) |
| Volatility | −0.008 | (−0.50) | **−0.038** | **(−3.75)** | **−0.058** | **(−1.81)** | **−0.065** | **(−2.53)** |
| Bond Ret | −0.004 | (−1.25) | **−0.007** | **(−1.81)** | −0.006 | (−0.89) | −0.010 | (−1.15) |
| $R^2$ | 0.021 | | 0.113 | | 0.012 | | 0.038 | |
| N | 248,952 | | 149,270 | | 188,498 | | 97,547 | |

Bold numbers indicate that coefficients are statistically significant on conventional levels

**Table 8** Large-cap funds versus small-cap funds. This table reports regression estimates of eq. (2) for large-cap and small-cap oriented funds by country. We take the style classification from Morningstar Categories, which is based on the underlying portfolios. In case of French (German) mutual funds, $\Delta FUT^{morning}$ are log changes in futures prices between 9 am and 12 pm (3 pm). $\Delta FUT^{afternoon}$ are log changes in future prices between 12 pm (3 pm) and 5.30 pm. Standard errors are clustered by fund and year. Corresponding *t*-statistics are reported in parentheses. The time period for French mutual funds is June 2008 and for German mutual funds June 2006 through July 2014

| | Large-cap Funds | | | | Small-cap Funds | | | |
|---|---|---|---|---|---|---|---|---|
| | France | | Germany | | France | | Germany | |
| Intercept | 0.000 | (0.25) | **0.001** | **(2.34)** | **0.002** | **(2.07)** | 0.001 | (1.58) |
| $\Delta FUT^{morning}$ | 0.005 | (0.88) | 0.009 | (1.43) | 0.018 | (1.11) | 0.000 | (−0.00) |
| $\Delta FUT^{afternoon}$ | 0.007 | (1.30) | −0.006 | (−0.61) | −0.003 | (−0.69) | 0.004 | (0.32) |
| $\Delta FUT^{5.30pm\ to\ 6pm}$ | 0.008 | (0.57) | **0.061** | **(2.39)** | −0.014 | (−0.36) | 0.017 | (0.41) |
| $\Delta FUT^{6pm\ to\ 7pm}$ | **−0.014** | **(−0.44)** | **0.039** | **(2.52)** | 0.030 | (0.53) | 0.027 | (0.69) |
| $\Delta FUT^{7pm\ to\ 8pm}$ | **−0.007** | **(−0.56)** | **0.005** | **(0.13)** | −0.008 | (−0.24) | −0.028 | (−0.55) |
| $\Delta FUT^{8pm\ to\ 9pm}$ | **0.015** | **(1.03)** | **0.039** | **(1.40)** | **0.047** | **(1.99)** | −0.030 | (−1.37) |
| $\Delta FUT^{9pm\ to\ 10pm}$ | **0.014** | **(1.68)** | **0.031** | **(2.57)** | 0.023 | (1.40) | 0.005 | (0.18) |
| $Flow_{t-1}$ | **0.024** | **(1.80)** | **0.050** | **(5.38)** | 0.006 | (0.82) | 0.026 | (0.45) |
| $Flow_{t-2}$ | **0.021** | **(2.46)** | **0.030** | **(9.76)** | 0.021 | (1.58) | 0.027 | (1.63) |
| $Flow_{t-3}$ | **0.020** | **(4.19)** | **0.029** | **(2.56)** | **0.016** | **(3.22)** | 0.004 | (0.56) |
| $Flow_{t-4}$ | **0.012** | **(1.95)** | **0.030** | **(2.27)** | **0.020** | **(4.11)** | **0.021** | **(3.00)** |
| $Ret_{t-1}$ | 0.006 | (1.15) | 0.017 | (2.66) | 0.008 | (1.12) | **0.046** | **(2.34)** |
| $Ret_{t-2}$ | 0.003 | (0.83) | 0.014 | (1.61) | **0.021** | **(3.57)** | **0.044** | **(2.76)** |
| $Ret_{t-3}$ | −0.007 | (−0.80) | −0.006 | (−1.02) | −0.008 | (−0.47) | 0.018 | (0.84) |
| $Ret_{t-4}$ | −0.005 | (−1.31) | 0.008 | (1.13) | 0.002 | (0.26) | **0.021** | **(1.89)** |
| Volatility | −0.010 | (−0.56) | **−0.053** | **(−2.60)** | **−0.076** | **(−1.98)** | **−0.029** | **(−1.76)** |
| Bond Ret | 0.000 | (−0.09) | −0.006 | (−0.96) | −0.005 | (−0.74) | **−0.016** | **(−4.79)** |
| $R^2$ | 0.018 | | 0.062 | | 0.017 | | 0.035 | |
| N | 309,232 | | 186,818 | | 127,580 | | 66,189 | |

Bold numbers indicate that coefficients are statistically significant on conventional levels

magnitude and are statistically significant. Again, the coefficient estimates on lagged flow are all positive and mostly statistically significant. As before the positive estimates on lagged returns are consistent with positive feedback or return chasing trading strategies. The coefficient estimates on volatility and bond returns are negative and are significant for German funds.

Table 8 reports separate results for different investment styles based on Morningstar Categories. We only have a classification into large-cap and small-cap funds available. Small-cap stocks usually react more to (market) news and hence might provide an opportunity to maximize the benefits of late trading. In the case of French mutual funds, the flow of both fund types shows some correlation to after hour market movements. The coefficient estimate on $\Delta FUT^{8pm-9pm}$ (large-cap funds) is 0.01 with a *t*-statistic of 1.68, while the coefficient on $\Delta FUT^{9pm-10pm}$ (small-cap funds) is 0.05 and has a *t*-statistic of 1.99. However, in the case of German funds only net flow of large-cap funds is correlated with post cutoff market movements. The coefficient estimates on $\Delta FUT^{5.30pm-6pm}$, $\Delta FUT^{8pm-9pm}$ and $\Delta FUT^{9pm-10pm}$ are 0.06, 0.04 and 0.03 with *t*-statistics of 2.39, 2.52 and 2.57, respectively. None of the coefficients for small-cap funds are statistically significant. It appears that the incidence of late trading is more likely for funds investing in stocks that move closer with the market. We surmise that the additional risk from investing in small-cap stocks has been

**Table 9** Correlation of mutual fund returns with prior day changes in futures prices and predictive regression. This table reports the correlation of returns on equity funds with prior day changes in futures prices. The sample consists of 351 French mutual funds equally-weighted across all funds. The table also reports a regression predicting the funds next day return using changes in futures prices after the cutoff time and market close. *t*-statistics are based on heteroskedasticity consistent standard errors and reported in parentheses. The sample period is June 2008 through July 2014

| Correlation between changes in future prices and next day mutual fund returns | | | | | | |
|---|---|---|---|---|---|---|
| | $\Delta FUT_{t-1}^{9am-5.30pm}$ | $\Delta FUT_{t-1}^{9am-12pm}$ | $\Delta FUT_{t-1}^{12pm-5.30pm}$ | $\Delta FUT_{t-1}^{5.30pm-10pm}$ | $\Delta FUT_{t-1}^{12pm-10pm}$ | |
| $R_t^{EW}$ | **0.112** | 0.033 | **0.113** | **0.426** | **0.316** | |
| Regression predicting next day mutual fund returns | | | | | | |
| | $\Delta FUT_{t-1}^{9am-12pm}$ | $\Delta FUT_{t-1}^{12pm-10pm}$ | $\Delta FUT_{t-1}^{12pm-5.30pm}$ | $\Delta FUT_{t-1}^{5.30pm-10pm}$ | Obs. | R2 |
| Coef. | 0.06 | **0.29** | | | | |
| (t-stat.) | (0.89) | **(5.19)** | | | | |
| Coef. | 0.06 | | 0.05 | **0.67** | 1395 | 0.10 |
| (t-stat.) | (1.04) | | (0.91) | **(6.25)** | 1395 | 0.19 |

Bold numbers indicate that coefficients are statistically significant on conventional levels

considered too onerous for many late traders, a pattern which is also consistent with the limits to late trading arbitrage, especially in view of a sample period covering two major financial crises.[35]

## 4 Returns and amount of flow from late trading

In this section we quantify the potential return from late trading using French data and compare it to a simple buy-and-hold strategy. For this purpose, we assume an investor was given late trading capacity recognizing that in practice, this would be limited to the funds of specific investment companies or brokers that allow or facilitate late trading. We estimate the return from late trading as the equally-weighted return on the sample funds on day *t* if the change in futures prices after the cutoff time on day *t-1* is positive. If it is negative the investor stays out of the market and earns the risk free rate[36]; ergo

$$R_t^{\text{Late}} = \begin{cases} R_t^{EW}, & \Delta FUT_{CAC40,t-1}^{12pm-10pm} > 0 \\ R_t^{T-\text{bill}}, & \Delta FUT_{CAC40,t-1}^{12pm-10pm} \le 0 \end{cases}$$

Table 9 illustrates that prior day changes in futures prices might indeed be useful for guiding the illicit trades. The correlation of changes in futures prices after the cutoff time with next day's fund returns is between 0.113 and 0.426 (see Panel A). A predictive regression shows it is the changes after market close that matter the most (see Panel B). The coefficient on price changes during the afternoon is statistically insignificant, whereas the coefficient on $\Delta FUT_{t-1}^{5.30pm-10pm}$ is 0.67 with a *t*-statistic of 6.25.

Figure 1 shows that an investment of EUR 100 would have almost increased seven-fold had an investor been allowed to trade late at maximum frequency. Even during the GFC, late

[35] Following the referee's suggestion, we have also estimated the large- and small-cap equations for France and Germany using the simpler specification from Table 2 (Panel A). We find that for French mutual funds the effect of post 5:30 pm market movement is significant only for small-caps whereas for Germany is significant only for large-caps.

[36] We use the French 3-month Treasury bill rate as risk free rate.

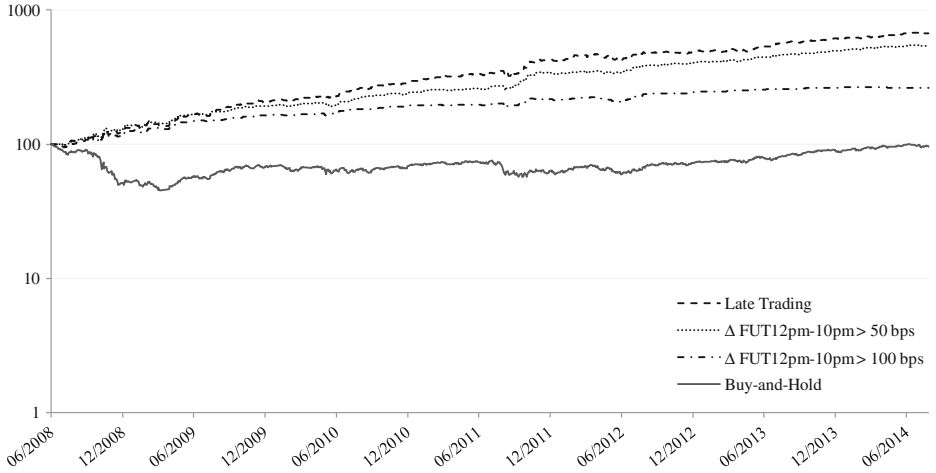


**Fig. 1** Growth of EUR 100 invested in an EW Portfolio of Equity Mutual Funds. This graph illustrates the growth of EUR 100 invested in an equally-weighted portfolio of 351 French mutual funds that invest domestic equities. The blue lines show daily changes in the investment from late trading. The grey line shows daily changes in the investment from a buy-and-hold strategy. The sample period is June 2008 through July 2014

trading mainly earned a positive return, whereas the buy-and-hold strategy has not yet fully recovered from its losses during the GFC.[37]

Table 10 presents summary statistics for both return series. Average daily return from late trading is 14 bps whereas it is 1 bps from the buy-and-hold strategy with *t*-statistics of 6.01 and 0.15, respectively.

Based on 250 trading days, late trading earns an uncompounded return of 35% per annum. At the same time, it has a much lower standard deviation.[38] This outperformance is mainly based on the strategy's ability to predict large positive fund returns. A late trader invests only half the time and avoids about half of the negative returns a buy-and-hold investor would experience. The table also shows statistics of returns from trading funds only when the change in futures prices is greater than 50 basis points or 100 basis points. This reduces the number of trades substantially and produces annualized returns of 31% and 18%, respectively. Considering that we ignore any possible refinements, the estimated returns in this section are rather conservative. For example, by trading only high beta or small cap funds, returns from late trading should be even higher.[39] We do not consider transaction costs in our example since it is unlikely that late traders face front- or back-end loads and the incurred costs of their trades are attributed to all investors of the funds. The potential gains from late trading are similar in magnitude to the returns reported in Goetzmann et al. (2001), Boudoukh et al. (2002) and Zitzewitz (2003). These papers study the same underlying concept of exploiting stale prices that also applies to late trading. The latter, however, is unambiguously unlawful and not a

[37] The buy-and-hold strategy has a cumulative return of 200% when the GFC is excluded from the sample period (March 2009 until July 2014), while late trading returns 471%.

[38] The results are qualitatively the same when we base late trading on changes in futures prices between 5.30 pm and 10 pm (after market close) and virtually unchanged assuming an investor earns zero return on cash instead of the risk free rate on days she has not invested in equity funds.

[39] Our test based on the equally-weighted portfolio of funds approximates an investor trading funds late randomly.

**Table 10** Summary statistics of return series from a late trading and buy-and-hold strategy. This table presents summary statistics on returns from late trading compared to a buy-and-hold strategy of an equally-weighted portfolio of 351 French mutual funds. The sample period is June 2008 through July 2014

| | Daily return in % | Standard deviation | t-Statistic | Number of days in the market | Number of returns <0 |
|---|---|---|---|---|---|
| Late Trading | 0.14 | 0.87 | 6.01 | 766 | 333 |
| Buy-and- Hold | 0.01 | 1.25 | 0.15 | 1395 | 659 |
| $\Delta$ $FUT^{12pm-10pm}$ > 50 bps | 0.12 | 0.74 | 6.28 | 415 | 205 |
| $\Delta$ $FUT^{12pm-10pm}$ > 100 bps | 0.07 | 0.59 | 4.51 | 217 | 163 |

question of legal limbo. Our analysis vividly shows why this practice was so widespread and probably still is in some areas of the world.

In addition, we measure long-term shareholder dilution from late trading using the methodology proposed by Zitzewitz (2006). We estimate losses due to late trading to be 1.04 basis points per year on average over the sample period.[40] This estimate is in line with Zitzewitz (2006) who reports an average annualized dilution of 0.88 basis points from 1998 to 2003 for US equity funds.

## 5 Conclusion

We find statistical evidence consistent with the occurrence of late trading in two countries for which no major shortcomings were identified during an investigation conducted by European securities regulators in 2004. We would have expected that following the events that rocked the US funds industry in 2003 and ensuing strengthening of regulation should have made late trading more difficult to execute, but our empirical evidence suggests that it may be still present. Many reasonable proposals have been considered to thwart late trading, most of which are recommendations for more effective trading procedures and internal controls, including different fee structures, strict forward pricing and fair value pricing. However, the merits from placing safer bets, the prospects of large gains and relative simplicity and appeal of this practice at least for a small number of market participants favored by mutual fund companies are obvious. The profits from trading late, however, are matched dollar-for-dollar by the losses of long term investors. Therefore, we fully endorse the suggestion of Zitzewitz (2006) that simple statistical methods may be helpful and should be used on a regular basis as part of the assessment and monitoring of the compliance of fund companies with law and best practices. However, such tests do not indicate if fund companies knowingly allow late trading or if late trading is mainly facilitated by intermediaries like brokerage firms, albeit they do raise a flag that may warrant further scrutiny. Nevertheless, if late trading is indeed the source behind the correlations found in this paper, it would be disheartening for investors considering an already long list of scandals beleaguering the financial services industry including the manipulation of the LIBOR and currency exchange rates and several cases of insider trading in the hedge funds industry.

[40] Dilution is based on the measure suggested by Zitzewitz (2006) and calculated using the model in Table 3 with 12 pm as pricing cutoff for NAV and hourly changes in the futures market after 5.30 pm. We find that dilution fluctuates slightly by year and is largest in 2008. Similarly, average annual dilution for Germany is 1.55 basis points and also largest in 2008.

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