Securities Lending and Information Acquisition

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Abstract

We show that mutual funds make portfolio allocation decisions conditional on information acquired from participating in the equity lending market. Using unique data from German mutual funds on fund-stock level lending decisions, we show that funds that lend shares are more likely to exit positions relative both to stocks that they do not lend and to funds that do not lend. Lenders also avoid losses by better timing the closure of long positions than for stocks they do not lend. Finally, we show information acquisition in the lending market allows lenders to front-run public disclosure of large short positions. The results suggest that the securities lending market provides a mechanism for mutual funds to acquire information.

Keywords: Equity lending markets, mutual funds, short sales, short interest, price revelation, public disclosure.

JEL classification: G10, G12, G14, G18.

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1 Introduction

The incorporation of information about asset values in share prices is one of the defining features of stock markets. The role of informed investors and learning from prices in stock markets is first modelled in the seminal paper by Grossman and Stiglitz (1980). The vast literature that followed is based on the assumptions that investors acquire information or price signals to update their expectations and portfolio holdings and that prices reflect the information of informed investors through their trading activity.[1] How do investors acquire information on which they update their expectations? Do alternate channels to the price process exist for conveying information from informed to uniformed investors? These are some of the most fundamental questions pertaining to the informativeness of stock markets.

In this paper, we show that active mutual fund investors make portfolio allocation decisions conditional on information acquired from participating in the equity lending market. Using unique micro-data on securities lending decisions by German mutual funds provided by a German regulator, we show that active funds that lend stocks and observe shorting demand are more likely to reduce or exit positions relative both to stocks that they do not lend and funds that do not lend. Lenders better time the closure of long positions in stocks for which they observe shorting demand than for closing positions in stocks they do not lend, consistent with information acquisition taking place in the lending market. Specifically, lenders exit stock positions in response to private signals acquired from shorting demand information before negative price information has been fully reflected in prices. This allows funds that lend stocks to avoid further losses and leave "losses-on-the-table." The results highlight that the securities lending market is an alternative mechanism through which information is conveyed by informed investors to other market participants and provides a channel through which mutual funds acquire information.

Securities lending markets match lenders of stocks with short sellers who need to borrow the stock. The lenders are typically large institutional investors – mutual funds, pension funds,

[1] Many articles have used noisy rational expectation models to study learning. See, for example, Hellwig (1980), Admati (1985), Diamond and Verrecchia (1987), Wang (1993), Chen et al. (2001), and Banerjee (2011).

index funds, and exchange-traded funds – who earn a fee in return for the shares that are lent to short sellers. Short sellers are typically hedge funds, arbitrageurs, or activists with private negative information. Short selling is an important channel through which negative price information is incorporated into stock prices.[2] The superior forecasting ability of short sellers stems from better interpretation of public information (Engelberg et al. (2012) and Porras Prado et al. (2016)) and the uncovering of negative private information (Karpoff and Lou (2010) and Boehmer et al. (2020)). Aggarwal et al. (2015) and Porras Prado et al. (2016) show that lending transactions contain information about the motivations behind the actions of both equity lenders and short sellers. Consequentially, being the lender in an equity lending contract with a short seller potentially gives mutual funds access to private information that is not revealed in prices or even stock-level short interest.[3] Specifically, lenders observe a more precise signal on the dispersion of investor beliefs because they have access to the composition of shorting demand, fees associated with short-selling, unfulfilled demand and supply for lending stocks, and observe equity lending trading in a more timely manner.

Identifying the private information channel in the equity lending market is empirically challenging for a few reasons. First, one needs to identify lenders and non-lenders to distinguish between information acquisition through equity lending and learning from publicly available price signals, like short interest and market news. Second, even if one identifies lenders, their decision to lend securities may be correlated with the funds' investment strategy and information acquisition at the fund-level, including their ability and number of analysts, information spillovers within the organization, and reliance on investment consultants. Consequently, examining fund-level lending and trading activity will be plagued with selection concerns. Third, within-fund stock-specific expertise might explain heterogeneity in holdings. Fourth, one needs to rule out reverse causality. Namely, it is plausible that short sellers increase short positions in response to mutual funds exiting long positions and withdrawing supply from the equity

[2]Short selling predicts lower abnormal stock returns (Asquith and Meulbroek (1995), Jones and Lamont (2002), Asquith et al. (2005), Boehme et al. (2006), Cohen et al. (2007), Diether et al. (2009), Rapach et al. (2016)), Boehmer et al. (2020).

[3]Blocher et al. (2013) show that short-interest is not a sufficient statistic for heterogeneity in beliefs because the equity lending market exhibits both search costs and slack supply.

lending market.

We use unique data on equity lending by German mutual funds from the Investment Funds Statistic (IFS) of the Deutsche Bundesbank to study securities lending and information acquisition. Since September 2009, all investment companies domiciled in Germany are required to report general fund information as well as information on their portfolio holdings to the IFS. The data is collected on a monthly basis and provides detailed security-by-security information on the portfolio of a fund. Since December 2014, the reporting requirements have been extended to include information on the securities lending activity of the investment fund. For each security in their portfolio, funds are now required to report the nominal value held in each equity lending transaction. This piece of information allows us to study the securities lending behavior of mutual funds on a very granular level. Specifically, we can identify fund-stock-level long positions and equity loans at the monthly level using the IFS data. We combine this data with Morningstar fund information, stock information from Datastream, and security lending market data from Markit to build a complete picture of funds' lending activity at the stock-level.

The data allows us to identify not just lenders and. non-lenders, but also whether a fund has the discretion to trade on information (active vs. passive index funds), and within-lender portfolio lending activity across individual stocks over time. Therefore, we can identify the effect of shorting demand information on lenders' portfolio decisions while absorbing public stock-time price signals common to all investors, fund-time information and investment decisions common to all stocks held in a fund's portfolio, and fund-stock time-invariant expertise. Specifically, we estimate how fund-stock portfolio positions are affected by shorting demand interacted with active fund lending activity in an estimation framework including security-time, fund-time, and fund-security fixed effects. Under the identification assumption that a fund's own effort to acquire information across funds within its portfolio is not positively correlated with its decision to make stocks available for lending, we can interpret the coefficient on shorting demand interacted with lending activity as the impact on portfolio holdings of acquiring negative information through the equity lending market. This identification assumption seems

reasonable given that the primary reason for lending securities is to earn fee income (Duffie et al. (2002) and Prado (2015)) and information from equity lending likely substitutes rather than complements, a fund's own investment in costly information.[4]

The German mutual fund setting comprises all all 314 mutual funds domiciled in Germany, including 264 active funds and 50 passive funds, with €7.2 Trillion assets under management. On average, 74% of passive funds and 25% of active funds lend stocks, consistent with the evidence that active funds are less likely to supply stocks to the US equity lending market (Porras Prado et al. (2016)). The average fund that lends securities lends 3.4% of its assets under management, and on average lends 55% of its long position when it lends a stock.

We start by examining variation in fund-stock portfolio holdings as a function of a fund observing shorting demand in the equity lending market. We examine monthly portfolio changes and exits at the fund-stock holding-level. Active funds are, on average, more likely to reduce positions than passive funds, consistent with active funds exercising discretion. Further, active funds that lend the stock are more likely to reduce positions when shorting demand is higher than non-lending active funds that hold the same stock. In our main estimations absorbing stock-time, fund-time, and fund-stock fixed effects, we show that active funds are 30% more likely to exit positions when they lend the stock compared to when they do not. Notably, the decision to exit positions varies with observed levels of aggregate shorting demand. In difference-in-difference estimations around changes in shorting demand, we find that active lenders are 1.7 times more likely to exit positions than active non-lenders given a one-standard deviation increase in shorting demand. The results are consistent with active lenders making discretionary investment decisions conditional on signals from the equity lending market.

Next, we examine how active lenders time exits and the impact on returns. We show that active funds are better at timing the closure of long positions in heavily-shorted stocks that they lend than those they do not. In particular, active lenders time exits ahead of short-selling while active non-lenders exit after short-selling activity. We find that stocks with top-quintile shorting demand exhibit average abnormal 12-month returns of –15%. However, active lenders

[4] A large literature examines the crowding out of private information in financial markets by public disclosure or externally available information. See Goldstein and Yang (2017) for a review.

successfully time exits of high shorting demand stocks to decrease these losses. Stocks in which an active lender exits after observing shorting demand have pre-exit 12-month abnormal returns of +6.4% and post-exit 12-month abnormal returns of –6.2% compared with stocks in which an active non-lender exits. The pattern of pre-exit positive and post-exit negative relative return represents losses that the active lender avoids compared with a comparable fund that does not lend. Therefore, active lenders who lend shares in the stock market exhibit better market timing ability than those that do not, consistent with information acquisition in the securities lending market.

Further, we investigate if there are information spillover effects across stocks within a fund and across funds within a stock. We find that, relative to funds that do not lend any stocks, an active fund is more likely to close positions in response to higher short demand for a stock, even when it does not lend the individual stock but lends other stocks in its portfolio. This implies that learning about aggregate shorting demand shocks or shorting demand in related stocks is also an important channel through which equity lending facilitates information acquisition. We find less evidence of information spillovers within a fund-family, consistent with the within-family competition documented by Kempf and Ruenzi (2008).

We supplement our findings by examining if lenders acquire information from equity lending around significant short sale events. Since November 1st, 2012, European Union regulators harmonized the disclosure of large short sale positions across all stock exchanges in the EU. Any short position larger than 0.5% of the market capitalisation for any firm traded on European exchanges has to be reported on the next trading day to the market.[5] These public disclosure events are informative in so much that they predict negative returns (Jank and Smajlbegovic (2015)), but do not fully reveal private information on the structure of shorting demand below the disclosure threshold (Jank et al., 2020). Therefore, disclosure of large short sales positions provide an ideal setting to identify trading on information acquisition through securities lending separately from trading on public information.

We find that active fund lenders not only reduce positions around the public disclosure but

[5]Prior to this date, the United Kingdom, France and Spain already had disclosing requirements for large short sales positions (Jones et al. (2016)).

in fact start to exit positions three months before the disclosure of large short sale positions. Further, active fund lenders are less responsive than non-lenders to shorting demand after the disclosure announcement, presumably because they have already reduced holdings prior to the public disclosure. The results highlight that funds can acquire information through equity lending, which provides a more precise signal about the dispersion of investor beliefs and informed negative sentiment. This allows funds to anticipate large negative trades and potentially front-run short positions and other market participants.

Our paper highlights that securities lending is a channel for information acquisition. The results are consistent with evidence that prices alone do not reflect dispersion in investor beliefs and that there is a disconnect between the long and short markets (Kolasinski et al. (2013) and Blocher et al. (2013)). Information is conveyed from informed to uninformed investors not only through prices and trades in the long market, but also through the prices and trades in the lending market. We show that active funds that lend stocks to short sellers acquire this information. Thus, our results speak directly to the questions on how information is acquired and the channel through which information is transferred in financial markets.

The results also have implications for price discovery. On the one hand, if active funds learn from and respond to information in the lending market then active funds may be complementary traders to short sellers, which could increase both price informativeness and short sellers' incentives to produce information. Goldstein and Yang (2015) show that complementarities between information acquisition and trading amplifies the effect of exogenous changes in the underlying information environment. Cvijanović et al. (2019) show that complementarities in information acquisition and trading improves governance via exit. On the other hand, active lenders may create fragility in lending supply by responding to information in the lending market. Withdrawing supply to exit positions in response to shorting demand can increase shorting risk by increasing search frictions and loan fees. The increase in shorting risk increases limits to arbitrage and dampens price informativeness (Porras Prado et al. (2016) and Engelberg et al. (2018)).

Results examining the composition of lending supply hint at complementary roles for short

sellers and active lenders. First, the number of active funds who lend decreases with shorting demand, consistent with them trading on short demand signals. Second, the price to borrow stocks is no higher for active lender funds controlling for shorting demand, inconsistent with higher shorting risk from loan supply fragility. Rather, the evidence is consistent with short sellers rationally "leaking" information to uninformed investors who then trade in a complementary manner (Indjejikian et al. (2014)). The finding that exits improve price informativeness by front-running short positions offers further support for the complementary trader mechanism proposed by Goldstein and Yang (2015). Overall, the results highlight the importance of looking at the interaction of information acquisition across the long and short markets to understand the overall efficiency of the financial market in generating and processing information.

The remainder of the paper is organised as follows. Section 2 discusses our testable hypothesis. Section 3 details the data used and our sample construction. Section 4 describes the reaction to changes in short selling demand, while section 5 examines stock returns after funds exit long positions. Section 6 shows the results of validity tests using a difference-in-differences approach based on large short sales disclosures. Section 7 concludes.

2 Hypotheses Development

Our main research question examines if and how active participants in the equity lending markets use information from shorting demand for portfolio allocation. Wang (1993) and Banerjee (2011) develop a dynamic model where investors with differences of beliefs learn from prices and trade to update stock valuations. Furthermore, several theories attempt to explain how complementarities between information acquisition and trading amplifies the effect of changes in the underlying information environment.[6] Goldstein and Yang (2015) examine how investors trade when there are several dimensions of uncertainty by which investors produce information and acquire expertise, akin to the behavior of short sellers and active funds. As investors interact and condition their decisions on security prices, strategic complementarity or

[6]Please refer to Goldstein and Yang (2017) for an extensive review.

substitutability arise, amplifying or attenuating shocks. Yang and Zhu (2019) show how interactions between fundamental investors and "back-runners" (i.e., those whose only information is past order flow), affect trading behavior of all types of traders.

Academic studies on short sellers provide ample evidence of their ability to exploit information. This skill includes using both public and private information (e.g., Karpoff and Lou (2010), Engelberg et al. (2012), Porras Prado et al. (2016), and Boehmer et al. (2020)), with short selling acting as an channel through which negative price information is incorporated into stock prices. Therefore, it is reasonable to expect that investors, upon observing variation in the demand for shorting, would change their own trading behavior. More specifically, actively-managed funds that observe shorting demand in the equity lending market should use this observed information when making portfolio allocation decisions. Therefore, these funds should react more aggressively and faster to changes in shorting. This motivates our first hypothesis:

Hypothesis 1: *Actively-managed funds that lend a stock decrease their holdings after an increase in shorting demand for the stock.*

Hypothesis 1 hinges on the assumption that private signals obtained from the equity lending market are more informative than those available from publicly-available aggregate short interest data. Hence, funds that lend stocks to short sellers should act upon the revelation of negative information and reduce their holdings. In contrast, if there is no benefit from using equity lending market information, there should not be any difference in trading activity between funds that own the stock and lend it and those funds that own the stock but choose to not lend it. Hypothesis 1 naturally lead to a difference-in-differences estimation strategy: actively-managed funds that lend a stock should be more likely to reduce holdings after an increase in shorting demand relative to both other active funds holding the same stock and the same fund holding different (not-lent) stocks. Further, Hypothesis 1 implies that we should also observe that actively-managed funds, with discretionary decision making about portfolio holdings, should be more likely to respond to shorting demand revelation in the equity lending market than passively-managed funds (such as index funds and ETFs).

If active funds alter their trading behavior in response to changes in shorting demand, a natural extension is to investigate effects on fund-stock holding returns. Past research finds that short sellers can forecast negative abnormal stock returns (e.g., Asquith and Meulbroek (1995), Cohen et al. (2007), Boehmer et al. (2008), and Rapach et al. (2016)). Therefore, funds that react to an increase in shorting demand by reducing (or exiting) their investment in a given stock can front-run future price decreases, leaving "losses-on-the-table" rather than realizing price decreases. Therefore, we expect actively-managed funds that lend a stock to better time position closures in response to shorting demand.

Hypothesis 2: *Actively-managed funds that lend a stock decrease their holdings after an increase in shorting demand relatively faster than actively-managed funds that do lend the stock*

If participation in the equity lending market allows active funds to infer information and change their portfolios in response to shorting demand, as per Hypothesis 2, we expect to find differences in holding-level returns for funds that lend shares in a particular company relative to those that do not lend for stocks with large shorting demand. First, we expect pre-exit cumulative abnormal returns to be higher (less negative) for active funds that take part in equity lending than those that do not. Second, we expect post-exit cumulative abnormal returns to be lower (more negative) for active funds that take part in equity lending than those that do not. Consequently, funds can front-run future price decreases and leave "losses-on-the-table", leading to our next hypotheses.

Hypothesis 3A: *Actively-managed funds that lend the stock realize higher (less negative) abnormal returns when closing positions in response to shorting demand than actively-managed funds that do not lend the stock.*

Hypothesis 3B: *Exits by actively-managed funds that lend the stock predict future negative returns relative to exits by actively-managed funds that do not lend the stock.*

Inferring information about shorting demand from the equity lending market also has implications for investors' reactions to public information disclosures. In many countries, short sellers are forced to publicly reveal their short positions beyond certain certain thresholds (Jank

and Smajlbegovic (2015)). If equity lenders acquire private information from large short sellers in the equity lending market, we should find that actively managed funds that lend the stock are not only more likely to close positions but also to do so before a public disclosure about a large short sales position is made to the market. This is consistent with the mechanism of strategic complementarities in trading put forward by Goldstein and Yang (2015). Actively-managed funds trade more aggressively and amplify shocks by trading in the same direction as the large short sellers before the wider market receives information from public disclosure. Using portfolio holdings and equity lending decisions by actively-managed funds around large short sales positions disclosures allow us to study who incorporates new information into prices. This motivates our fourth assumption:

Hypothesis 4: *Information acquisition in the equity lending market allows active lenders to front-run public information disclosures about large short sales positions.*

3 Data and descriptive statistics

Our data on German mutual funds comes from the Investment Funds Statistic (IFS) of the Deutsche Bundesbank, from December 2014 through December 2018. Since September 2009, all investment companies domiciled in Germany are required to report general fund information as well as information on their portfolio holdings to the IFS. The data is collected on a monthly basis and provides detailed security-by-security information on the portfolio of a fund. In particular, a fund reports the ISIN, the number of shares held, as well as the nominal and the market value of each holding.[7]

In December 2014, the reporting requirements have been extended to include information on the securities lending activity of the investment fund. For each portfolio position, funds are now required to report the nominal value of the position which is held in a lending transaction. This piece of information allows us to study the securities lending behavior of mutual funds

[7] Dötsch et al. (2018) provide a general description of the data and the variables collected for the Investment Fund Statistic.

on a very granular level. Since the IFS data is collected on a share class level, we merge it with Morningstar fund information and aggregate the data to the fund level, matching the share classes' ISINs to the fund identifier provided by Morningstar. For funds with multiple share classes, we calculate fund returns and expenses as asset-weighted averages across share classes. For assets under management, fund flows, and fund holdings we aggregate across all share classes. Fund age is based on the inception date of the oldest share class.

Next, we apply several filters. First, we drop funds in the IFS for which no Morningstar information is available. Second, we exclude closed-end funds and alternative investment funds. Third, we delete non-equity, sector, and emerging market funds based on their Morningstar fund category. Fourth, we only keep funds that are older than three years and have more than $10 million of assets under management to mitigate potential incubation biases (Evans, 2010). This results in a final sample of 314 German open-end equity mutual funds from 36 different fund families. According to the IFS, 264 are actively-managed funds while the remaining are passively-managed ones. The investment focus of these funds is rather broad, as shown on Table 1. 87 funds have a global investment focus, 135 funds have a European investment focus and only 57 funds focus on German investments. In terms of assets under management, 38% of the sample funds' assets under management are invested with a focus on global equity markets, 27% with a focus on European equity, and 32% with a focus on German equity.

For the subsequent analysis, we combine the IFS data with stock information from Datastream, security lending market information from Markit, and the Fama-French risk factors obtained from Kenneth French's data library.[8] Furthermore, we restrict our sample to holdings of securities identified as common or preferred equity and to securities traded in the 23 developed markets as listed in Fama and French (2012). Additionally, we drop an observation if the reporting date of the holding in the IFS data exceeds the retirement date of the stock in Datastream. Also, if a fund closes all positions in a given month, presumably because the fund is liquidated, we drop the fund-month pair.

We then use the holdings data to calculate two variables related to the monthly trading

[8]Following Ferreira et al. (2018), we estimate four-factor alphas using regional factors based on a fund's investment region and use world factors in the case of global funds.

activity of a fund. First, $PosChange_{i,j,t-1}$ is the percentage change in the number of shares of stock i held by fund j in month t.[9] Here, we take the numbers of shares (adjusted for stock splits) to ensure that the position changes we observe are not driven by market value adjustments. Moreover, we create a dummy variable $Exit$ which is equal to 1 if a fund closes a particular position in a given month and 0 otherwise.

With regard to the securities lending activity of a fund, we compute the share of a particular portfolio position in stock i being lent by fund j in any given month t ($sh\_sec\_lend_{i,j,t-1}$).

Table 2 provides summary statistics on the security lending behavior of German investment funds. About a third of all funds are participating in securities lending in our sample period. The share of securities lenders is lower for actively-managed funds (25%) compared to passive funds (74%). Investment funds typically lend only a small fraction of their portfolio. The market value on loan in relation to the total assets under management (AUM) amounts to 3.4% on average. These figures are comparable to recent figures on mutual funds' securities lending practices in the U.S.. According to the Investment Company Institute (ICI), among the 500 largest U.S. mutual funds 37.6% engaged in securities lending in 2014. These funds had 2.28% of their assets under management on loan (Grohowski and Collins, 2014).

Table 3 displays summary statistics for the monthly fund-security panel data that we use in all the following analyses. We will focus our interpretation on the most relevant variables. As can be seen in Panel A, 1.9% of funds' position are lend out in a given month and 4.8% are lend out over the past twelve months. The relative frequency at which funds exit a position is 3.7%. Panel B of Table 3 shows stock characteristics. As a proxy for market-wide shorting demand we use the amount of securities on loan scaled by the total market capitalization of that security ($OnLoan$), which is provided by Markit. For the stocks held by German investment funds, the overall shorting demand is on average 2.10% and its median value is 0.99%. Panel C of Table 3 shows fund characteristics. In our sample 77.1% of the observations originate from active funds. 33.4% of the observations are from funds that participated in the securities lending market in the last 12 months and more than half of the observations (54.7%)

[9] We winsorize the variable at the 99.5% level.

are from fund families in which at least one fund participated in the securities lending market in the last 12 months.

4 Reaction to short selling demand

4.1 Baseline model

In the following section we investigate how asset managers react to rising short selling demand. We make use of our high-dimensional panel data set by controlling for various fixed effects. For our baseline model we run the following regression:

$$\begin{aligned} Y_{i,j,t} &= \beta_1 SecLend_{i,j,t-1} \times Active_j \times OnLoan_{i,t-1} + \beta_2 SecLend_{i,j,t-1} \times OnLoan_{i,t-1} \\ &+ \beta_3 SecLend_{i,j,t-1} \times Active_j + \beta_4 SecLend_{i,j,t-1} + \mathbf{X}'_{i,j,t-1}\gamma_1 + \mathbf{X}'_{i,j,t-1}\gamma_2 \times Active_j \\ &+ \alpha_{i,t} \times Active_j + \alpha_{j,t} + \alpha_{i,j} + \epsilon_{i,j,t} \end{aligned} \tag{1}$$

The dependent variables in Equation (1) are *PosChange* and the *Exit* dummy. As explanatory variables, we include *SecLend* which indicates whether a fund has lent a security over the last 12 months,[10] *Active*, a dummy equal to one for active funds and *OnLoan*, the dollar value of shares on loan relative to market capitalization. We de-mean *OnLoan* before running the regressions for the ease of interpretation. The main variable of interest is the triple interaction of these variables. It measures how active funds who have lent stock i respond to an increase in short selling demand relative to active funds who have not lent the stock, compared with how passive lenders of the stock respond to an increase in short selling demand relative to passive non-lenders.

The multi-dimensional panel structure of our data allows us to control for various unobservable stock and fund characteristics using a saturated fixed-effects regression approach. In particular, we include in our specification stock-time fixed effects $\alpha_{i,t}$, which control for any

[10] We define the dummy variable *SecLend* as follows: $SecLend_{i,j,t-1} = \mathbb{1}(\sum_{s=-13}^{-1} sh\_sec\_lend_{i,j,t-s} > 0)$, where $\mathbb{1}(.)$ is an indicator function equal to one when the condition is true. sh_sec_lend is the fraction of a portfolio position in stock i being lent by fund j in month t.

observable or unobservable stock characteristics that vary over time. Since active and passive funds may react differently to changes in stock characteristics, we interact $\alpha_{i,t}$ with the active fund dummy $Active_j$. We also include fund-time fixed effects, which control for any time-varying fund characteristics. Importantly, these fixed effects absorb any fund manager skill that is unobservable. Lastly, fund-security fixed effects $\alpha_{i,j}$ control for any stock-specific expertise a fund would have in a particular stock.

In some specifications we control for additional variation on the portfolio level by including the following explanatory variables: the lagged $PosChange$, the lagged position market value as a fraction of the fund market value ($PosWeight$), and $ILLIQ$, a measure for the relative liquidity of a holding within a portfolio. Details on the definition of the variables is given in Table A.1.

Table 4 reports the results. We first examine whether being a past lender of a stock affects the position holding in general. The coefficients in Column (1) show that, on average, actively managed funds reduce their position in a stock they have lent in the past as compared to passive funds who have lent the stock and active funds who hold but have not lent the stock. For passive funds, the past decision to lend does not affect the portfolio position as can be seen from the insignificant result for $SecLend$. These results are consistent with Honkanen (2020), who finds that only actively managed funds rebalance their portfolio away from stocks they have lent in the quarters following the loan. Next, we consider how position holdings vary with shorting demand and the past decision to lend a stock. Our focus lies on the triple interaction, which measures the different reaction of active lenders versus active non-lenders compared to passive lenders versus passive non-lenders. If active funds exploit information from the shorting demand for the shares they lend while passive funds do not, and given that higher short selling is linked to negative news, we expect β_1 to be negative. The evidence presented in Table 4 is consistent with this idea. In Columns (2) and (3), β_1 is negative and significant at the 1% level, even after adding the portfolio-level control variables. The coefficient estimates imply that following a one standard deviation increase in shorting demand, active lenders reduce

their position by 3.21% more than active non-lenders.[11] Given an average position change of 2.96%, the decision to participate in the lending market thus has an economically meaningful impact on a fund's portfolio allocation decision.

Observing a negative position change after an increase in shorting demand can be due to two reasons: funds can simply reduce their position but still continue to hold the stock, or funds can close the position completely. In order to distinguish these two alternatives, we separately look at position changes and position exits. More specifically, we consider position changes excluding all exits in Columns (4) to (6). In Column (7) to (9), we focus on the *Exit* dummy to examine the probability of completely closing a position. The coefficient for the triple interaction in Columns (4) to (6) is still significant and negative, albeit the magnitude is smaller. Thus, the position reduction we observe is not exclusively driven by funds closing their positions. With regard to position exits, the results in the last three columns suggest that active funds who are past lenders of a stock are also more likely to close their position in the stock. Given an unconditional exit probability of 0.0372, the coefficient of 0.0106 in Column (7) suggests that active funds who are past lenders of a stock are 30% more likely (=0.0106/0.0372) to exit their position relative to passive lenders or active non-lenders. Moreover, the significantly positive coefficient for the triple interaction in the last two columns suggests that active funds condition their exit decision in stocks they have lent on the shorting demand they observe. A one standard deviation increase in *OnLoan* from the mean is associated with a 1.7x higher likelihood of an active fund exiting the position.[12]

The control variables suggest that both actively and passively managed funds reduce their position holdings when a stock is relatively less liquid or when a stock has a high portfolio weight in the previous month. Also, the past month's position change is positively related to this month's position change for active funds, which suggests that they gradually build up

[11] Based on Table 4, Column (3), the difference in position changes between active lenders and active non-lenders associated with a one standard deviation increase in short selling demand (3.22%) is given by: $-1.9238 - 0.1519 + (-0.5297 + 0.1774) \times 3.22\% = -3.21\%$.

[12] Since we de-mean *OnLoan*, the propensity of an active fund to exit a position in stocks lent, at the average *OnLoan*, is given by: $0.0052 + 0.0020 = 0.0072$ or 0.72%. For a one standard deviation increase in short selling demand from the mean, the exit propensity increases to: $0.0052 + 0.0020 + (0.0035 - 0.0019) \times 3.22 = 1.24\%$. This amounts to a relative increase of 71.55%

or reduce their positions. For passive funds, in turn, the coefficient on lagged *PosChange* is negative.

4.2 Active vs. passive funds

To better understand the behavioral differences of active and passive funds we run the following double-interaction regression

$$\begin{aligned} Y_{i,j,t} &= \beta_1 SecLend_{i,j,t-1} \times OnLoan_{i,t-1} + \beta_2 SecLend_{i,j,t-1} + \\ &\quad \mathbf{X}'_{i,j,t-1}\gamma + \alpha_{i,t} + \alpha_{j,t} + \alpha_{i,j} + \epsilon_{i,j,t} \end{aligned} \tag{2}$$

separately for active and passive funds. The dependent variables in Equation (2) are again *PosChange* and the *Exit* dummy and all other variables are defined as before. The coefficient β_1 of the double interaction measures within passive and active funds how funds having lend a given stock respond to an increase in short selling demand relative to funds not having lend the stock.

Results are shown in Table 5. Panel A displays the results for actively managed funds, Panel B for passively managed funds. Focusing on Panel A, we observe that active funds decrease their position in stocks they have lent in the past, both in general (Column 1) and in particular following an increase in short selling demand (Column 2 and 3). This is again in line with the idea that active funds exploit information from short selling demand when they are past lenders of a stock. When we exclude the position exits in Columns (4) to (6), the coefficient for the double interaction remains negative and significant. Furthermore, actively managed funds are not only more likely to decrease their position in stocks they have lent as a reaction to higher short selling demand, but they are also more likely to exit the position as indicated by the positive coefficient for the double interaction in Columns (8) and (9).

For passive funds, we get a different picture. Here, the results suggest that past lenders of a stock increase their exposure to stocks for which short selling demand increases. Also, for higher *OnLoan*, passive funds having lent a stock are less likely to exit these stocks relative to

funds who have not lent the stock. This finding is consistent with Blocher and Whaley (2016), who show that exchange-traded funds tend to tilt their portfolio holdings towards stocks with higher lending fees in order to maximize lending income.

4.3 Information usage in funds and fund families

So far, our results show that active funds that lent a particular stock in the past are more likely to reduce or completely close their position in that stock compared to non-lenders when shorting demand is high. This suggests that security lenders monitor shorting demand for stocks they lend closely. A question that arises in this context is to what degree are securities lenders also monitoring shorting demand in other stocks of their portfolio? Furthermore, are security lenders possibly sharing their knowledge with other fund managers in the same fund family? To study these questions we augment the regression model for active funds in the following way:

$$\begin{aligned} Y_{i,j,t} \;=\; & \beta_1 SecLend_{i,j,t-1} \times OnLoan_{i,t-1} + \beta_2 FundLend_{i,j,t-1} \times OnLoan_{i,t-1} + \\ & \beta_3 FamilyLend_{i,j,t-1} \times OnLoan_{i,t-1} + \beta_4 SecLend_{i,j,t-1} + \\ & \mathbf{X}'_{i,j,t-1}\gamma + \alpha_{i,t} + \alpha_{j,t} + \alpha_{i,j} + \epsilon_{i,j,t} \end{aligned} \tag{3}$$

where $FundLend_{i,j,t-1}$ is a dummy variable that is one, if fund j has been a security lender in the past 12 months, but has not lent stock i in the past 12 months; the dummy is zero otherwise. Hence, the interaction term $FundLend_{i,j,t-1} \times OnLoan_{i,t-1}$ picks up to what degree a security-lending fund is monitoring the securities lending market for stocks that it does not lend. Following the same logic, $FamilyLend_{i,j,t-1}$ is a dummy variable that is one, if other funds of the funds family (asset management company) have been participating in securities lending in the past, but not the fund itself; the dummy is zero otherwise. [13] The interaction term $FamilyLend_{i,j,t-1} \times OnLoan_{i,t-1}$ captures to what degree a non-lending fund profits from

[13] Specifically, we define the dummy variables as follows: $FundLend_{i,j,t-1} = \mathbb{1}(\sum_j SecLend_{i,j,t-1} > 0$ and $SecLend_{i,j,t-1} = 0)$ and $FamilyLend_{i,t-1} = \mathbb{1}(\sum_i \sum_j SecLend_{i,j,t-1} > 0$ and $\sum_j SecLend_{i,j,t-1} = 0)$, where $\mathbb{1}(.)$ is an indicator function equal to one when the condition is true.

information regarding shorting demand collected by other funds in the fund family.

Results regarding information spillovers are shown in Table 6. The coefficient estimates for the interaction $SecLend_{i,j,t-1} \times OnLoan_{i,t-1}$ are comparable in magnitude to the results shown in Table 5: Active lenders decrease their position in stocks they have lent in the past following an increase in short selling demand. They do so by both reducing their existing position and by exiting positions.

The regression results show also negative coefficient for the interaction of $FundLend$ dummy with $OnLoan$ that is about half the size of the $SecLend$ interaction with $OnLoan$ (Column 1 and 2). This result suggests that lenders monitor the securities lending market in general more than non-lenders. However, the reaction to high shorting demand is less pronounced as indicated by the in absolute terms lower coefficient. Excluding exits from the position changes (Columns 3 and 4) yields an insignificant β_2 coefficient. Lenders are, however, more likely to exit a position when shorting demand is high (Columns 5 and 6). The reaction on information gathered by generally monitoring the securities lending market is hence focused on exiting positions rather than under weighing positions.

The regression results show now evidence that non-lenders profit from the information gathered by lenders within the same fund family. The coefficient estimates for the interaction $FamilyLend_{i,j,t-1} \times OnLoan_{i,t-1}$ are insignificant for both position changes and the exit propensity. The fact that this particular trading signal is not shared within fund family is in line with intra-family competition documented by Kempf and Ruenzi (2008).

5 Returns after position exits

In this section, we examine whether security lending has an impact on the timing ability of active lenders to close a position. For that, we collect all position exits of actively managed funds who have lend a security in the year prior to the exit. We then partition the position exits into two groups: stocks lend prior to the exit and stocks not lend prior to the exit. Since the previous analysis has shown that active lenders react to higher short selling demand, we focus on the cases in which a fund closes a position in a highly shorted stock. Specifically, we

compute quintiles of *OnLoan* one month prior to the exit across all events and focus on exit events in the highest quintile.

For the analysis, we define an event window of 12 months surrounding the position exit happening at $t = 0$.[14] For each event, we compute the abnormal stock return based on the Carhart 4-factor model.[15]. We sum up the abnormal return over the event window and normalize it to zero at the time of the exit. In doing so, positive (negative) returns prior to the exit (from $t = -12$ to $t = -1$) can be interpreted as additional returns the fund would have gained (lost) by closing the position at an earlier point in time. Correspondingly, positive (negative) returns after the exit month (from $t = 1$ to $t = 12$) can be interpreted as returns the fund missed (avoided) by closing the position in $t = 0$. To make sure that post-exit returns indeed represent returns the fund has "left on the table", we drop all cases in which a fund re-enters the position in the 12 months after the exit.

The final sample contains 50,397 observations in event time. Using this sample, we perform the following event-time regression to examine abnormal returns associated with the position exits of active lenders:

$$Y_{i,j,\tau} = \sum_{\tau=-12}^{12} \beta_{1,\tau} \times D_\tau + \sum_{\tau=-12}^{12} \beta_{2,\tau} \times D_\tau \times SecLend_{i,j} + \alpha_i + \alpha_j + \alpha t + \epsilon_{i,j,\tau} \quad (4)$$

The dependent variable is the abnormal return of stock i exited by fund j, prior to the exit for $\tau < 0$, and since the exit for $\tau > 0$. D_τ is a set of event-time dummies and *SecLend* is a dummy equal to one if the fund has lent the stock in the 12 months prior to the exit. α_i, α_j, and α_t are stock, fund and time fixed effects, respectively.

Figure 1 plots the estimated coefficients. The solid line displays the sum of the coefficients $\beta_{1,\tau} + \beta_{2,\tau}$, for $\tau = -12, ..., 12$, and can be interpreted as the abnormal return before and after a past lender of a stock closes its position in the stock. The dashed line displays the estimates for $\beta_{1,\tau}$, for $\tau = -12, ..., 12$. It represents the abnormal return when a fund exits a stock it

[14] Since the IFS data contains end-of-month holdings, the exit can indeed happen at any point between $t = -1$ and $t = 0$. Setting the exit time to $t = 0$ is therefore a very conservative timing assumption.

[15] We use region-specific factors for the risk adjustment. We follow Fama and French (2012) to assign a region to each stock. Moreover, we compute the parameters for the risk adjustment 13 months prior to each exit to avoid an overlap with the event window

has not lend prior to the exit. Both lines suggest that the abnormal returns of heavily-shorted stocks in the 12 months surrounding a fund exit amount to approximately -15%. However, active lenders are able to time their exits in the stocks they have lent in that a significant part of the decline in abnormal returns is realized only after the exit. More specifically, abnormal returns decline by about 8% until the exit and continue to decline by another 8% following the exit. This suggests that the fund is able to close the position before the negative information is fully incorporated into the stock price, thereby leaving "losses on the table". In contrast to that, the full loss is realized for stocks that have not been lend by the fund, as abnormal returns for these stocks do not further decline after the exit.

Table 7 reports the coefficient estimates corresponding to Figure 1: for stocks lend in Column (1) and for stocks not lend in Column (2). The last column displays the estimates for $\beta_{2,\tau}$, which capture the difference in abnormal returns between these two groups. It indicates that pre-exit 12-month abnormal returns are significantly higher, by 6.4%, and post exit 12-month abnormal returns are significantly lower, by 6.2%, for stocks that have been previously lend by a fund. This pattern of higher pre-exit and lower post-exit returns is consistent with Hypothesis 3A and suggests that funds can front-run price decreases with the help of information they acquire from participating in the lending market.

To further investigate whether position exits of past lenders of a stock can predict abnormal stock returns, we run the following regression:

$$\begin{aligned} Y_{i,j,t} &= \beta_0 + \beta_1 SecLend_{i,j} \times OnLoan_{i,t-1} + \beta_2 SecLend_{i,j,t-1} + \beta_3 OnLoan_{i,t-1} + \\ &\quad + \mathbf{X}'_{j,t-1}\gamma + \alpha_t + \alpha_j + \alpha_{j,t} + \epsilon_{i,j,t}, \end{aligned} \tag{5}$$

$Y_{i,j,t}$ is the abnormal stock return of stock i in the six or twelve months following a position exit by fund j. $SecLend_{i,j}$ indicates whether the fund has lend the stock in the year prior to the exit. $X_{j,t-1}$ is a vector of fund characteristics measured one month prior to the exit. We control for fund family size, fund size, fund age, fund flows, fund costs, fund alpha, fund R^2, and fund turnover. Moreover, we include time fixed effects (α_t), fund fixed effects (α_j), or fund-time fixed effects ($\alpha_{j,t}$).

If actively managed funds are better at timing position closures due to information they receive from participating in the securities lending market, we expect β_1 to be negative. Table 8 shows that this is indeed the case. In Columns (1) to (3), the dependent variable is the 6-month abnormal return. In all specifications, we get a negative coefficient for the interaction of *SecLend* and *OnLoan*. After a fund closes a position in a stock previously lent, the abnormal return is significantly lower if the stock is in high demand by short sellers.

In Columns (4) to (6), we replace our dependent variable with the 12-month abnormal return to examine whether the negative abnormal performance in the six months after an exit in stocks having been lent is reversed during the subsequent months. Again, all specifications yield a negative coefficient for β_1 which is comparable in magnitude to the results in Columns (1) to (3). Hence, there is no evidence of a reversal in abnormal returns.

6 Big Short Disclosures

To disentangle the effects of information acquisition through securities lending from informative public price signals we make use of the disclosure requirement of large short sale positions in the European Union (EU). Since November 1st, 2012, any net short position larger than 0.5% of the market capitalization of the company shorted has to be disclosed on the next trading day to the public. Disclosures contain the name of the investor, the date of the short position, identifying information on the shorted stock, and the magnitude of the position reported as a percentage of market capitalization. Above the disclosure threshold of 0.5%, further thresholds are implemented at increments of 0.1%, i.e. the thresholds lie at 0.6%, 0.7%, 0.8% (...). Whenever a positions reaches or falls below the next disclosure threshold, the report has to be updated to reflect the new position value. These public disclosure events are informative in so much that they predict negative returns (Jank and Smajlbegovic (2015)), but do not fully reveal private information on the structure of shorting demand below the disclosure threshold (Jank et al., 2020).

We collect the public short position disclosure data from the web pages of the national competent authorities of the EU. In our analysis we focus on new short position disclosures.

Specifically, we flag all events where a stock transitions from not having a public short position (in the last 6 months) to having one.[16]

In a first step, we examine position changes of active funds from six months before to six months after the disclosure of a large short position in an event study framework. Similar to Equation 5 in the previous section, we perform a regression including a set of event-time dummies and a dummy variable to indicate whether a fund has lent a particular stock in the months prior to the disclosure. The main variable of interest is the interaction term between the event-time dummies and the *SecLend* dummy It captures how portfolio allocation decisions differ conditional on whether the fund is a past lender of the stock or not.

Figure 2 displays the result. The grey bars show the coefficient estimates for the interaction terms. Prior to a disclosure, portfolio adjustments of active lenders are significantly different compared to those of active non-lenders. More specifically, past lenders of a stock reduce their positions starting already three months in advance of the disclosure. In cumulative terms, as shown by the solid line, the position of an active lender is 8% lower in the month before the disclosure of a large short position relative to the position of an active non-lender. Once the information is public, there is no significant difference in the behavior of active lenders and non-lenders. All in all, these initial results suggest that participation in the lending market allows active funds to anticipate large negative trades and to potentially front-run short sellers.

For a more formal test, we study mutual funds' portfolio adjustments in the months around

[16]The 6-month period between the last reported public short position and the new disclosure makes it more likely that the new disclosure represent an informative public price signal instead of a follow-on disclosure, which have been found to be less informative (Jones et al., 2016).

the disclosure of a large short positions in the following regression framework:

$$
\begin{aligned}
Y_{i,j,t} \quad = \quad & a_0 + \beta_1 Disclosure_{i,t-1} \times SecLend_{i,j,t-1} + \beta_2 Disclosure_{i,t} \times SecLend_{i,j,t-1} + \\
& \beta_3 Disclosure_{i,t+1} \times SecLend_{i,j,t-1} + \\
& \beta_4 Disclosure_{i,t-1} \times SecLend_{i,j,t-1} \times OnLoan_{i,t-1} + \\
& \beta_5 Disclosure_{i,t} \times SecLend_{i,j,t-1} \times OnLoan_{i,t-1} + \\
& \beta_6 Disclosure_{i,t+1} \times SecLend_{i,j,t-1} \times OnLoan_{i,t-1} + \\
& \beta_7 SecLend_{i,j,t-1} \times OnLoan_{i,t-1} + \beta_8 SecLend_{i,j,t-1} + \\
& \mathbf{X}'_{i,j,t-1}\gamma + \alpha_{i,t} + \alpha_{j,t} + \alpha_{i,j} + \epsilon_{i,j,t} \qquad (6)
\end{aligned}
$$

where $Disclosure_{i,t}$ is a dummy that is one if there is a new short position disclosure in month t for stock i. The coefficients of interest in this regression specification are β_3 and β_7. β_3 measures how security lenders adjust their stock positions in month t prior to the disclosure of a big short position in month $t+1$ compared to non-lenders. β_7 captures how security lenders respond to $OnLoan$ in month t prior to the disclosure of a big short position in month $t+1$ compared to non-lenders.

Regression results are shown in Table 9. Column (1) and (2) show that securities lenders reduce their positions by around 3 percentage points prior to a large position disclosure. Turning to coefficient β_7 of the triple interaction, we find that security lenders are more responsive than non-lenders to shorting demand prior to a disclosure event (see Column 3). At the same time lenders are less responsive post disclosure, presumably because they have already reduced holdings prior to the public disclosure. In Column (9) we see a similar pattern for exits. Security lenders are more responsive to shorting demand by exiting positions prior to disclosures (and less so after disclosures). These results suggest that funds can acquire valuable information through security lending that allows them to anticipate large negative trades.

7 Conclusion

We use unique micro data on German mutual fund long and lending positions to provide evidence that securities lending is a mechanism for information acquisition and a channel through which informed investors convey their information to uninformed investors.

Active funds that become informed by observing non-public signals of shorting demand in the securities lending market are more likely to exit positions than active fund observing only public signals. The informed exits front-run negative price revelation from shorting demand, resulting in active lenders realising lower losses and earning positive abnormal returns relative to active funds that do not participate in securities lending. However, somewhat surprisingly, we find very modest effects on fund-level performance.

The results are perhaps best viewed through the lens of short sellers and active lenders having complementary roles in information acquisition and trading in a manner that improves price informativeness (Goldstein and Yang, 2015). This new perspective is important given the ongoing debate on how financial technology and big data might destroy incentives for information production and decrease price informativeness. Our results highlight the importance of examining at the interaction of information acquisition by agents across the long and short markets to understand the overall efficiency of the financial market in generating and processing information.

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Figure 1.
Position Exits of Active Lenders: Abnormal Stock Returns
This figure displays abnormal stock returns from 12 months before to 12 months after position exits in event time. The figure is based on the coefficient estimates shown in Table 7. The sample consists of all stock exits of active lenders in heavily-shorted stocks, i.e. stocks which are in the highest quintile of short selling demand (*OnLoan*) one month prior to the exit. The single solid line shows abnormal returns for position closures of stocks which have been lend by the fund in the year prior to the exit (Table 7, Column 1). The dashed line shows abnormal returns for position closures of stocks which have not been lend by the fund in the year prior to the exit (Table 7, Column 2). Abnormal returns are calculated based on the Carhart 4-factor model, using regional risk factors.

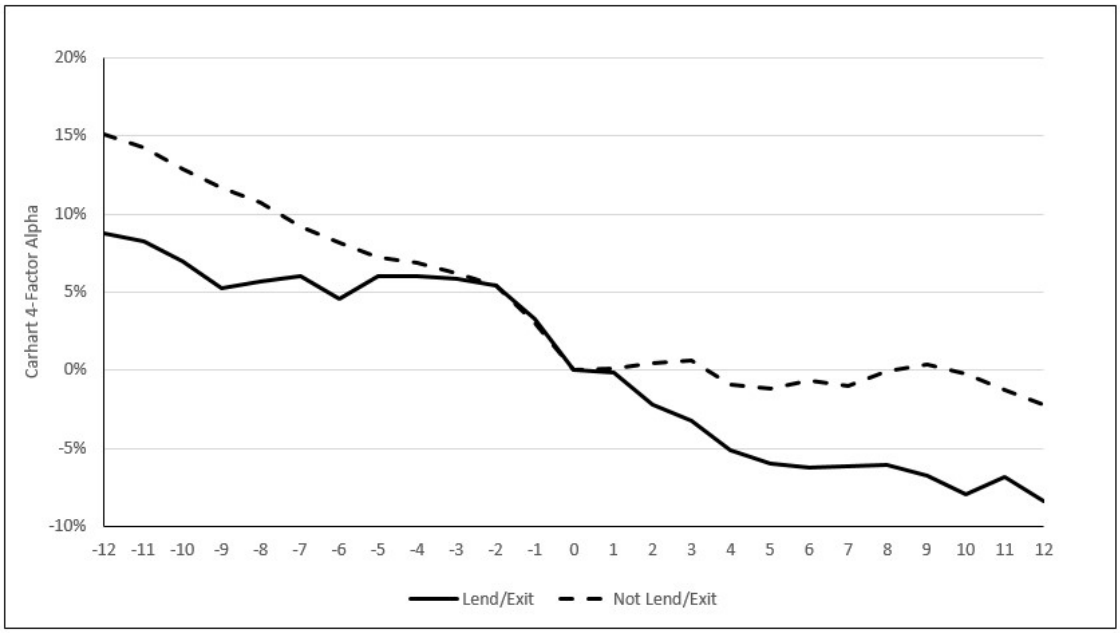

Figure 2.
Position Changes of Active Funds Around Public Disclosure of Large Short Positions
This figure displays position changes of active funds from 6 months before to 6 months after the disclosure of a large short position in event time. The disclosure takes place between $t = -1$ and $t = 0$. The figure is based on the coefficient estimates resulting from a regression of *PosChange* on a set of event-time dummies and *SecLend*, a dummy variable which indicates whether a fund is a past lender of a stock. The regression includes stock, fund, and time fixed effects. The grey bars show the coefficients associated with the interaction terms of the event-time dummies with the *SecLend* dummy. They depict the difference in percentage position changes for stocks lend relative to stocks not lend prior to the disclosure. Significance levels are reported below the bars, based on standard errors clustered at the fund-level. The solid line plots the cumulated coefficient estimates.

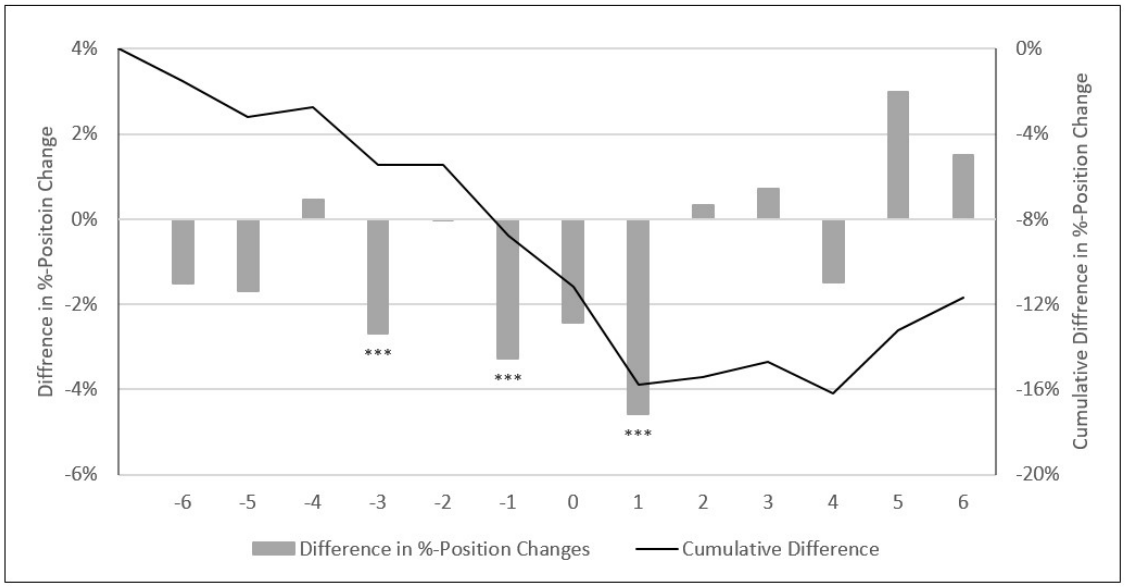

Table 1
Descriptive Statistics: German Mutual Funds - Investment Focus
This table reports descriptive statistics of the sample of German mutual funds used in the analysis. Data on fund portfolio holdings is from the IFS fund statistic. Other fund information is from Morningstar.

Investment Focus	*Number of Funds*	*AUM (in billion EUR)*
Global	87	2,712
Europe	135	1,934
Germany	57	2,328
Other	35	239
ALL	**314**	**7,213**

Table 2
Descriptive Statistics: German Mutual Funds - Securities Lending Behavior
This table reports descriptive statistics of the sample of German mutual funds used in the analysis. Data on fund portfolio holdings is from the IFS fund statistic. Other fund information is from Morningstar.

Panel A: Fund-Level Lending	Obs	% of Funds Lending
All Funds	314	33.12%
Active Funds	264	25.38%
Passive Funds	50	74.00%

Panel B: Portfolio-Level and Position-Level Lending	Obs	Mean	Median	St. Dev.	25th Pct.	75th Pct.
% of AUM Lend	2551	3.40%	3.52%	0.90%	2.31%	4.71%
% of Position MV Lend	21649	55.44%	36.18%	17.74%	57.71%	92.75%

Table 3
Descriptive Statistics
This table reports monthly descriptive statistics of the main variables used in the analysis. Data on fund portfolio holdings and equity lending activities is from the IFS fund statistic. Stock data is from Datastream. Equity market lending data are provided by Markit. Fund information is from Morningstar. The variable definitions are in Internet Appendix B.

Variable	Mean	Median	St. Dev.	25th Pct.	75th Pct.	Obs.
Panel A: Portfolio Variables						
Position Change (in %)	-2.96	0.00	25.14	0.00	0.00	1,131,356
Position Weight (in %)	1.08	0.63	1.34	0.23	1.43	1,178,351
Dummy: Position Exit	0.0372	-	0.1893	-	-	1,178,888
Dummy: Stock Lend	0.0191	-	0.1368	-	-	1,134,849
Dummy: Stock Lend (past 12 months)	0.0484	-	0.2147	-	-	1,178,888
Panel B: Stock Variables						
On Loan (in % of Market Cap.)	2.10	0.99	3.22	0.43	2.26	1,165,035
Fee (bps p.a.)	44.11	17.44	164.34	11.47	23.47	1,156,020
Stock Return (in %)	0.53	0.51	7.88	-3.84	5.00	1,175,441
Stock Carhart 4-Factor Alpha (in %)	0.09	0.08	7.21	-3.54	3.71	1,130,982
Dummy: Disclosed Short Position	0.2632	-	0.4404	-	-	1,178,888
Panel C: Fund Variables						
Dummy: Active Fund	0.7711	-	0.4201	-	-	1,178,888
Dummy: Fund Lends (past 12 months)	0.3344	-	0.4718	-	-	1,178,888
Dummy: Family Lends (past 12 months)	0.5470	-	0.4978	-	-	1,178,888
Gross Return (in %)	0.43	0.72	3.92	-1.75	3.06%	1,172,043
Net Return (in %)	0.33	0.63	3.92	-1.85	2.94	1,172,043
Gross Alpha Carhart 4-Factor) (in %)	-0.01	0.00	1.30	-0.69	0.67	1,169,620
Net Alpha (Carhart 4-Factor) (in %)	-0.12	-0.09	1.30	-0.79	0.57	1,170,916
Fund R^2 (in %)	90.53	93.24	7.91	87.42	95.64	1,171,720
Fund Costs (excl. Transaction Fees) (in %)	1.27	1.45	0.71	0.62	1.69	1,172,206
Net Asset Value (in bn EUR)	0.68	0.14	1.65	0.04	0.40	1,178,888
Family Net Asset Value (in bn EUR)	108.62	113.75	89.87	33.03	150.10	1,178,888
Fund Flows (in % of AUM)	0.87	-0.03	37.44	-0.56	0.47	1,178,054
Fund Age (in years)	18.75	16.25	13.18	9.92	20.92	1,178,888
Fund Turnover (in %)	4.45	1.60	8.26	0.14	5.47	1,178,197

Table 4

Equity Lending, Changes in Portfolio Positions, and Portfolio Position Exits: OLS-FE Regressions

This table reports regressions of changes in portfolio position and the likelihood of exiting a portfolio position in month t as a function of security loan demand in month *t-1* and stock lending of fund i in stock j over the last 12 months. The variable definitions are in Internet Appendix B. We report t-statistics based on standard errors clustered at the fund levels in brackets. All regressions have stock-time-active fund, fund-time, and fund-stock fixed effects.

	Dependent Variable								
	%-Position Changes			%-Position Changes (w/o exits)			Exit Probability		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$SecLend_{i,j,t-1} \times Active_i \times OnLoan_{i,t-1}$		-0.6484***	-0.5297***		-0.2870***	-0.1934***		0.0038***	0.0035***
		(-6.31)	(-5.20)		(-4.11)	(-2.69)		(5.52)	(5.11)
$SecLend_{i,j,t-1} \times OnLoan_{i,t-1}$		0.1676***	0.1774***		0.0086	0.0065		-0.0017***	-0.0019***
		(5.06)	(5.26)		(0.59)	(0.42)		(-5.16)	(-5.38)
$SecLend_{i,j,t-1} \times Active_j$	-3.3375***	-2.9066***	-1.9238***	-2.3386***	-2.2079***	-1.4593***	0.0106***	0.0076***	0.0052**
	(-8.73)	(-8.32)	(-6.52)	(-7.43)	(-7.28)	(-5.65)	(4.00)	(3.03)	(2.21)
$SecLend_{i,j,t-1}$	0.0169	-0.1781	-0.1519	0.0702*	0.0600	0.0705	0.0002	0.0021*	0.0020*
	(0.13)	(-1.50)	(-1.33)	(1.76)	(1.29)	(1.56)	(0.12)	(1.71)	(1.66)
$ILLIQ^{Rank}_{i,j,t-1}$			-0.0121**			-0.0107***			0.0000
			(-2.41)			(-4.72)			(0.71)
$Active_j \times ILLIQ^{Rank}_{i,j,t-1}$			-1.5437			-0.0212***			-0.0001
			(-1.21)			(-2.64)			(-0.59)
$PosChange_{i,j,t-1}$			-0.1708***			-0.1722***			0.0000
			(-3.69)			(-3.65)			(0.13)
$Active_j \times PosChange_{i,j,t-1}$			0.2417***			0.1746***			-0.0007***
			(5.07)			(3.63)			(-9.20)
$PosWeight_{i,j,t-1}$			-2.5320***			-1.9818***			0.0052**
			(-6.46)			(-5.63)			(2.26)
$Active_j \times PosWeight_{i,j,t-1}$			-1.8702***			-5.0979***			-0.0298***
			(-3.40)			(-9.09)			(-10.13)
$Adj.R^2$	0.2168	0.2165	0.2414	0.1902	0.1904	0.2354	0.2523	0.2515	0.2659
N	1047346	1039263	996429	1005373	997647	957923	1049476	1039300	996449
Security×Time×Active FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund×Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security×Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5

Equity Lending, Changes in Portfolio Positions, and Portfolio Position Exits: Sample Split

This table reports regressions of changes in portfolio position and the likelihood of exiting a portfolio position in month t as a function of security loan demand in month *t-1* and stock lending of fund i in stock j over the last 12 months. The sample is split into active and passive funds. Panel A reports results for active funds. Panel B reports results for passive funds. The variable definitions are in Internet Appendix B. We report t-statistics based on standard errors clustered at the fund levels in brackets. All regressions have stock-time-active fund, fund-time, and fund-stock fixed effects.

	Dependent Variable								
	%-Position Changes			%-Position Changes (w/o exits)			Exit Probability		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Active Funds									
$SecLend_{i,j,t-1} \times OnLoan_{i,t-1}$		-0.4808***	-0.3522***		-0.2784***	-0.1869***		0.0021***	0.0016***
		(-5.06)	(-3.75)		(-4.18)	(-2.73)		(3.52)	(2.85)
$SecLend_{i,j,t-1}$	-3.3206***	-3.0846***	-2.0758***	-2.2684***	-2.1479***	-1.3888***	0.0107***	0.0097***	0.0072***
	(-9.43)	(-9.61)	(-7.82)	(-7.45)	(-7.34)	(-5.60)	(4.80)	(4.55)	(3.65)
$Adj.R^2$	0.1991	0.1990	0.2189	0.1291	0.1295	0.1617	0.2616	0.2610	0.2755
N	796284	790989	750386	756158	751178	713657	797617	791022	750404
Panel B: Passive Funds									
$SecLend_{i,j,t-1} \times OnLoan_{i,t-1}$		0.1676***	0.1774***		0.0086	0.0065		-0.0017***	-0.0019***
		(4.62)	(4.80)		(0.54)	(0.38)		(-4.71)	(-4.91)
$SecLend_{i,j,t-1}$	0.0169	-0.1781	-0.1519	0.0702	0.0600	0.0705	0.0002	0.0021	0.0020
	(0.12)	(-1.37)	(-1.21)	(1.61)	(1.18)	(1.43)	(0.11)	(1.56)	(1.52)
$Adj.R^2$	0.7862	0.7866	0.7896	0.9298	0.9294	0.9336	0.5315	0.5285	0.5258
N	251034	248246	246015	249187	246441	244238	251831	248250	246017
Fund × Security × Time controls	No	No	Yes	No	No	Yes	No	No	Yes
Security×Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund×Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security×Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 6
Equity Lending and Information Spillover: OLS-FE Regressions
This table reports regressions of changes in portfolio position and the likelihood of exiting a portfolio position in month t as a function of security loan demand in month *t-1* stock lending of fund i in stock j, fund lending and fund family lending over the last 12 months. The variable definitions are in Internet Appendix B. We report t-statistics based on standard errors clustered at the fund levels in brackets. All regressions have stock-time, fund-time, and fund-stock fixed effects.

	Dependent Variable					
	%-Position Changes		**%-Position Changes** (w/o exits)		**Exit Probability**	
	(1)	(2)	(3)	(4)	(5)	(6)
$SecLend_{i,j,t-1} \times OnLoan_{i,t-1}$	-0.5615***	-0.4483***	-0.2774***	-0.1922**	0.0029***	0.0026***
	(-5.05)	(-4.05)	(-3.65)	(-2.42)	(4.15)	(3.84)
$FundLend_{i,j,t-1} \times OnLoan_{i,t-1}$	-0.1616**	-0.2013***	-0.0013	-0.0200	0.0016***	0.0019***
	(-2.10)	(-2.78)	(-0.03)	(-0.40)	(3.27)	(3.84)
$FamilyLend_{i,t-1} \times OnLoan_{i,t-1}$	-0.0349	-0.0281	0.0132	0.0287	0.0005	0.0005
	(-0.41)	(-0.33)	(0.30)	(0.57)	(0.72)	(0.86)
$SecLend_{i,j,t-1}$	-3.0561***	-2.0335***	-2.1466***	-1.3814***	0.0095***	0.0069***
	(-9.38)	(-7.50)	(-7.35)	(-5.57)	(4.37)	(3.43)
$Adj.R^2$	0.1990	0.2190	0.1295	0.1617	0.2610	0.2755
N	790989	750386	751178	713657	791022	750404
Fund × Security × Time controls	No	Yes	No	Yes	No	Yes
Security×Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Fund×Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Security×Fund FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 7
Position Exits of Active Lenders: Abnormal Stock Returns
This table reports abnormal returns from 12 months before to 12 months after position exits of active lenders in event time. Based on Equation 4, abnormal stock returns are modelled as a function of a set of event-time dummies and *SecLend*, a dummy which indicates whether a fund is a past lender of a stock. All regressions include stock, fund, and time fixed effects. Abnormal returns are calculated based on the Carhart 4-factor model. The regression sample is based on all position exits of active lenders in heavily-shorted stocks, i.e. stocks in the highest quintile of short interest in the month prior to the exit. Column 2 and 3 show coefficient estimates of abnormal returns and corresponding t-statistics for stocks that have been lent by the fund in the 12 months preceding the exit. Column 4 and 5 show coefficient estimates of abnormal returns for stocks that actively-managed funds have not lent in the 12 months preceding the exit. Column 6 and 7 contains the coefficient estimates and t-statistics associated with the interaction term of the event-time dummies and *SecLend*, which shows the difference in abnormal returns between stocks lend and stocks not lend. t-statistics are based on standard errors clustered at the stock-level and given in brackets.

	Stock Lend		**Stock Not Lend**		**Difference**	
Event Time	4-Factor Alpha	t-statistic	4-Factor Alpha	t-statistic	4-Factor Alpha	t-statistic
-12	0.088**	(2.48)	0.151***	(9.08)	-0.064*	(-1.72)
-11	0.082**	(2.50)	0.143***	(8.75)	-0.061*	(-1.75)
-10	0.070**	(2.18)	0.129***	(8.67)	-0.059*	(-1.78)
-9	0.053*	(1.85)	0.117***	(8.22)	-0.064**	(-2.20)
-8	0.056**	(2.24)	0.108***	(8.33)	-0.051**	(-2.00)
-7	0.061**	(2.55)	0.092***	(6.84)	-0.032	(-1.31)
-6	0.045**	(2.27)	0.082***	(7.02)	-0.037*	(-1.78)
-5	0.060***	(3.80)	0.072***	(6.50)	-0.012	(-0.70)
-4	0.061***	(4.39)	0.069***	(7.10)	-0.008	(-0.55)
-3	0.059***	(4.61)	0.062***	(6.83)	-0.004	(-0.25)
-2	0.054***	(4.84)	0.054***	(7.43	-0.001	(-0.05)
-1	0.033***	(4.16)	0.030***	(5.64)	0.003	(0.29)
1	-0.002	(-0.19)	0.001	(0.21)	-0.002	(-0.29)
2	-0.022**	(-2.04)	0.005	(0.64)	-0.027**	(-2.06)
3	-0.033**	(-2.39)	0.006	(0.72)	-0.038**	(-2.49)
4	-0.052***	(-3.30)	-0.009	(-0.90)	-0.042**	(-2.37)
5	-0.060***	(-3.19)	-0.012	(-0.96)	-0.048**	(-2.30)
6	-0.062***	(-2.99)	-0.007	(-0.48)	-0.055**	(-2.31)
7	-0.062***	(-2.81)	-0.010	(-0.76)	-0.052**	(-2.08)
8	-0.060***	(-2.63)	-0.001	(-0.07)	-0.059**	(-2.28)
9	-0.068***	(-2.95)	0.003	(0.23)	-0.071***	(-2.76)
10	-0.080***	(-2.96)	-0.002	(-0.14)	-0.077***	(-2.62)
11	-0.068**	(-2.47)	-0.013	(-0.74)	-0.056*	(-1.80)
12	-0.084***	(-2.90)	-0.022	(-1.22)	-0.062*	(-1.90)

Table 8
Position Exits of Active Lenders: OLS-FE Regressions
This table reports regressions of cumulative 6-month and 12-month abnormal returns following position closures of active lenders as a function of security loan demand in the month prior to the closure and stock lending of fund i in stock j over the last 12 months prior to the closure. The sample is limited to positions which are held for at least 6 months prior to the exit and are not re-opened in the 6 months following the exit. The variable definitions can be found in Table A.1. All variables are measured one month prior to the position exit, i.e. at $t = -1$ (we define $t = 0$ as the time at which the position is being closed). We report t-statistics based on standard errors clustered at the stock and time levels in brackets.

	Dependent Variable					
	Cumulative 6-Month Alpha			**Cumulative 12-Month Alpha**		
	(1)	(2)	(3)	(4)	(5)	(6)
$SecLend_{i,j,-1} \times OnLoan_{i,-1}$	-0.6715**	-0.6823**	-0.8725***	-0.9055**	-0.9513**	-0.9072**
	(-2.24)	(-2.27)	(-2.69)	(-2.29)	(-2.40)	(-2.06)
$SecLend_{i,j,-1}$	0.2147	0.4207	0.5259	-0.4681	-0.4065	0.8061
	(0.24)	(0.46)	(0.50)	(-0.25)	(-0.21)	(0.42)
$OnLoan_{i,-1}$	0.1126	0.1190	0.1462	0.2853	0.3048	0.1902
	(0.76)	(0.80)	(0.96)	(1.08)	(1.14)	(0.74)
$Log(FamilyTNA)_{j,-1}$	-0.9394	9.5718		-1.1224	5.1595	
	(-0.88)	(1.27)		(-0.68)	(0.31)	
$Log(TNA)_{i,-1}$	-0.0404	0.2623		-0.2221	-5.7556	
	(-0.20)	(0.13)		(-0.83)	(-1.58)	
$Log(Age)_{j,-1}$	0.7005	-4.2704		0.9181	20.8025	
	(1.63)	(-0.44)		(0.95)	(1.19)	
$RelFlow_{j,-1}$	0.0088	0.0039		-0.0278	0.0267	
	(0.41)	(0.15)		(-0.83)	(0.57)	
$Fund\ Costs_{j,-1}$	-1.0477*	1.1150		-2.6855**	-5.2165*	
	(-1.65)	(0.63)		(-2.31)	(-1.70)	
$Fund\ Alpha_{j,-1}$	1.5296	0.4246		-2.0174	-10.0763	
	(0.89)	(0.15)		(-0.58)	(-1.43)	
$Fund\ R^2_{j,-1}$	-0.2110***	-0.0258		-0.2214	0.3223	
	(-3.16)	(-0.13)		(-1.63)	(0.97)	
$Fund\ Turnover_{j,-1}$	0.1005**	0.0960**		0.1155	0.1197	
	(2.33)	(2.15)		(1.42)	(1.54)	
$Adj.R^2$	0.0448	0.0492	0.0769	0.0412	0.0516	0.0781
N	7733	7733	7278	6104	6104	5726
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	No	Yes	Yes	No	Yes	Yes
Fund×Time FE	No	No	Yes	No	No	Yes

Table 9

Equity Lending and Big Short Position Disclosure

This table reports regressions of changes in portfolio position and the likelihood of exiting a portfolio position in month t as a function of observing the disclosure of a large short position in month *t-1*, t, or *t+1*, security loan demand in month *t-1*, and stock lending of fund i in stock j over the last 12 months. The sample is limited to portfolio holdings of active funds. The variable definitions are in Table A.1. We report t-statistics based on standard errors clustered at the fund levels in brackets. All regressions have stock-time, fund-time, and fund-stock fixed effects.

	Dependent Variable								
	%-Position Changes			%-Position Changes (w/o exits)			Exit Probability		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Disclosure_{i,t-1} \times SecLend_{i,j,t-1}$	-2.8051*	-3.0488**	-2.5814*	-2.2875**	-2.4178**	-2.4071**	0.0094	0.0103	0.0056
	(-1.89)	(-2.07)	(-1.77)	(-2.31)	(-2.45)	(-2.52)	(0.82)	(0.90)	(0.50)
$Disclosure_{i,t} \times SecLend_{i,j,t-1}$	-2.0435	-2.0897	-2.2406	-2.4969**	-2.4732*	-2.1802*	0.0005	0.0012	0.0016
	(-1.40)	(-1.46)	(-1.59)	(-1.98)	(-1.95)	(-1.83)	(0.03)	(0.09)	(0.10)
$Disclosure_{i,t+1} \times SecLend_{i,j,t-1}$	-3.2989**	-3.3828**	-2.4847*	-1.3915*	-1.3971*	-1.3691*	0.0143	0.0153	0.0114
	(-2.01)	(-2.04)	(-1.72)	(-1.73)	(-1.69)	(-1.67)	(1.09)	(1.15)	(0.98)
$Disclosure_{i,t-1} \times SecLend_{i,j,t-1} \times OnLoan_{i,t-1}$			0.9255*			-0.1914			-0.0104**
			(1.69)			(-0.43)			(-2.12)
$Disclosure_{i,t} \times SecLend_{i,j,t-1} \times OnLoan_{i,t-1}$			-0.2802			0.0368			0.0034
			(-0.36)			(0.08)			(0.51)
$Disclosure_{i,t+1} \times SecLend_{i,j,t-1-1} \times OnLoan_{i,t-1}$			-0.9047*			-0.3078			0.0067*
			(-1.93)			(-1.30)			(1.83)
$SecLend_{i,j,t-1} \times OnLoan_{i,t-1}$		-0.4839***	-0.3498***		-0.2810***	-0.1861***		0.0021***	0.0016***
		(-5.10)	(-3.71)		(-42.4)	(-2.73)		(3.54)	(2.79)
$SecLend_{i,j,t-1}$	-3.2500***	-3.0093***	-2.0109***	-2.2175***	-2.0950***	-1.3403***	0.0105***	0.0095***	0.0070***
	(-9.34)	(-9.55)	(-7.62)	(-7.29)	(-7.18)	(-5.40)	(4.70)	(4.45)	(3.50)
$adj.R^2$	0.1991	0.1990	0.2189	0.1291	0.1295	0.1617	0.2616	0.2610	0.2755
N	796284	790989	750386	756158	751178	713657	797617	791022	750404
Fund × Security × Time controls	No	No	Yes	No	No	Yes	No	No	Yes
Security×Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fund×Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security×Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A.1
Variable Definition

Variable Name	Description
sh_sec_lend	Position Market Value in Lending Transaction divided by Position Market Value
SecLend	Fund i lends stock j in past year (Dummy: 0/1)
FundLend	Dummy: All stocks not in a lending transaction in month t if fund i lends at least one security in month t
FamilyLend	Dummy: All funds not lending if at least one fund in the fund family is lending
Exit	Dummy: Fund closes position in month t
PosChange	Number of shares held minus lagged number of shares held divided by lagged number of shares held
Active	Dummy: Fund classified as non-index fund according to IFS
ILLIQ	Percentile rank of portfolio position sorted on AmihudIlliq
PosWeight	Position Market Value divided by Sum of Position Market Values
SecAlpha	Carhart 4-Factor Stock Alpha (loadings estimated over past 36 months, by region of headquarters)
SecDGTW	Stock Return minus Benchmark Portfolio Return (5x5x5 Portfolios sorted on size, book-to-market, momentum)
OnLoan	Monthly average fraction of market capitalization effectively lent out
ShortFee	Monthly average of value-weighted loan fee (in annualized basis points)
SecReturn	Monthly stock return
IdioVola	Idiosyncratic stock return volatility (Carhart 4-Factor model fitted to daily data, residuals averaged over a month)
AmihudIlliq	Daily Stock Return (in absolute terms) divided by Stock Trading Volume in EUR) (averaged over a month)
InvestmentRegion	Fund Investment Region (Global, Europe, Northern America, Asia-Pacific ex. Japan, Japan)
FundAlpha	Carhart 4-Factor Fund Alpha (loadings estimated over past 36 months, by region of Morningstar fund category)
FundDGTW	Position-weighted average of SecDGTW
FundReturn	Monthly fund return (asset-weighted average across share classes, net of costs)
FundCost	Morningstar Fund Costs (excluding transaction costs)
Disclosure	Dummy: Public Short Position Disclosure w/o any publicly disclosed position in the previous 6 months
NAV	Fund Net Asset Value
FamilyNAV	Fund Family Net Asset Value
Turnover	Minimum of Aggregate Buys and Sells (in absolute terms) divided by lagged net asset value
RelFlow	Fund Net Flows divided by Lagged Net Asset Value
FundAge	Fund Age (in years) since inception month of oldest share