Passive Ownership and the Securities Lending Market

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Abstract

We exploit quasi-exogenous variation in passive ownership around the Russell 1000/2000 cutoff to explore the causal effects of passive ownership on the securities lending market. We find that passive ownership causes an increase in lendable supply and short interest, while lending fees remain largely unchanged. Interestingly, the utilization ratio—i.e., the ratio of short interest over lendable supply—tends to go up, implying that shorting demand increases by more than what can be justified by a pure surge in lendable supply. We argue that this additional shorting demand results from an increase in the quality of lending supply as passive funds are less likely to recall stock loans. We show that, in line with this argument, the average maturity of stock loans increases and the likelihood of delivery failures decreases with higher passive ownership. Finally, we document that the additional shorting activity due to passive ownership improves information efficiency.

JEL classification: G11, G12, G14, G15

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The last decades have seen a tremendous growth in passive investment. In August 2019, passive investment funds have for the first time overtaken active funds in terms of assets under management.[1] A growing body of research tries to understand the consequences of this seismic shift in the market landscape (e.g., Wurgler, 2010; Ramaswamy, 2011; Da and Shive, 2016; for a survey, see Ben-David et al., 2017). We contribute to this literature by studying the impact of passive ownership on the securities lending market. In a way, we feel like research has jumped ahead by studying the consequences of passive ownership on diverse issues such as corporate governance, payout policy, firm value, mergers and acquisitions, corporate investment, price efficiency, activist investing etc. (Crane et al., 2014; Mullins, 2014; Boone and White, 2015; Appel et al., 2016; 2019; Schmidt and Fahlenbrach, 2017; Israeli et al., 2017; Antoniou et al., 2018; Ben-David et al., 2018; Glosten et al., 2020) without mapping out fully the more direct and immediate consequences of passive ownership. We argue that one such direct consequence concerns equity lending markets, in which passive funds are known to actively participate as security lenders (Blocher and Whaley, 2016). Specifically, we conjecture that, through their role as suppliers of shares, passive lenders facilitate short selling, which can help explain—and potentially even drive—some of the aforementioned effects ascribed to passive ownership.

Short sellers that want to keep open a position for more than one day need to borrow the security in the equity lending market. This makes equity lending key for enabling short selling, which itself is vital for the price and informational efficiency of the underlying shares in the stock market (Saffi and Sigurdson (2011), Beber and Pagano (2013), Boehmer and Wu (2013)). We hypothesize that, because passive funds are known to actively participate as security lenders (Blocher and Whaley, 2016), a sudden increase in passive ownership should first and foremost be associated with an increase in lendable supply. If this were the only effect, we would then expect a decrease in the equilibrium lending fee and a resulting increase in short interest (i.e., the fraction of shares that are shorted over the number of outstanding shares) as displayed in

[1] Confer Bloomberg article by John Gittelsohn: "End of Era: Passive Equity Funds Surpass Active in Epic Shift," published September 11, 2019.

Figure 1 Panel A. Our results, however, paint a more nuanced picture. In particular, we find evidence of a simultaneous and pronounced shift in lending supply *and* short selling demand. Importantly, the utilization ratio (i.e., the ratio of short interest over lendable supply) and the lending fee if anything increase, as depicted in Figure 1 Panel B.

Why does passive ownership cause additional short selling demand? We entertain two hypotheses. First, increased short selling demand could come from ETF arbitrage. Indeed, when an ETF trades below its basket value, arbitrageurs want to buy the ETF in the market and short sell the stocks in the basket.[2] Second, short sellers may have a preference for borrowing shares from passive lenders, who are long-term and stable shareholders and thus less likely to recall equity loans. Hence, short sellers may be willing to pay more and/or demand larger quantities when borrowing shares from passive investors. Our results point in the latter direction, suggesting that passive owners increase both the quantity and the *quality* of the supply for lendable shares.

Identifying the causal effects of passive ownership is challenging. Given ample confounding factors, the interpretation of simple correlations between ownership and short selling variables are fraught with peril. To name one example, larger stocks are more likely to be tracked by passive investors and are known to be less short sale constrained. Controlling for firm size is no solution as the relation between firm size, passive ownership, and short sale constraints may well be non-linear. Other confounding factors are likely to be unobserved. For instance, it is plausible that investors' recognition of a stock drives both short selling and the extent with which it is included in stock market indexes and thus held by passive index funds. To circumvent these endogeneity concerns, we employ a well-established identification strategy surrounding Russell 1000/2000 reconstitution events (Chang et al., 2015; Appel et al., 2016). Every year in June, Russell decides which stocks from the Russell 1000 (2000) move down (up) to the Russell 2000 (1000) based on

[2] Authorized participants (APs) could deliver the shares to the ETF provider in order to receive basket stocks in return, with which they can then cover their short positions. Thus, short sales coming from APs are expected to have very short maturity. However, other arbitrageurs without AP license may also trade on the ETF mispricing by just holding the long-short arbitrage position until convergence.

their end-of-May market capitalization. Both indexes are tracked by large passive funds with substantial assets under management (Chang et al., 2015). Importantly, stocks at the top of the Russell 2000 have a much larger portfolio weight in their respective index compared to stocks at the bottom of the Russell 1000, and hence stocks that are demoted to the Russell 2000 experience a surge in passive ownership. Following Appel et al. (2016; 2019; 2020), we therefore use Russell 2000 index membership as an instrumental variable for passive ownership. The identification assumption is that after controlling for market capitalization, which is the key variable that determines index membership, stocks above and below the Russell 1000/2000 are similar except for their quasi-exogenous difference in passive ownership . Crucially, Appel et al. (2019) further show that overall institutional ownership is not significantly affected by the index assignment. Hence, Russell reconstitution events lend themselves to study the causal effects of passive ownership.

We implement this identification design by carefully taking into account the latest recommendations from the literature (Appel et al., 2020; Ben-David et al., 2019). We pay particular attention to sampling and to using the right market capitalization controls. Our results obtain in the cross-section (i.e., by comparing firms around the Russell 1000 membership threshold), as well as when we focus on switching firms—i.e., those that change index membership.

Our results can be summarized as follows. In the first stage, we find that Russell 2000 membership increases passive ownership by 1.9 percentage points, which represents an increase of 17% relative to the mean of passive ownership in our sample. This number is in line with what has been found in prior studies (Appel et al., 2016; 2019). In the second stage, we document a large increase in lendable supply. Indeed, the magnitude of our coefficient estimate implies that passive ownership and lendable supply go up one-for-one, essentially suggesting that the new passive owners offer all their shares for lending. Concomitant to this rise in lendable supply, we find a sizable increase in short interest; i.e., the fraction of outstanding shares that are on loan. Moreover, we find that the lending fee and the utilization ratio—i.e., the ratio of shares lent to the lendable supply—if anything go up. This shows that both the supply and the demand for short selling shift up in response to increased passive ownership.

In subsequent analyses, we analyze the channels driving the increase in shorting demand. We first consider the possibility that increased short selling demand comes from ETF arbitrage. To test for this possibility, we match our sample with data on ETF mispricing and examine if there is a larger increase in short selling on days when ETFs with large ownership stakes in the stock are undervalued (i.e., when ETF arbitrageurs would want to short-sell the stock). While our results point in the expected direction, the effect is economically small and statistically insignificant. We conclude that the bulk of increased short selling demand comes from elsewhere. Our second hypothesis posits that short sellers have a preference for borrowing from passive stockowners, so that an increase in the proportion of passive owners entices additional borrowing demand. This preference could occur for two reasons. First, passive owners are long-term shareholders with little discretion to adjust their stock positions. As such, a short seller will find it more likely that his equity loan is not recalled prematurely when he borrows from a passive fund. Second, short sellers may be worried that active owners opportunistically recall their shares (in order to sell them) when they see a rise in short interest (Honkanen, 2019). We find several pieces of evidence consistent with a preference for passive lenders. First, we show that passive ownership increases the average tenure of equity loans. This means that equity loans are kept open for longer, either because lenders don't recall them or because there are more long-horizon short sellers. Second, we find that the risk of loan recall decreases with passive ownership, as both the probability of supply shortages and of failures to deliver (henceforth FTD) is significantly reduced for large Russell 2000 stocks. Finally, we document that this additional short selling demand improves information efficiency. Using the price-jump ratio around earnings announcements (Weller (2018)), we find that the prices for stocks with high passive ownership better anticipate imminent negative earnings surprises.

Taken together, our results suggest that passive ownership promotes short selling not only because of an increase in supply, but also by enticing additional short selling demand. This finding has important implications for our understanding of the causal effects of passive ownership. For example, Appel et al. (2016) find that passive owners improve governance and argue that passive owners actively lobby for better governance (because they cannot "vote with their feet"). Our findings suggest a complementary mechanism. By promoting short selling, passive owners indirectly increase the pressure on management to adopt better governance practices (Massa et al. (2015), Fang et al. (2016)). Such an indirect effect of passive ownership via short selling may similarly play a role in explaining other findings that have commonly been attributed to passive owners directly, such as the effects on firm value (Schmidt and Fahlenbrach, 2017), activist investing (Appel et al., 2019), price and information efficiency (Boone and White, 2015; Israeli et al., 2017; Glosten et al., 2020), and volatility (Ben-David et al., 2018). While our point may appear subtle, it becomes important for correctly evaluating the effectiveness of regulatory policy. Indeed, our results suggest there is a complementarity between ownership structure and the equity lending market. This implies that policies that aim to promote passive ownership will be more beneficial when short selling is frictionless and vice versa.

We contribute to several strands of the literature. First, we contribute to the literature on equity lending (e.g. Geczy et al. (2002), Kolasinski et al. (2013), Kaplan et al. (2013), Thornock (2013), Aggarwal et al. (2015)). Here, our paper is closest related to Porras Prado et al. (2016), who find that a larger lending supply is correlated with higher, less concentrated, long-term, and passive ownership. We contribute by focusing on and cleanly identifying the effect of passive ownership on equity lending markets. One important insight that emerges from our study is that passive owners do not only cause additional lending supply, but that they also spur short-selling demand. Indeed, our results suggest that short sellers have a preference for borrowing shares from passive owners, presumably because these lenders pose a lower recall risk and/or are less likely to free-ride on the short seller's information (Honkanen, 2019).

Our second contribution is to the literature on passive investment. As pointed out before, this literature has been burgeoning recently; with papers establishing the causal effects of passive ownership on diverse topics such as corporate governance (Mullins, 2014; Appel et al., 2016), payout policy (Crane et al., 2014), firm value (Schmidt and Fahlenbrach, 2017), mergers and acquisitions (Antoniou et al., 2018), corporate investment (Fich et al., 2015), activist investing (Appel et al., 2019), price and information efficiency (Boone and White, 2015; Israeli et al., 2017; Glosten et al., 2020), and volatility (Ben-David et al., 2018). Somewhat surprisingly, however, the more immediate effects of passive ownership on the equity lending market have so far been overlooked. We show that these effects are more subtle than what might have been predicted (i.e., a mere upshift in supply) and—perhaps more importantly—that they may inform the underlying channels of the aforementioned papers.

Our paper proceeds as follows. Section 1 discusses the related literature and outlines our hypotheses. Section 2 presents the data and Section 3 the empirical methodology. Section 4 documents the main results for lendable supply, short interest, lending fees, and the utilization ratio. Section 5 explores the channels behind those results. Section 6 studies the effects on the informational efficiency of the stock market. Section 7 offers robustness checks and Section 8 concludes.

1. Hypotheses

In this section, we explain the empirical hypotheses for the effects of passive ownership on the equilibrium in the securities lending market. In the next section, we describe how we can instrument for passive ownership using the Russell 1000/2000 cutoff.

Existing evidence suggests that passive funds (and especially ETFs) are active lenders in the securities lending market (Blocher and Whaley, 2016). Our first prediction is therefore that passive ownership will lead to an increase in lendable supply; i.e., the fraction of outstanding shares that is available to be lent out to short sellers. Moreover, if the shift in supply was the only effect (i.e., if there was no concomitant shift in demand), then one would further expect a decrease in the equilibrium lending fee and an increase in short interest; i.e., the fraction of shares that are actually shorted. This situation is depicted in Figure 1 Panel A.

Finally, as the equilibrium demand would go up by less than the total upshift in supply, the utilization ratio—i.e., the fraction of short interest over lendable supply—should not increase.

We posit two channels for why an increase in passive ownership might—in addition to the upshift in lendable supply—also lead to an upshift in shorting demand. First, many passive owners are ETFs, which are themselves trading in a secondary market. This creates room for ETF arbitrage; i.e., trades that exploit price differences between the ETF price and the price of the underlying stock basket. Such arbitrage is common and has been found to cause excess volatility in the underlying stocks (Ben-David et al., 2018). Authorized participants (APs) who conduct ETF arbitrage do not necessarily borrow the stocks they are shorting. Rather, at the end of the day, they can deliver ETF shares to the ETF sponsor and convert them into individual stocks to close their short position. However, some arbitrageurs (without AP license) may also bet on price convergence and these traders have to borrow shares if they want to keep positions open overnight.

The second channel why passive ownership causes an increase in short-selling demand has to do with the nature of passive owners as security lenders. Indeed, passive owners are long-term shareholders with little discretion to rebalance their stock positions. This feature may be appreciated by short sellers that want to hold on to their short positions for some time. Since by design equity loans are bilateral, renegotiable, and short-term agreements (Reed, 2013), such long-horizon short sellers may find it more likely that their borrowed shares are not recalled if the lender is a passive investor. Relatedly, passive lenders cannot opportunistically recall shares or free-ride on the information provided by the short seller. Active lenders, in contrast, appear to be reducing their stock position after a short seller borrows some shares (Honkanen, 2019).

If one or both of these channels are at work, short sale supply and short sale *demand* are increasing in passive ownership. To the extent that the demand increase is on par with the supply increase, the equity lending fee may be unchanged or even go up (Figure 1 Panel B). The same is true for the utilization ratio.

To tease out which of these two channels is more important for explaining a short sale demand increase, we conduct several auxiliary tests. For the first channel, we relate short selling to ETF mispricing; i.e., the difference between the ETF price and the price of the underlying stock basket. If short selling demand is driven by ETF arbitrage, we expect this short selling demand to be pronounced on days on which the ETF is underpriced (i.e., when arbitrageurs would want to short sell the basket stocks). For the second channel, we investigate the effect of passive ownership on equity loan maturity and the probability of loan recall (as proxied by delivery failures). If passive owners are indeed more stable equity lenders as hypothesized, we expect loan maturity to increase and recall risk to decrease with passive ownership. Finally, by attracting long-horizon short sellers that are presumably informed, passive ownership should be associated with an improved information efficiency surrounding negative news events.

2. Data

In this section, we describe the datasets used in the study. To reduce the effect of outliers, we winsorize all continuous variables at the 1st and 99th percentile.

2.1 Passive and active fund holdings data and Russell 1000/2000 index membership

We follow Appel et al. (2016) in how we construct the percentage of stocks held by active and passive funds. We use the S12 mutual fund holdings data from Thompson Reuters, which contains quarterly holdings of all (open-ended) mutual funds and exchange traded funds (ETFs) as reported to the SEC, and match it with CRSP mutual fund data using the MFLINKS table available on WRDS. We define a fund as passively managed if the CRSP Mutual Fund Database classifies the fund as an index fund or if its name in CRSP contains a string that suggests that it is an index fund.[3] All other funds that we can match to CRSP are classified as active funds; funds that are not matched to CRSP are left unclassified. Then we compute

[3] We use the same set of strings to identify index funds as Appel et al. (2016): Index, Idx, Indx, Ind_ (where _ indicates a space), Russell, S & P, S and P, S&P, SandP, SP, DOW, Dow, DJ, MSCI, Bloomberg, KBW, NASDAQ, NYSE, STOXX, FTSE, Wilshire, Morningstar, 100, 400, 500, 600, 900, 1000, 1500, 2000, and 5000. The comparison is case sensitive.

the percentage of each stock's shares outstanding (obtained from CRSP securities data) that is owned by active, passive, and unclassified funds at the end of each quarter.

We obtain monthly data on the constituents of the Russell 1000 and Russell 2000 indexes from Mergent. In addition to index assignments and weights, the data includes Russell's float-adjusted market capitalization, which Russell uses to determine the weights in the index. We merge Russell data to our other datasets using 8-digit CUSIPs.

2.2 Market capitalization data and equity lending data

For our identification strategy, it is important to control for a stock's market capitalization, as this is the key variable that determines whether the stock is assigned to the Russell 1000 or Russell 2000 (see details below). Because we do not have access to the exact market capitalization variable used by Russell, we follow the approach proposed by Ben-David et al. (2019) in order to obtain a close substitute market capitalization measure from CRSP and Compustat data. We construct this measure using the SAS-code provided in their paper and describe it in more detail in Appendix B. For robustness, we verify that our results obtain if we simply use market capitalizations computed from CRSP.

We obtain equity lending data from IHS Markit (formerly DataExplorers) for the period July 2006 to December 2018. IHS Markit collects its equity lending data from custodians and prime brokers that lend and borrow securities and is the leading provider of such data. We have access to the underlying raw data that includes all individual equity lending transactions in the dataset. We aggregate these data on the stock-day level and compute the following variables: *Lendable supply* is defined as the number of shares available to lend (this includes the shares that are actually lent out) divided by shares outstanding (from CRSP). *Short interest (equity loans)* is defined as shares currently on loan divided by shares outstanding.[4] *Lending fee* is defined as the value-weighted average fee that the borrower pays to the equity lender. *Tenure* is the average number of days that equity loans have been open. *Utilization* is the fraction of shares available to lend that

[4] We call this variable *Short interest* because short selling is the main reason for borrowing equities.

is actually lent out.[5] Finally, we compute monthly averages of these variables and merge the data via 8-digit CUSIPs to our other datasets.

2.3 Short interest and fails to deliver data

As mentioned above, we proxy for short selling using equity lending transactions because short selling is the main reason to borrow equities. However, there may be other reasons to borrow equities such as tax arbitrage around dividend dates (Thornock (2013)) or vote lending before annual meetings (Aggarwal et al. (2015)). Therefore, as a robustness check, we also use short interest data from Compustat. These data are provided by NASDAQ, NYSE, and American Stock Exchange and are available twice each month on the 15th business day and the last business day of the month. We average these variables to compute *Short interest (Compustat)* at the monthly level.

We also obtain data on failures to deliver (FTD) from the National Securities Clearing Corporation's settlement system, provided on the Securities and Exchange Commission (SEC)'s website.[6] Failures to deliver are closely related to shorting because short sellers (by definition) do not own the stocks they are selling. When they cannot borrow the promised stock before the sell transaction settles, a failure to deliver happens. Moreover, fails can occur when a stock loan is recalled and the short seller does not return the share within the settlement window. Indeed, as we show in Appendix C, failures to deliver and the level of short selling are extremely closely correlated. We define *Failures to deliver* as the number of shares that fail to deliver divided by open short positions as measured using the equity lending data. We compute this variable for each trading day and then average it over the month. The FTD data is available starting in February 2004. Prior to September 16, 2008, the FTD data is restricted to outstanding balances of 10,000 shares or more. We merge short interest and failure to deliver data with our other datasets using 8-digit CUSIPs.

[5] Markit receives data from both lenders and borrowers but can only get "shares available to lend" from equity lenders. Thus, when computing utilization, we only include shares on loan where HIS Markit received the information from the lender.

[6] SEC failures to deliver data: https://www.sec.gov/data/foiadocsfailsdatahtm.

2.4 Price jump ratio

To gauge the impact of passive ownership-induced short selling on information efficiency, we rely on the price jump ratio measure developed by Weller (2018). Intuitively, this measure captures the fraction of the return associated with a positive or negative earnings surprise that occurs at the time of the earnings announcement compared to what has already been priced in during the days before. The lower this measure, the more information finds its way into prices prior to being publicly announced and hence the higher the information efficiency.

We construct the price jump ratio as described in Weller (2018). We take earnings announcement dates from IBES and compute the price jump ratio as

$$Price\ jump\ ratio\ (alpha) = \frac{Alpha_{t-1,t+2}}{Alpha_{t-21,t+2}},$$

where $Alpha_{t-n,t+m}$ is the cumulative 3-factor Fama French (1993) alpha from 1 day before to 2 days after the earnings announcement day. We describe the details of constructing 3-factor Fama French (1993) alphas in Appendix E. The price jump ratio can get very large if $Alpha_{t-21,t+2}$ is close to zero. For this reason, we follow Weller (2018) and only include earnings announcements if the absolute value of $Alpha_{t-21,t+2}$ is sufficiently large. Specifically, we only include observations if

$$\left|Alpha_{t-21,t+2}\right| > \sqrt{24} * \hat{\sigma}_{past\ month}\ ,$$

where $\hat{\sigma}_{past\ month}$ is the standard deviation of daily alphas over the previous month. This filter only keeps about 38% of the observations (which is similar to Weller (2018)). For robustness, we also compute *Price jump ratio (return)*, where all inputs (including to the volatility filter) are based on raw returns instead of alphas.

2.5 Summary Statistics

We display summary statistics in Table 1. We show summary statistics separately for our two samples with bandwidths of 250 and 500 stocks. The summary statistics for both samples are quite similar. *Passive ownership* is about 11% of shares outstanding, while *Active ownership* is about 21%. With 4% owned by unclassified funds, we get a total fund ownership of about 36 percent. *Lendable supply* is 27% of shares outstanding. *Shorting* is on average 6% to 7% of shares outstanding, regardless of whether it is measured using equity lending data or short interest data. *Utilization* is 11% on average and the *Lending fee* is 28 basis points. However, the *Lending fee* has a large standard deviation of 120 basis points, suggesting that a few stocks are hard to borrow leading to very high fees. On average, equity loans are open for about 70 calendar days, or slightly above 2 months. Indeed, half of equity loans have a *Tenure* above one month. *Delivery failures* are fairly rare at 0.22% of shorted stocks but also have a high standard deviation, suggesting that for some stocks delivery failures are much more common. The median of the *Price jump ratio* in our sample is 54% when based on alpha and 46% when based on returns, similar to the 46% median reported in Weller (2018).

Our sample period spans the period from July 2006 to December 2018 and is dictated by the availability of the equity lending data.

3. Methodology

Identifying the causal effects of passive ownership on equity lending and short selling is challenging. For example, omitted variables such as unobservable firm characteristics may drive both passive ownership and short selling at the same time. In addition, there could be reverse causality; for example, a large shorting demand may increase the fee that lenders can charge and thereby make the stock more attractive to passive investors. To address these issues, we use Russell 1000 and Russell 2000 index membership as a source of exogenous variation to passive ownership. Appel et al. (2020) explain that, when implemented carefully, index membership provides a powerful instrument for passive ownership and, as such, this approach has been widely used (e.g., Chang et al. (2015), Appel et al. (2016, 2019), and Ben-David et al., 2018). We briefly describe and motivate this identification strategy below and refer the reader to Appel et al. (2020) for more detail.

The Russel 1000 index comprises the 1000 U.S. stocks with the largest market capitalization and the Russell 2000 index comprises the next largest 2000 stocks. Both indexes are tracked by many index funds and ETFs. Importantly, the largest stocks in the Russell 2000 index have a much higher weight in their index than the smallest stocks in the Russell 1000 index, even though they are of roughly similar size. Thus, when a stock's market capitalization falls enough so that it moves from the Russell 1000 to the Russell 2000 index, its passive ownership increases significantly. Because Russell uses clear rules to assign stocks into its indexes, we obtain exogenous variation to passive ownership by using Russell 2000 index membership as an instrumental variable and controlling for the variables that determine index membership.

Every year at the end of June, Russell reconstitutes the indexes to account for changes in market capitalization. The variable that determines index membership is the total (not float-adjusted) market capitalization at the end of May. The weight within the index is then determined using the float-adjusted market capitalization at the end of June (i.e, weights are based on market capitalizations excluding closely held shares). Until 2007, Russel simply ranked stocks by their end-of May (total) market capitalization and assigned the top 1000 stocks to the Russell 1000 index. From 2007 onwards, Russell has implemented a banding policy, according to which stocks that are close to the cut-off remain in the index they have been assigned to before. Russell has implemented this policy to reduce the number of stocks that switch indexes each year. We implement the instrumental variable strategy developed in Appel at al. (2019), which allows for identification despite the banding policy.

Specifically, we run monthly instrumental variable regressions with the following first-stage regression:

$$Passive\ Ownership_{i,t} = \alpha_t + \beta_1 * D\left(Russell\ 2000_{i,t}\right) + \sum_{n=1}^{3} \gamma_n * \left(Ln\left(Mktcap_{i,last\ May}\right)\right)^n$$

$$+\beta_2 * D\left(banded_{i,last\ May}\right) + \beta_3 * D\left(Russell_{i,last\ May}\right)$$

$$+\beta_4 * D(banded_{i,last\ May}) * D(Russell\ 2000_{i,last\ May}) + \beta_5 * Float_{i,last\ June} + \varepsilon_{i,t}$$

where α_t are time fixed effects, *D(Russell 2000)* is a dummy variable equal to one if the company is in the Russell 2000 index and equal to zero if it is in the Russell 1000 index, $Mktcap_{i,last\ May}$ is our estimate of total market capitalization at the end of last May (based on which index membership for the following year is decided) estimated from CRSP and Compustat data using the methodology of Ben-David et al. (2019), $D(banded_{i,last\ May})$ is a dummy variable equal to one if the company was close enough to the threshold to be banded, $D(Russell\ 2000_{i,last\ May})$ is a dummy variable equal to one if the stock was in the Russell 2000 index as of last May (and thus over the course of the prior year), and $Float_{i,t}$ is the float-adjusted market capitalization at last June as provided by Russell. Russell uses this measure to assign index weights for the following year. Because we control for all variables that determine Russell membership (market capitalization, banding controls, and prior index membership), the use of *D(Russell 2000)* as an instrument provides plausibly exogenous variation in passive ownership.

To determine whether a firm is banded, we compute the total market capitalization of the Russell 3000 index and sort all firms in that index by market capitalization.[7] We then compute the market capitalization percentiles for each firm (for example, if a firm has a 75th percentile, it means that firms smaller than it make up 75% of the total market capitalization of the Russell 3000 index). A firm is banded if its *percentile* is less than 2.5 percentage points different from the percentile of the 1000th stock. This approach follows the instructions by Russell and we show in Appendix D that it is quite predictive of actually realized index changes.

Identification will be tighter for stocks close to the cutoff between the Russell 1000 and Russell 2000 index. However, there is a trade-off as a smaller bandwidth implies fewer stocks and thus less statistical power to

[7] Russell actually uses the Russell 3000E index, which includes a few additional small stocks relative to the Russell 3000. Unfortunately, our data does not contain the Russell 3000E members. However, given the fact that the additional stocks are very small, us using the Russell 3000 index instead of the Russell 3000E index does not make much of a difference. In fact, we show in Appendix D that we can replicate index switches accurately using our data.

reject the null. We therefore show results for two samples: a larger sample of 500 stocks around the cut-off as used in Appel et al. (2019) and a smaller sample of only 250 stocks around the cut-off. Following Appel et al. (2019), we use Russell's float-adjusted market capitalization at the end of the previous June to form these samples. However, we show in Table 8 that our results are robust if our sampling is based on market capitalizations computed from CRSP/Compustat.

4. Lendable Supply and Short Selling

4.1 Graphical analysis

Before implementing cross-sectional IV specification as described above, we present here graphical evidence based on a simple event study analysis for stocks that switch indexes. For this event study analysis, we exploit the fact that our equity lending variables are available at the daily frequency.

In Figure 2, we start by plotting passive ownership in the 4 quarters before and after the quarter of a Russell 1000/2000 index reconstitution event. In the left panel we focus on stocks that move from the Russell 2000 up to the Russell 1000. We see that passive ownership climbs from about 8.7% of outstanding shares to about 10% in the quarter of the reconstitution event and to about 11% subsequently. The right panel, which focuses on stocks that move from the Russell 1000 down to the Russell 2000, shows a corresponding decrease in passive ownership. In Figure 3, we plot average *Lendable supply* and *Short interest* in the 100 trading days around the date of a Russell 1000/2000 index reconstitution event. Again, the left (right) panels display the effects for stocks that move from the Russell 2000 (1000) to the 1000 (2000) index. Panel A shows a sharp decrease in lendable supply of about 2.5 percentage points after a stock moves up to the Russell 1000 index and a corresponding 2.5 percentage point increase in lendable supply for stocks switching to the Russell 2000 index. Such a swift change is unlikely to be driven by an underlying trend and thus strongly suggests a causal effect of index reconstitution events. Panel B displays similarly striking results for short selling activity. Stocks moving down (up) to the Russell 2000 (1000) indices experience on average a roughly 1.5 percentage point increase (decrease) in short interest. Taken together, our results indicate that both lendable supply and short selling demand increase with passive ownership around index reconstitution events.

4.2 Lendable supply

We now turn to our instrumental variable regression in order to study the causal effect of passive fund ownership on lendable supply and short selling. Table 2 presents the IV regression results, where we instrument passive fund ownership by the Russell 2000 index inclusion dummy. Columns 1 and 3 present, respectively, the first and second stage regressions for the narrow band of 250 stocks (on either side of the index cutoff), and Columns 2 and 4 present first and second stage regressions for the wider band of 500 stocks. All regressions control for a third-degree polynomial of the logarithm of total market capitalization at the end of last May computed using the methodology of Ben-David et al. (2019) as well as the logarithm of float-adjusted market capitalization at the end of last June as provided by Russell. In addition, we include a dummy variable indicating whether the stock was close enough to the cutoff to be banded, a dummy for whether the stock was included in the Russell 2000 index in the previous year, as well as the interaction of these two dummy variables. We include month fixed effects (in a robustness test, we confirm that our results continue to hold when we further include stock fixed effects). Standard errors are double-clustered by stock and month.

The first stage results show that a stock's inclusion in the Russell 2000 index increases passive fund ownership by about 1.8 percentage points. The result is very similar in magnitude regardless of the bandwidth around the cutoff. The Kleibergen-Paap (2006) F-statistic comfortably exceeds the Stock-Yogo (2005) critical value of 10, confirming the instrument is not weak. In the second stage, where we instrument passive fund ownership by the Russell 2000 index dummy, we find that a 1 percentage point change in passive fund ownership increases lendable supply by 1.2 to 1.4 percentage points. The magnitude of the effect is large and suggests that basically all of the stocks newly held by passive investors are made available to be lent. In fact, the coefficients suggest a response that is more than one-for-one but we confirm in unreported tests that the coefficients are not statistically different from one, i.e. we cannot reject a proportionate response to passive fund ownership. In any case, our results demonstrate a striking increase in lendable supply following an increase in passive ownership.

4.3 Short selling

Next, we study the effect of passive ownership on short selling. Table 3 reports the second stage coefficients from the IV regression (the first stage is reported in Table 2). We focus on three measures of short selling activity: *Short interest* (i.e., the fraction of outstanding shares that are lent out), the *Utilization* rate, and the *Lending fee*. Columns 1, 3, and 5 report the results for the narrow bandwidth around the index cutoff, and Columns 2, 4, and 6 report results for regressions using the wider sample of 500 stocks on either side of the cutoff. We include the same control variables as above.

Short interest (equity loans), as measured by equity loans, increases 0.6 to 0.9 percentage points for every percentage point increase in passive fund ownership (Columns 1 and 2). This is a surprisingly large effect. Indeed, given that the average utilization rate in the sample is only about 11% (see Table 1), an increase in *Short interest* of about 0.11 percentage points would keep the utilization rate constant. The 0.6 to 0.9 percentage point increase that we find thus suggests that the utilization rate goes up with passive ownership. This is confirmed in Columns 3 and 4, in which we directly examine *Utilization* as the dependent variable. We find an increase in utilization of about 0.6 percentage points in the narrow sample (though the coefficient is not statistically significant), and of about 1.2 percentage points in the wider sample.

Columns 5 and 6 focus on the lending fee. In the narrow sample, the lending fee increases by a meager 2.6 basis points and the coefficient is statistically insignificant. In the wider sample, the lending fee goes up by 7.5 basis points for every one percentage point increase in passive ownership and this effect is marginally statistically significant. The difference between the two samples can presumably be attributed to the high standard deviation of stock lending fees: most stocks are very easy and cheap to borrow, but some stocks in high demand have very high lending fees.

In aggregate, we find strong evidence of a large increase in *Short interest* and some evidence suggesting an increase in *Utilization* and *Lending Fee*. Interestingly, the increase in shorting is larger than what would be expected if passive ownership would only lead to an increase in the quantity of lendable supply. Indeed, such a pure supply increase should lead to a decrease in *Utilization* and *Lending Fee*. The increase in these variables thus suggests that being added to the Russell 2000 leads to a simultaneous increase in shorting demand.

5. Why does Short Selling Demand increase?

In this section, we examine two possible explanations for the documented increase in shorting demand: ETF arbitrage and passive lenders providing a higher quality of lendable supply.

5.1 ETF arbitrage

We start by examining ETF arbitrage. As mentioned above, authorized participants can directly convert stocks into ETF shares with the ETF sponsor and thus do not have to rely on equity lending in order to exploit differences between the ETF price and the price of the underlying stock index portfolio. Other investors, however, may establish short positions (relying on the equity lending market) in order to engage in ETF arbitrage. Hence, given that the inclusion in the Russell 2000 index causes additional ETF ownership, additional short selling demand may come from increased ETF arbitrage activity. Importantly, additional short selling in the underlying stocks should only happen if the ETF is undervalued relative to the underlying securities. Thus, if ETF arbitrage was responsible for the increase in shorting demand, we would expect a larger increase in *Shorting* on days where ETFs are undervalued.

We examine this hypothesis in Table 4. We conduct a daily analysis in which we regress *Short interest* on an interaction between *D(ETF undervalued)* and the Russell 2000 membership dummy. *D(ETF undervalued)* is a dummy variable equal to 1 if the ETFs holding the stock on average are overvalued.[8] We

[8] In this daily regression, we account for the fact that short sellers only need to borrow the shares 2-3 days after they open the short position because equities settle at t+3 (or t+2 since September 5, 2017).

measure ETF overvaluation by computing the difference between the ETF price and its net asset value (NAV) taken from CRSP. We employ the same control variables as above and also interact them with *D(ETF undervalued).* This set-up is the reduced form version of our instrumental variable regression run at the daily level and interacted with *D(ETF undervalued).*

The coefficient of interest is the interaction between *D(Russell 2000)* and *D(ETF undervalued).* We would expect the coefficient of this interaction to be positive: when ETFs are undervalued, arbitrageurs will buy the ETF and short sell the underlying securities, thus giving rise to pronounced short selling. The interaction coefficient is indeed positive, but it is economically small and statistically insignificant.

Importantly, the coefficient of the Russell 2000 dummy remains statistically significant and positive, suggesting that there is increased *Shorting* also on days when ETFs are overvalued. This suggests that the increase in short selling is not due to increased ETF arbitrage.

5.2 Loan tenure

Given that ETF arbitrage cannot explain the increase in shorting, we now turn to our second potential explanation for the increase in short selling demand: passive owners provide lendable supply of higher quality. For this purpose, we look at the tenure of stock loans. If the increased short selling and stock lending documented above is solely for the purposes of ETF arbitrage, the average tenure of loans should *decrease* as ETF arbitrage opportunities are short lived.[9] If, on the other hand, passive owners are preferred as equity lenders because they do not recall the shares, we would expect the average tenure of equity loans to increase. Table 5 presents the second stage IV regression on two measures of loan tenure. The dependent variable in Columns 1 and 2 is the average tenure of equity loans, whereas Columns 3 and 4 look at the share of loans with a tenure greater than 30 days.

[9] Marshall et al. (2013) find that ETF mispricings between SPY and IVV (two ETFs tracking the same underlying index) persist only for a few minutes. We expect mispricings between an ETF and its constituent stocks to exhibit a durations in the same ballpark.

We find that loan tenure increases by 6.3 to 7.7 percent, and the share of long-tenure loans (longer than 30 days) increases by about 2.6 percentage points. These findings are strongly statistically significant and suggest that short sellers are able or want to maintain short positions for longer when they can borrow from passive owners.

5.3 Supply shortages and Delivery Failures

If passive owners are indeed more reliable providers of equity loans, we would expect that higher passive ownership leads to fewer supply shortages, i.e. a situation where a potential short seller cannot borrow the stock. To this end, we look at the *probability of a supply shortage*, which we define as *Lendable supply* being below 2% of shares outstanding (this corresponds roughly to the 1st percentile of *Lendable supply* in our sample). We report the second stage of the IV regression in Table 6, Columns 1 and 2. We find that the likelihood of a supply shortage *decreases* by about 0.3% for every percentage point increase in passive ownership, suggesting that passive funds are more stable lenders and increase lendable supply permanently. This is in line with Honkanen (2019), who finds that passive funds do not adjust their positions after lending, whereas active funds start reducing their portfolio weights in stocks that they lend.

When equity loans are recalled, short sellers have to find a new lender or buy back the stock. If they are unable to do so,, they will trigger a fail to deliver. Therefore, if passive ownership provides more reliable supply, we would expect a decrease in the fraction of shorts that fail to deliver. We use *Delivery failure* as the dependent variable in Columns 3 and 4 of Table 6. Indeed, we find that the occurrence of delivery failures significantly decreases by about 0.1 percentage points (about 10% relative to its mean) for every percentage point increase in passive ownership. This result further supports our hypothesis that passive funds are more stable lenders than active funds.

6. Information Efficiency

In this section, we test whether passive ownership-induced short selling improves the information efficiency of the stock market. Our measure for information efficiency is the price jump ratio (Weller (2018)), which captures the fraction of the return associated with a positive or negative earnings surprise that is priced in on the earnings announcement date compared to before. If passive ownership entices long-horizon short sellers to trade on their private information, we expect more information to find its way into prices prior to the earnings announcement. Hence, we expect the *Price jump ratio* to go down for earnings announcement events with *negative* surprises.

To test this conjecture, we regress in reduced form the price jump ratio on the Russell 2000 index membership dummy, a dummy for a negative earnings announcement, and the interaction of the two, as well as our usual set of controls (which we also interact with the negative announcement dummy). The analysis is at the earnings announcement level (typically once per quarter) since the price jump ratio is calculated for each earnings announcement. Table 7 shows the results. In Columns 1 and 2, the dependent variable is the *Price jump ratio* calculated from 3-factor alphas following Weller (2018). Columns 3 and 4 show results for the *Price jump ratio* calculated from raw returns. In all cases, the coefficient on the interaction between the Russell 2000 dummy and the negative announcement dummy—our coefficient of interest—is negative and statistically significant. It is also economically significant as the price jump ratio declines by 10-13 percentage points (relative to an unconditional median of 46-54 percent). Our results imply that being added to the Russell 2000 increases the share of information that is priced in prior to the actual announcement when the earnings news is negative, but not when it is positive. This is consistent with the idea that passive ownership improves information efficiency by facilitating short selling.

7. Robustness Checks

In this section, we perform a variety of robustness checks. We focus on the second stage IV regressions at the monthly frequency with a 500 firm bandwidth for the following dependent variables: *Lendable supply*, *Short interest, Utilization*, *Average tenure*, and *Delivery failure*. We present the results in Table 8. All control variables are added but not reported for brevity.

In our main specification, we identify our results from the cross-section (because we only include month fixed effects). In Panel A of Table 8, we show as a robustness check that our results remain statistically significant if we add firm fixed effects. Adding firm fixed effects to the specification implies that the identification now comes only from firms that have changed the index.

Next, in Panels B and C, we focus on the variables used for sample selection. In our main specification, we follow Appel et al. (2019) and build the samples based on the float-adjusted market capitalization measure provided by Russell. In Panel B, we instead form samples based on the total market capitalization estimate calculated from Compustat/CRSP data according to the Ben-David et al. (2019) methodology. In Panel C, we instead form samples based on simple CRSP market capitalization. In this case, we also base our control variables on CRSP market capitalization (instead of Compustat/CRSP total market capitalization). In both cases, our results remain statistically and economically significant.

In our main analyses, we show results for samples using a 250 and 500 firm bandwidth around the cut-off. In Panel D, we show that our results remain significant if we use an even smaller bandwidth of 150 stocks. In Panel E and Panel F, we show that our results are unchanged if we use one more or one less polynomial to control for market capitalization.

Finally, in Panel G, we use a different measure of short selling activity. In our main specification, we measure shorting as the fraction of shares that are on loan according to the IHS Markit data. In Panel G, we instead use a measure of short selling based on short interest data provided by the stock exchanges (as reported in Compustat). The result confirms our earlier finding and is very similar in magnitude: short selling increases by about 0.6 to 1 percent for evert percentage point increase in passive ownership.

8. Conclusion

Exploiting Russell 1000/2000 index reconstitution events, this paper studies the causal effects of passive ownership on equity lending and short selling. We find that passive ownership leads to an increase in both the lendable supply *and* the demand for short selling. This latter demand increase does not come from ETF arbitrage, but rather seems to be driven by a higher *quality* of lendable supply. Indeed, we find that higher passive ownership is associated with a longer maturity of equity loans, as well as with a reduction in the number of supply shortages and delivery failures. Finally, we show that passive ownership-induced short selling improves the information efficiency of stock prices around negative news events.

An important takeaway of our study is that not all lending supply is created equal. Passive owners do not only supply a larger fraction of their portfolios for equity lending, but—due to them being stable and long-term shareholders—they also lower operational risks to short sellers (e.g., by being less likely to recall loaned shares). Together, these two factors increase the propensity to short and contribute to market quality by making negative information be incorporated into prices faster.

We believe our results are important for understanding the channels through which passive ownership may affect diverse topics such as corporate governance, investment, innovation, mergers, and/or payout policy. Indeed, the short selling literature usually identifies short sellers as an informed group of investors with the power to influence corporate actions (e.g., through activist campaigns).[10] Hence, despite of themselves being passive and possibly less engaged shareholders, passive owners matter indirectly for corporate policy by facilitating short selling. Future research on the impact of passive investors on financial markets and corporate activity should take this indirect effect into account. Moreover, policymakers ought to be aware of the complementarity between ownership structure and the equity lending market.

[10] See, for example, Boehmer et al. (2008), Christophe et al. (2010), and Appel and Fos (2020).

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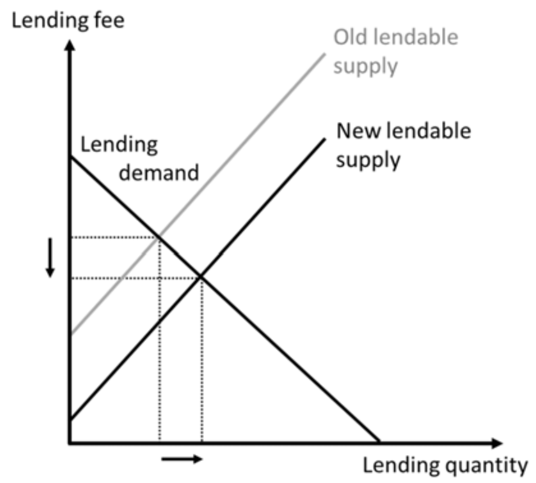
Figure 1: Illustration of Demand and Supply Shifts in the Securities Lending Market

Panel A shows the equilibrium implications that are expected when an increase in passive ownership leads only to a shift in lendable supply. As the supply curve for lendable shares shifts down, the new equilibrium in the securities lending market features a lower lending fee and an increase in lending quantity (also called short interest). Panel B shows the equilibrium implications that are expected when the increase in passive ownership leads to a simultaneous demand and supply shift in the securities lending market. As the supply curve for lendable shares shifts down and the demand curve shifts up, the new equilibrium in the securities lending market features an increase lending quantity, but the lending fee remains unchanged.

Panel A: Only supply shift



Panel B: Simultaneous supply and demand shift

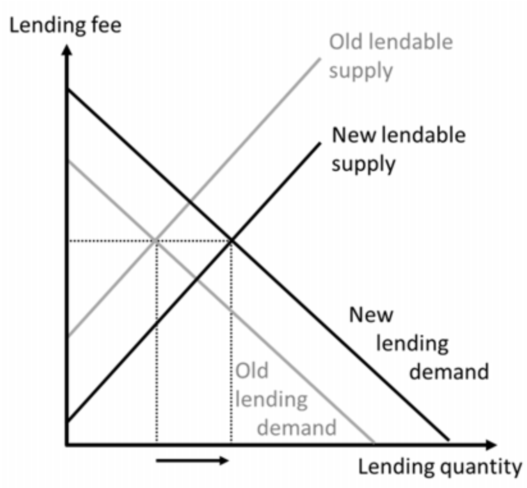


Figure 2: Changes after moving to Russell 1000 / Russell 2000

This figure shows changes to passive ownership after a stock switches between the Russell 1000 and Russell 2000 index. In blue, we show the average passive ownership for stocks that moved (up) from the Russell 2000 to the Russell 1000. In orange, we show the same for stocks that moved (down) from the Russell 1000 to the Russell 2000. In both cases, we display 4 quarters before and after the index change.

Passive Ownership

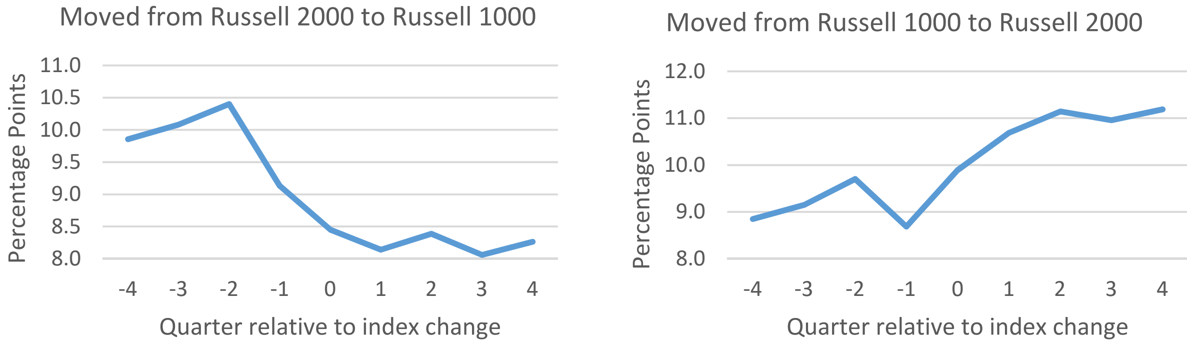
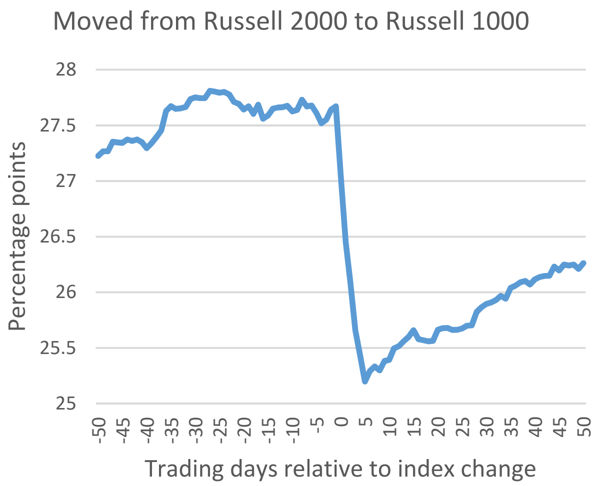
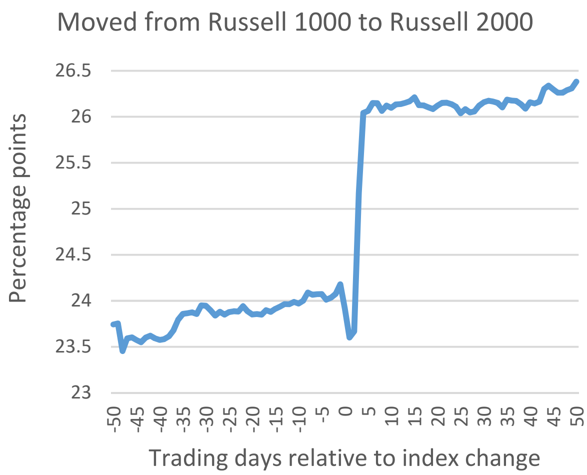


Figure 3: Changes after moving to Russell 1000 / Russell 2000

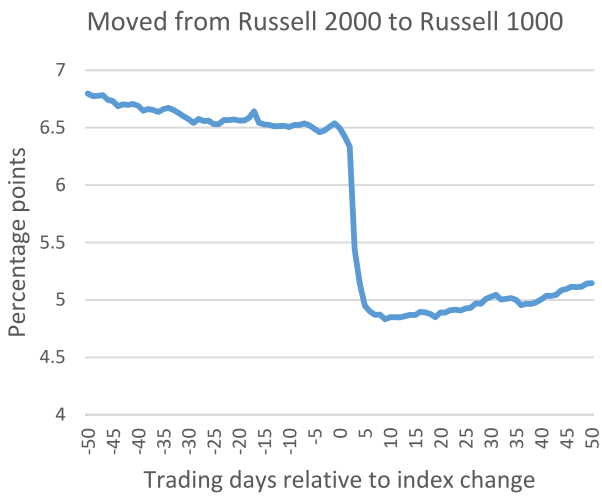
This figure shows changes to lendable supply and short selling after a stock switches between the Russell 1000 and Russell 2000 index. On the left, we show the average lendable supply and short interest for stocks that moved (up) from the Russell 2000 to the Russell 1000. On the right, we show the same for stocks that moved (down) from the Russell 1000 to the Russell 2000. In both cases, we display 50 trading days before and after the index change.

Panel A: Lendable supply





Panel B: Short interest (equity loans)



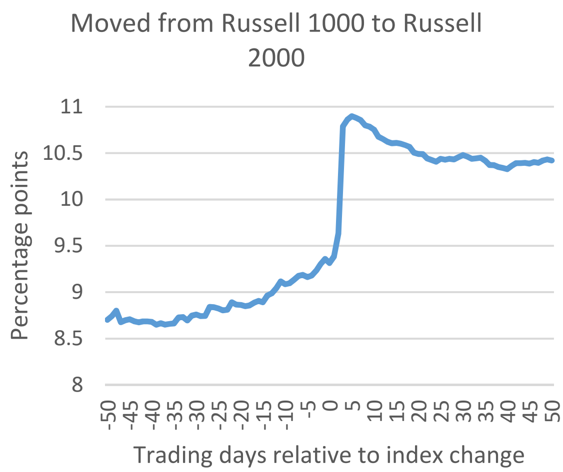


Table 1: Summary statistics

This table displays monthly summary statistics for our two samples. In Panel A, we display the summary statistics for the smaller sample of +/- 250 companies around the cut-off, while it is +/- 500 companies in Panel B. *Passive*, *Active*, and *Fund ownership* is the percent of shares outstanding held by the respective funds. Some funds are not classified as either active or passive. Lendable supply is the fraction of shares that are available to be lent out by equity lenders. *Short interest (equity loans)* is the average fraction of shares that are lent out. *Short interest (Compustat)* is the fraction of shares in outstanding short positions from bi-weekly short interest data. *Utilization* is the fraction of lendable supply that is lent out. *Lending fee* is the value-weighted average fee that equity borrowers pay to borrow the stock. *Average tenure* is the average number of days that an equity loan has been open. *Fraction of loans with tenure above 30 days* is the fraction of outstanding equity loan volume with a tenure above 30 days. *Probability of supply shortage* is the fraction days where lendable supply is below 2% of shares outstanding. *Delivery failure* is the number of shares that were not delivered divided by number of shares that were shorted. *Price jump ratio (alpha)* is defined as $\frac{Alpha_{t-1,t+2}}{Alpha_{t-21,t+2}}$ and *Price jump ratio (return)* is defined as $\frac{Return_{t-1,t+2}}{Return_{t-21,t+2}}$, where these are returns around earnings announcements.

Panel A: sample +/- 250 companies around cut-off

Variable	Mean	10th Percentile	Median	90th Percentile	Standard Deviation
Passive ownership (%)	10.7	3.33	10.2	18.8	5.82
Active ownership (%)	21.4	6.75	21.6	35.1	10.4
Fund ownership (%)	36.3	16.1	38.5	52.4	13.9
Lendable supply (%)	27.4	14.2	28.3	38.9	9.53
Short interest (equity loans) (%)	6.14	0.58	4.06	15.0	6.09
Short interest (Compustat) (%)	7.02	1.48	5.30	14.9	5.84
Utilization (%)	11.2	0.83	6.98	28.1	12.3
Lending fee (bp)	28.0	1.98	8.95	23.4	120.7
Average tenure (days)	68.5	29.5	62.0	114.8	36.1
Fraction of loans with tenure above 30 days (%)	51.3	23.1	54.0	74.2	19.2
Probability of supply shortage (%)	0.48	0.019	0.11	0.97	1.34
Delivery failure (%)	0.22	0	0	0	4.60
Price jump ratio (alpha) (%)	54.4	-1.39	54.0	109.4	46.1
Price jump ratio (return) (%)	46.5	-5.48	45.7	99.7	43.1
Observations	72368				

Panel B: sample +/- 500 companies around cut-off

Variable	Mean	10th Percentile	Median	90th Percentile	Standard Deviation
Passive ownership (%)	10.9	3.97	10.3	18.8	5.71
Active ownership (%)	21.3	7.31	21.3	34.7	10.2
Fund ownership (%)	36.6	18.3	38.3	52.1	13.3
Lendable supply (%)	27.9	16.3	28.4	38.9	8.84
Short interest (equity loans) (%)	5.96	0.57	3.81	14.8	6.06
Short interest (Compustat) (%)	6.86	1.50	5.06	14.8	5.83
Utilization (%)	10.7	0.72	6.49	26.9	12.0
Lending fee (bp)	25.5	1.46	8.82	21.3	113.6
Average tenure (days)	68.8	29.3	61.7	116.5	37.3
Fraction of loans with tenure above 30 days (%)	50.8	22.1	53.6	74.3	19.5
Probability of supply shortage (%)	0.47	0.019	0.11	0.96	1.34
Delivery failure (%)	0.11	0	0	0	3.28
Price jump ratio (alpha) (%)	54.5	-0.87	54.2	109.2	46.3
Price jump ratio (return) (%)	46.8	-4.46	45.9	100	43.5
Observations	144602				

Table 2: Passive ownership increases lendable supply

This table displays an instrumental variable regression where passive ownership is instrumented by membership of the Russell 2000 index. In Columns 1 and 2, we display the first stage, in which we regress passive ownership on an indicator whether a firm is member of the Russell 2000 index. In Columns 3 and 4, we display the second stage of regressing lendable supply on passive ownership (instrumented). Lendable supply is the percent of shares outstanding made available to be lent out by equity lenders. In all regressions, we control for a third polynomial of log-market cap measured at the end of (previous) May, the logarithm of float-adjusted market cap as of the end of June, and the following banding controls: D(banded), an indicator for having an end-of-May market cap sufficiently close to the cutoff such that the firm will not switch indexes, D($Russel\ 2000_{last\ May}$), an indicator whether the firm was in the Russell 2000 index at the end of last May (and thus over the course of the previous year), and their interaction. The sample consist of either the top 250 or 500 stocks in the Russell 2000 index and the bottom 250 or 500 stocks in the Russell 1000 index. The regressions are run on monthly data from 2006 to 2018. We include month fixed effects. Details on variable constructions can be found in Appendix A. All standard errors are two-way clustered by stock and month. We report t-statistics below the coefficients in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% level.

	First stage		Second stage	
Dependent variable:	Passive ownership (%)		Lendable supply (%)	
	(1)	(2)	(3)	(4)
D(Russell 2000)	1.824***	1.858***		
	(7.04)	(8.36)		
Passive ownership (%)			1.441***	1.153***
			(4.94)	(5.08)
Float-adjusted market cap	4.316***	5.002***	5.101***	6.948***
	(13.60)	(17.25)	(3.77)	(5.82)
D(banded)	0.161	-0.133	1.307***	0.909***
	(0.75)	(-0.71)	(3.06)	(2.72)
D($Russel\ 2000_{last\ May}$)	0.312	0.225	1.311***	1.293***
	(1.27)	(1.17)	(2.85)	(4.23)
D($Russel\ 2000_{last\ May}$)* D(banded)	-0.026	-0.174	-0.853	-0.561
	(-0.08)	(-0.69)	(-1.39)	(-1.32)
Observations	64727	129337	64727	129337
Adjusted R^2	0.537	0.506	0.401	0.392
F-Statistic	78.3	91.4		
Month fixed effects	Yes	Yes	Yes	Yes
Polynomial order of market cap	3	3	3	3
Number of firms around threshold	250	500	250	500

Table 3: Passive ownership effect on short selling

This table displays an instrumental variable regression where passive ownership is instrumented by membership of the Russell 2000 index. In Columns 1 and 2, the dependent variable is the percent of shares outstanding that are lent out in the equity lending market (the main reason to borrow equities is to conduct short selling). In Columns 3 and 4, the dependent variable is Utilization, which measures the fraction of lendable supply that is lent out. In Columns 5 and 6, the dependent variables is the lending fee measured in basis points per year. In all regressions, we control for a third polynomial of log-market cap measured at the end of (previous) May, the logarithm of float-adjusted market cap as of the end of June, and the following banding controls: D(banded), an indicator for having an end-of-May market cap sufficiently close to the cutoff such that the firm will not switch indexes, D($Russel\ 2000_{last\ May}$), an indicator whether the firm was in the Russell 2000 index at the end of last May (and thus over the course of the previous year), and their interaction. The sample consist of either the top 250 or 500 stocks in the Russell 2000 index and the bottom 250 or 500 stocks in the Russell 1000 index. The regressions are run on monthly data from 2006 to 2018. We include month fixed effects. Details on variable constructions can be found in Appendix A. All standard errors are two-way clustered by stock and month. We report t-statistics below the coefficients in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% level.

	Second stage					
Dependent variable:	Short interest (equity loans) (%)		Utilization (%)		Lending fee (bp)	
	(1)	(2)	(3)	(4)	(5)	(6)
Passive ownership (%)	0.649***	0.908***	0.662	1.170***	2.507	7.544*
	(2.76)	(4.37)	(1.40)	(2.92)	(0.60)	(1.92)
Float-adjusted market cap	-1.842*	-3.819***	-6.229***	-9.970***	-47.942**	-78.098***
	(-1.69)	(-3.51)	(-2.72)	(-4.57)	(-2.16)	(-3.28)
D(banded)	-0.311	0.256	-0.493	0.677	-0.828	1.675
	(-0.93)	(0.82)	(-0.76)	(1.23)	(-0.15)	(0.37)
D($Russel\ 2000_{last\ May}$)	-0.704	-0.877**	-1.555*	-1.651***	-15.074*	-23.687***
	(-1.58)	(-2.52)	(-1.85)	(-2.85)	(-1.74)	(-3.94)
D($Russel\ 2000_{last\ May}$)* D(banded)	0.311	0.358	0.224	0.143	2.921	6.064
	(0.64)	(0.87)	(0.25)	(0.20)	(0.38)	(0.95)
Observations	64724	129332	64724	129332	64724	129332
Adjusted R^2	-0.081	-0.239	0.152	0.045	0.001	-0.087
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Polynomial order of market cap	3	3	3	3	3	3
Number of firms around threshold	250	500	250	500	250	500

Table 4: ETF arbitrage

This table examines if ETF arbitrage can explain the increased shorting in stocks of the Russell 2000 index. We display daily regressions of shorting, measured using the amount of outstanding equity loans, on an interaction between *D(Russell 2000)* and *ETF overvalued*. D(Russell 2000) is an indicator variable equal to one if the stock is in the Russell 2000 index. *ETF overvalued* is the average of overvaluations in the ETFs that hold the specific stock. In all regressions, we control for a third polynomial of log-market cap measured at the end of (previous) May, the logarithm of float-adjusted market cap as of the end of June, and the following banding controls: D(banded), an indicator for having an end-of-May market cap sufficiently close to the cutoff such that the firm will not switch indexes, D($Russel\ 2000_{last\ May}$), an indicator whether the firm was in the Russell 2000 index at the end of last May (and thus over the course of the previous year), and their interaction. In addition, we interact all of these variables with *ETF overvalued*. The sample consist of either the top 250 or 500 stocks in the Russell 2000 index and the bottom 250 or 500 stocks in the Russell 1000 index. The regressions are run on daily data from 2006 to 2018. We include month fixed effects. Details on variable constructions can be found in Appendix A. All standard errors are two-way clustered by stock and month. We report t-statistics below the coefficients in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% level.

	Reduced form regression	
Dependent variable:	Short interest (equity loans) (%)	
	(1)	(2)
D(Russell 2000) * ETF undervalued	0.121	0.216
	(0.92)	(1.54)
D(Russell 2000)	1.218***	1.576***
	(3.17)	(4.71)
ETF undervalued	-99.061**	-32.623
	(-2.19)	(-1.15)
Observations	1341691	2677852
Adjusted R^2	0.120	0.075
Month fixed effects	Yes	Yes
Banding and market cap controls	Yes	Yes
Banding and market cap controls interacted with ETF undervalued	Yes	Yes
Polynomial order of market cap	3	3
Number of firms around threshold	250	500

Table 5: Passive ownership effect on tenure

This table displays an instrumental variable regression where passive ownership is instrumented by membership of the Russell 2000 index. In Columns 1 and 2, the dependent variable is the lending fee measured in basis points per year. In Columns 3 and 4, the dependent variable is the average tenure that the equity loans in that stock have been open, measured in log of days. In Columns 5 and 6, the dependent variable is the fraction of equity loans with a tenure above 30 days, measured in percent. In all regressions, we control for a third polynomial of log-market cap measured at the end of (previous) May, the logarithm of float-adjusted market cap as of the end of June, and the following banding controls: D(banded), an indicator for having an end-of-May market cap sufficiently close to the cutoff such that the firm will not switch indexes, D($Russel\ 2000_{last\ May}$), an indicator whether the firm was in the Russell 2000 index at the end of last May (and thus over the course of the previous year), and their interaction. The sample consist of either the top 250 or 500 stocks in the Russell 2000 index and the bottom 250 or 500 stocks in the Russell 1000 index. The regressions are run on monthly data from 2006 to 2018. We include month fixed effects. Details on variable constructions can be found in Appendix A. All standard errors are two-way clustered by stock and month. We report t-statistics below the coefficients in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% level.

	Second stage			
Dependent variable:	Average tenure (log)		Fraction of loans with tenure above 30 days (%)	
	(1)	(2)	(3)	(4)
Passive ownership (%)	0.063***	0.077***	2.597***	2.628***
	(3.38)	(4.73)	(4.03)	(4.97)
Float-adjusted market cap	-0.245***	-0.360***	-11.359***	-13.826***
	(-2.84)	(-4.33)	(-3.77)	(-5.06)
D(banded)	0.016	0.047*	-0.254	1.561*
	(0.52)	(1.77)	(-0.25)	(1.82)
D($Russel\ 2000_{last\ May}$)	0.050	0.046*	0.777	1.562**
	(1.43)	(1.93)	(0.67)	(2.03)
D($Russel\ 2000_{last\ May}$)* D(banded)	-0.026	-0.027	-0.589	-0.679
	(-0.63)	(-0.81)	(-0.41)	(-0.64)
Observations	64724	129332	64724	129332
Adjusted R^2	-0.081	-0.158	-0.197	-0.173
Month fixed effects	Yes	Yes	Yes	Yes
Polynomial order of market cap	3	3	3	3
Number of firms around threshold	250	500	250	500

Table 6: Passive ownership effect on supply shortages and delivery failures

This table displays an instrumental variable regression where passive ownership is instrumented by membership of the Russell 2000 index. In Regressions 1 and 2, the dependent variable is *Probability of supply shortage*, which is equal to 100% when the lendable supply is below 2% of shares outstanding and 0% otherwise. In Regressions 3 and 4, the dependent variable is *Delivery failure*, which is the number of shares that were not delivered divided by number of shares that were shorted. In all regressions, we control for a third polynomial of log-market cap measured at the end of (previous) May, the logarithm of float-adjusted market cap as of the end of June, and the following banding controls: D(banded), an indicator for having an end-of-May market cap sufficiently close to the cutoff such that the firm will not switch indexes, D($Russel\ 2000_{last\ May}$), an indicator whether the firm was in the Russell 2000 index at the end of last May (and thus over the course of the previous year), and their interaction. The sample consist of either the top 250 or 500 stocks in the Russell 2000 index and the bottom 250 or 500 stocks in the Russell 1000 index. The regressions are run on monthly data from 2006 to 2018. We include month fixed effects. Details on variable constructions can be found in Appendix A. All standard errors are two-way clustered by stock and month. We report t-statistics below the coefficients in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% level.

	Second stage			
Dependent variable:	Probability of supply shortage (%)		Delivery failure (%)	
	(1)	(2)	(3)	(4)
Passive ownership (%)	-0.261*	-0.275**	-0.144***	-0.132***
	(-1.79)	(-2.00)	(-3.45)	(-3.86)
Float-adjusted market cap	-0.922	-0.428	0.422**	0.458***
	(-0.66)	(-0.77)	(2.20)	(2.68)
D(banded)	0.013	-0.305*	-0.037	-0.103**
	(0.07)	(-1.87)	(-0.64)	(-2.23)
D($Russel\ 2000_{last\ May}$)	0.343	0.075	0.009	-0.070
	(0.74)	(0.53)	(0.13)	(-1.54)
D($Russel\ 2000_{last\ May}$)* D(banded)	0.160	0.355*	0.088	0.113*
	(0.48)	(1.98)	(1.14)	(1.95)
Observations	64727	129337	61112	122197
Adjusted R^2	0.054	-0.070	-0.000	0.015
Month fixed effects	Yes	Yes	Yes	Yes
Polynomial order of market cap	3	3	3	3
Number of firms around threshold	250	500	250	500

Table 7: Passive ownership effect on information efficiency

This table examines whether information efficiency is higher for negative earnings announcements if a stock is in the Russell 2000 (our instrument for passive ownership). We display the results of earnings announcement-level regressions, where the dependent variable is the *Price jump ratio* (Weller (2018)) and the explanatory variable of interest is the interaction between *D(Russell 2000)* and *D(Negative Announcement)*. In regressions 1 and 2, the price jump ratio is defined as in Weller (2018) as $\frac{Alpha_{t-1,t+2}}{Alpha_{t-21,t+2}}$, where Alpha is the 3-factor Fama French (1993) alpha in days around the earnings announcement. In regressions 3 and 4, the price jump ratio is based on raw returns instead. *D(Negative Announcement)* is a dummy variable equal to one when the cumulative announcement alpha or return from t-21 to t+2 is negative. *D(Russell 2000)* is an indicator variable equal to one if the stock is in the Russell 2000 index. In all regressions, we control for a third polynomial of log-market cap measured at the end of (previous) May, the logarithm of float-adjusted market cap as of the end of June, and the following banding controls: *D(banded),* an indicator for having an end-of-May market cap sufficiently close to the cutoff such that the firm will not switch indexes, *D*($Russel\ 2000_{last\ May}$), an indicator whether the firm was in the Russell 2000 index at the end of last May (and thus over the course of the previous year). In addition, we include all these variables interacted with *D(Negative Announcement)*. Following Weller (2018), we only include earnings announcements if the absolute value of the cumulative announcement alpha or return from t-21 to t+2 is larger than $\sqrt{24}$ times the variance of the daily alpha from t-50 to t-22. The sample consist of either the top 250 or 500 stocks in the Russell 2000 index and the bottom 250 or 500 stocks in the Russell 1000 index. We include month fixed effects. Details on variable constructions can be found in Appendix A. All standard errors are two-way clustered by stock and month. We report t-statistics below the coefficients in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% level.

	Reduced Form Regression			
Dependent variable:	Price jump ratio (Alpha) (%)		Price jump ratio (Return) (%)	
	(1)	(2)	(3)	(4)
D(Russell 2000)* D(Negative Announcement)	-13.288***	-10.360**	-11.629**	-10.514*
	(-3.06)	(-2.61)	(-2.42)	(-1.97)
D(Russell 2000)	5.588*	2.642	6.620**	3.976
	(1.77)	(1.00)	(2.19)	(1.43)
D(Negative Announcement)	-603.998	237.282	-1529.127	-112.161
	(-0.44)	(0.31)	(-1.05)	(-0.13)
Observations	8187	16519	7423	14932
Adjusted R^2	0.029	0.026	0.070	0.067
Month fixed effects	Yes	Yes	Yes	Yes
Banding and market cap controls	Yes	Yes	Yes	Yes
Banding and market cap controls interacted with D(Negative Announcement)	Yes	Yes	Yes	Yes
Number of firms around threshold	250	500	250	500

Table 8: Robustness checks

This table displays robustness checks to our main results. We show the second stage of instrumental variable regression where passive ownership is instrumented by membership of the Russell 2000 index. In Panel A, we add firm fixed effects to our baseline regression. In Panel B, we form our sample based on the ranking of our CRSP/Compustat market capitalization variable rather than on float-adjusted market capitalization provided by Russell. In Panel C, we form our sample based on market capitalization using only information from CRSP. Similarly, all market cap control variables (and banding controls) are based only on CRSP market capitalization. In Panel D, we rerun our main specification on a smaller sample with a bandwidth of just 150 companies in each direction around the threshold. Finally, in Panel E, we show a robustness check for our short selling results in which we proxy for short selling using short interest data rather than equity lending data. All regressions are run on monthly data from 2006 to 2018. Details on variable constructions can be found in Appendix A. All standard errors are two-way clustered by stock and month. We report t-statistics below the coefficients in parenthesis. ***, **, * indicate significance at the 1%, 5% and 10% level.

Panel A: Adding Firm Fixed Effects

	Second stage				
Dependent variable	Lendable supply (%)	Short interest (equity loans) (%)	Utilization (%)	Average tenure (log)	Delivery failure (%)
	(1)	(2)	(3)	(4)	(5)
Passive ownership (%)	1.348***	0.998***	1.081**	0.048**	-0.157***
	(5.67)	(4.33)	(2.41)	(2.49)	(-3.73)
Observations	129337	129332	129332	129332	122197
Month fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Banding controls	Yes	Yes	Yes	Yes	Yes
Polynomial order of market cap	3	3	3	3	3
Number of firms around threshold	500	500	500	500	500

Panel B: Sampling based on CRSP/Compustat market cap

	Second stage				
Dependent variable	Lendable supply (%)	Short interest (equity loans) (%)	Utilization (%)	Average tenure (log)	Delivery failure (%)
	(1)	(2)	(3)	(4)	(5)
Passive ownership (%)	1.254***	0.706***	0.985**	0.054***	-0.117***
	(4.46)	(3.10)	(2.00)	(2.78)	(-2.94)
Observations	129618	129613	129613	129613	122543
Month fixed effects	Yes	Yes	Yes	Yes	Yes
Banding controls	Yes	Yes	Yes	Yes	Yes
Polynomial order of market cap	3	3	3	3	3
Number of firms around threshold	500	500	500	500	500

Panel C: Sampling and control variables only based on CRSP market cap

	Second stage				
Dependent variable	Lendable supply (%)	Short interest (equity loans) (%)	Utilization (%)	Average tenure (log)	Delivery failure (%)
	(1)	(2)	(3)	(4)	(5)
Passive ownership (%)	1.196***	0.533***	0.762**	0.042***	-0.111***
	(7.08)	(3.51)	(2.42)	(3.42)	(-4.03)
Observations	129754	129749	129749	129749	122663
Month fixed effects	Yes	Yes	Yes	Yes	Yes
Banding controls	Yes	Yes	Yes	Yes	Yes
Polynomial order of market cap	3	3	3	3	3
Number of firms around threshold	500	500	500	500	500

Panel D: Smaller sample (bandwidth of 150 firms around threshold)

	Second stage				
Dependent variable	Lendable supply (%)	Short interest (equity loans) (%)	Utilization (%)	Average tenure (log)	Delivery failure (%)
	(1)	(2)	(3)	(4)	(5)
Passive ownership (%)	1.573***	1.097***	1.181*	0.063***	-0.153***
	(4.29)	(3.03)	(1.79)	(2.88)	(-2.69)
Observations	38668	38665	38665	38665	36569
Month fixed effects	Yes	Yes	Yes	Yes	Yes
Banding controls	Yes	Yes	Yes	Yes	Yes
Polynomial order of market cap	3	3	3	3	3
Number of firms around threshold	150	150	150	150	150

Panel E: Use only 2nd degree polynomial to control for market capitalization

	Second stage				
Dependent variable	Lendable supply (%)	Short interest (equity loans) (%)	Utilization (%)	Average tenure (log)	Delivery failure (%)
	(1)	(2)	(3)	(4)	(5)
Passive ownership (%)	1.453***	1.215***	1.208**	0.066***	-0.173***
	(5.63)	(4.76)	(2.58)	(3.21)	(-3.80)
Observations	129337	129332	129332	129332	122197
Month fixed effects	Yes	Yes	Yes	Yes	Yes
Banding controls	Yes	Yes	Yes	Yes	Yes
Polynomial order of market cap	2	2	2	2	2
Number of firms around threshold	500	500	500	500	500

Panel F: Use 4th degree polynomial to control for market capitalization

	Second stage				
Dependent variable	Lendable supply (%)	Short interest (equity loans) (%)	Utilization (%)	Average tenure (log)	Delivery failure (%)
	(1)	(2)	(3)	(4)	(5)
Passive ownership (%)	1.289***	0.957***	0.987**	0.041**	-0.151***
	(5.60)	(4.24)	(2.25)	(2.20)	(-3.70)
Observations	129337	129332	129332	129332	122197
Month fixed effects	Yes	Yes	Yes	Yes	Yes
Banding controls	Yes	Yes	Yes	Yes	Yes
Polynomial order of market cap	4	4	4	4	4
Number of firms around threshold	500	500	500	500	500

Panel G: Short interest based on Compustat data

	Second stage	
Dependent variable	Short interest (Compustat) (%)	
	(1)	(2)
Passive ownership (%)	0.646***	0.973***
	(6.89)	(11.64)
Observations	25703	25703
Month fixed effects	Yes	Yes
Banding controls	Yes	Yes
Polynomial order of market cap	3	3
Number of firms around threshold	250	500

Appendix A: Variable definitions

This table displays the variable definitions for all variables used in the regressions. All continuous variables are winsorized at the 1% level on both sides.

Variable Name	Definition
D(Russell 2000)	Dummy variable equal to one if the stock is in the Russell 2000 index in the specific month and equal to zero if the stock is in the Russell 1000 index (missing if the stock is in neither index).
Passive ownership (%)	Percentage of shares outstanding held by passive investors. To determine the fraction of passive ownership, we follow Appel, Gormley, Keim (2016). Specifically, we obtain fund names by merging the Thomson Reuters data with CRSP mutual fund data using the MFLINKS table available on WRDS. We then flag a fund as passively managed if its marked as an index fund in the CRSP Mutual Fund database or if the fund name includes one of the following strings that identify it as an index fund: Index, Idx, Indx, Ind_ (where _ indicates a space), Russell, S & P, S and P, S&P, SandP, SP, DOW, Dow, DJ, MSCI, Bloomberg, KBW, NASDAQ, NYSE, STOXX, FTSE, Wilshire, Morningstar, 100, 400, 500, 600, 900, 1000, 1500, 2000, and 5000. (The comparison is case sensitive).
Float-adjusted market cap	The natural logarithm of the float-adjusted market cap as of the end of last June as provided by Russell.
D(banded)	Dummy variable equal to one if a stock has an end-of-May market cap sufficiently close to the cut-off such that the firm will not switch indexes. To determine whether a firm is banded, we compute the total market capitalization of the Russell 3000 index and sort all firms in that index by market capitalization. We then compute the market capitalization percentiles for each firm (for example, if a firm has a 75 percentile, it means that firms larger than it make up 75% of the market capitalization of the Russell 3000 index). A firm is banded if its percentile is less than 2.5 percentage points different from the percentile of the 1000th stock. This approach follows the instructions by Russell and as we show in Appendix D, it is fairly predictive of actually realized index changes. Our data includes 2006, where Russell was not yet implementing banding. To be consistent, we nonetheless include the same banding controls in 2006. This should only lower the power of the test and not lead to any bias.
D(Russell $2000_{last\ May}$)	Dummy variable equal to one if the stock was in the Russell 2000 index in the previous May (and thus over the course of the previous year).
Lendable supply (%)	Monthly average of number of shares available to be lent in markit (sometimes referred to as "inventory") divided by shares outstanding from CRSP. Shares that are actually lent out are included in this measure.
Short interest (equity loans) (%)	Monthly average of number of shares lent out provided by markit (sometimes referred to as "demand") divided by shares outstanding from CRSP.
Short interest (Compustat) (%)	Monthly average of number of shares sold short according to short interest data from Compustat divided by shares outstanding from CRSP.
Utilization (%)	Monthly average of shares lent out divided by shares available to lent out as provided by markit. To avoid double counting, shares lent out only includes the case where markit received the data from the equity lender (rather than the borrower).
Lending fee (bp)	Monthly average of the daily value-weighted average fee for borrowing the specific security (provided by markit).
Average tenure (log)	The natural logarithm of the monthly average of the number of days that equity loans in this stock have been open.
Fraction of loans with tenure above 30 days (%)	Monthly average of the fraction of equity loan volume that has a tenure above 30 days.
Probability of supply shortage (%)	Fraction of days within the month where *Lendable supply* was below 2% of shares outstanding.
Delivery failure (%)	Number of shares that were not delivered divided by number of shares that were lent out as reported in markit. Fails to deliver (FTD) balances are obtained from the SEC website (https://www.sec.gov/data/foiadocsfailsdatahtm), and are available daily from February 2004 onwards for stocks with an outstanding balance of FTDs of 10,000 shares or more. From September 16, 2008 the balance is available for all stocks with one or more shares that have failed to deliver.
D(ETF overvalued)	For each ETF, we compute the mispricing as the difference between the price (from CRSP security files) and the NAV (from CRSP mutual fund data). For each stock, we then compute the weighted average mispricing of ETFs holding the specific stock, where the weight is the number of shares that the ETF holds. D(ETF overvalued) is equal to 1 if this average mispricing is positive and 0 if it is negative.
Price jump ratio (Alpha)	$\frac{Alpha_{t-1,t+2}}{Alpha_{t-21,t+2}}$, where Alpha is the 3-factor Fama French (1993) alpha in (calendar) days around the earnings announcement. This variable is set to missing if: $\lvert Alpha_{t-21,t+2}\rvert > \sqrt{24} * \hat{\sigma}_{past\ month}$, where $\hat{\sigma}_{past\ month}$ is the standard deviation of alphas in the prior month.
Price jump ratio (Return)	$$\frac{Return_{t-1,t+2}}{Return_{t-21,t+2}}$$ This variable is set to missing if: $\lvert Return_{t-21,t+2}\rvert > \sqrt{24} * \hat{\sigma}_{past\ month}$, where $\hat{\sigma}_{past\ month}$ is the standard deviation of returns in the prior month.

Appendix B: Methodology to compute market cap

Russell assigns stocks into the Russell 1000 and 2000 indexes using the (total) market capitalization at the end of May. Unfortunately, this market capitalization is not available. Therefore, we follow Ben-David, Franzoni, and Moussawi (2019) and construct a proxy of this market capitalization from a combination of CRSP and Compustat data. We used the code that they provide in their paper. The following is an abbreviated description of the methodology copied from their paper.

CRSP and Compustat are our main sources of information. We match each Russell constituent to its CRSP PERMNO using historical CUSIP information in CRSP MSENAMES and to Compustat's GVKEY using the CRSP/Compustat Merged Database on WRDS. We rely on the CRSP database for information on reliable prices and shares outstanding for all securities traded on a major exchange (variable PERMNO), as CRSP provides reliable information on these measures for public stocks. We also use CRSP's mapping of the different issues to their company identifier (variable PERMCO), which we employ to compute our proxy for Russell's total market capitalization.

We next turn to Compustat for information on common shares of stocks that are traded over-the-counter (OTC), nonpublicly traded stocks, and securities that are not in CRSP. For companies that have one or more of their share classes listed in OTC markets, and for three companies that are not in the CRSP database,9 we use the Compustat Securities Daily database to aggregate the market capitalization of the multiple issues (variable GVKEY-IID) at the company level (variable GVKEY). For companies that have multiple shares of common stock where one or more of these share classes is closely held and not publicly traded, we use the aggregated shares outstanding variable in Compustat Quarterly for the nearest quarter (variable CSHOQ), which represents the total number of all common shares outstanding at fiscal quarter-end collected from Forms 10-Q and 10-K.

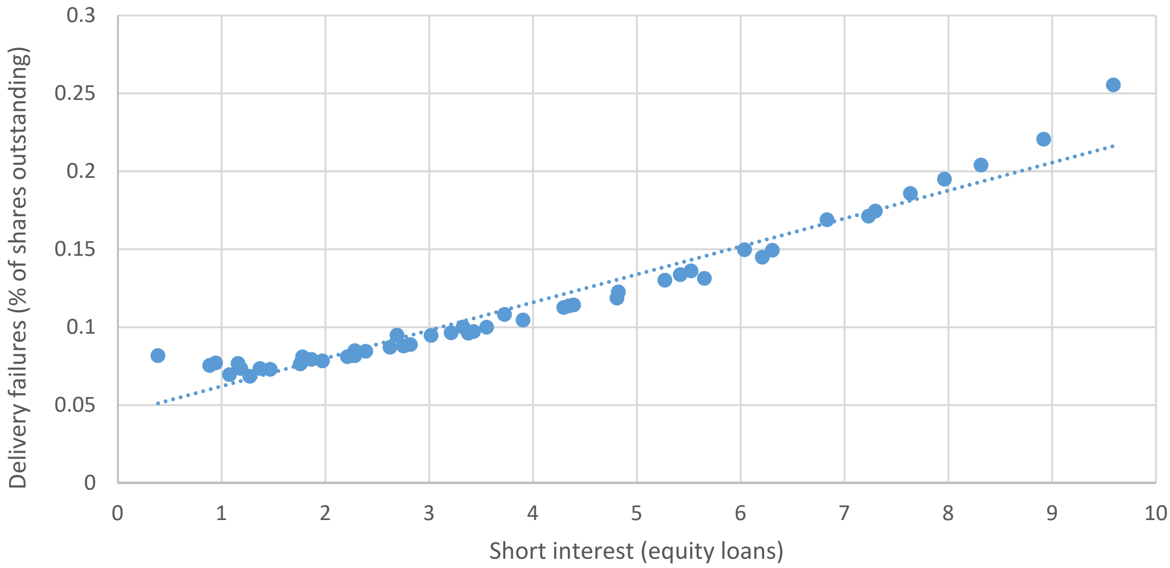
After carving out the proportion of CSHOQ attributable to nontraded share classes, we multiply it by the weighted-by-share-class-size average price of publicly traded share classes to compute the corresponding market capitalization. We then add the market capitalization of the closely held share classes to the market capitalization of the traded share classes computed using Compustat to obtain a second proxy for the total market capitalization used by Russell in ranking stocks.

In sum, we end up with two proxies for total market capitalization at the company level. We rely primarily on the CRSP-based proxy for total market capitalization. We use the Compustat-based proxy for total market capitalization only if it is higher than the CRSP-based figure.

Appendix C: Correlation of delivery failures and shorting

This figure shows a scatterplot that illustrates the correlation between failures to deliver and short selling. For each stock, we split days into 50 groups based on the amount of shorting (equity loans). Then, for each group we compute the average delivery failures, defined as the number of shares that were not delivered (as a percentage of shares outstanding), and the average of shorting, defined as shares lent out (as a percentage of shares outstanding). We then plot these averages for each of the 50 groups into the scatter plot and add a linear trend line.

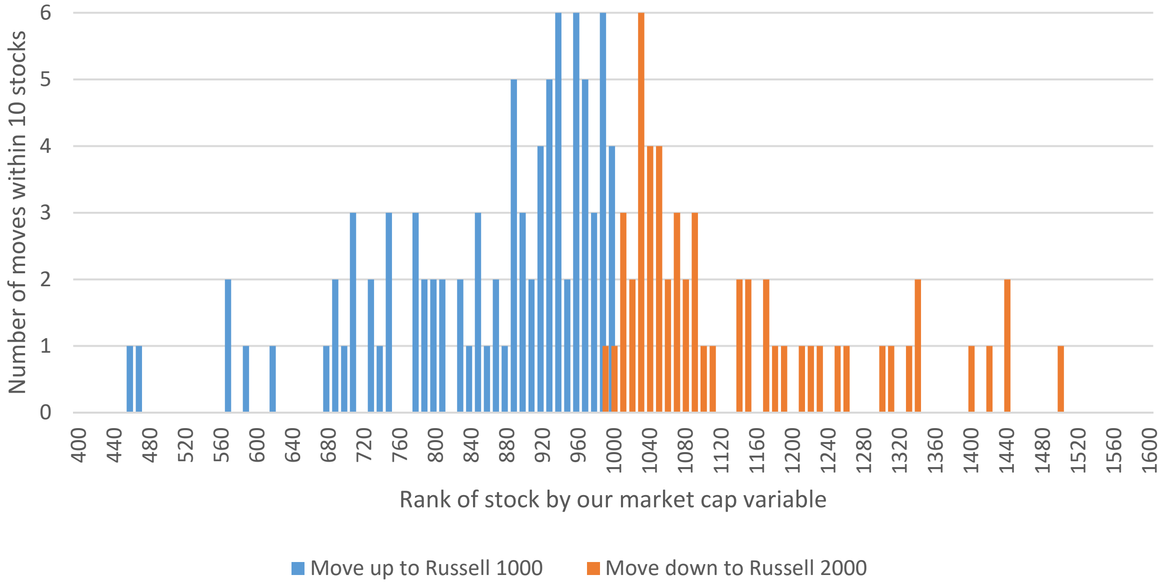
Scatterplot of delivery failures and shorting



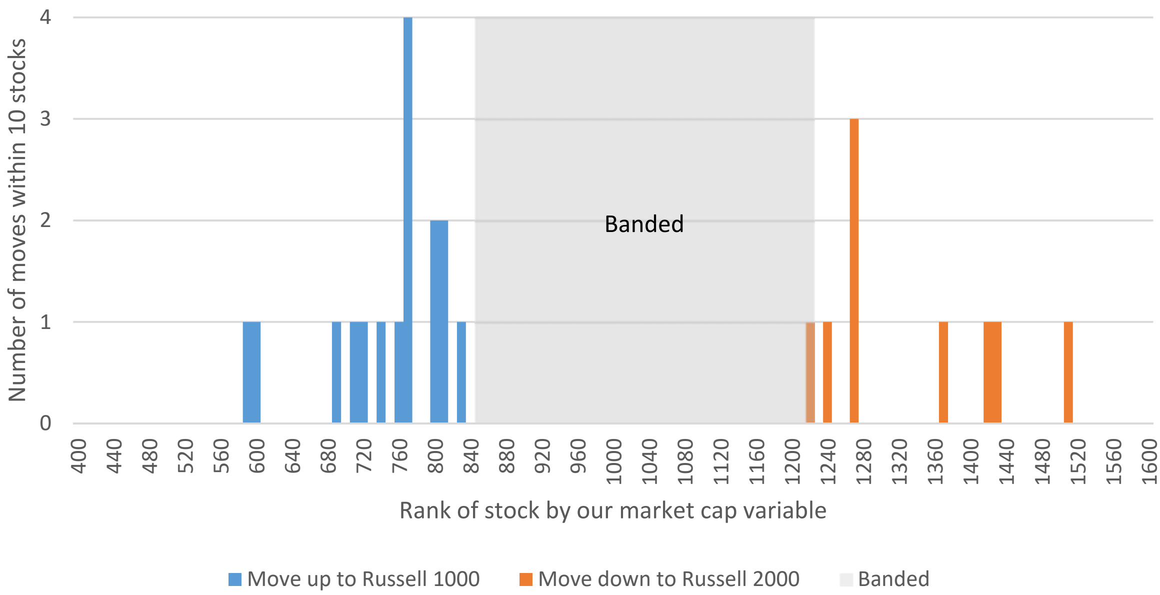
Appendix D: How well we predict the banding policy

In this figure, we display moves between the Russell 1000 and Russell 2000 indexes in 2006 (before banding) and in 2007 (with banding). For this purpose, we sort stocks by our market capitalization variable at the end of May and group them into groups of 10 stocks. We display how many stocks change indexes. In Panel A, there is a clear dividing line around rank 1000, where stocks above it move up (or stay up) and stocks below it move down (or stay down). However, up and down moves overlap a little bit, suggesting that our market capitalization variable may in a few cases be slightly different from the one used by Russell. In Panel B, we shade in grey the area for which we predict stocks to be banded. Indeed, except for one outlier at the margin, these stocks do not change rank, suggesting that our implementation of the banding policy is accurate.

Panel A: Moves between Russell 1000 and Russell 2000 in 2006 (before banding)



Panel B: Moves between Russell 1000 and Russell 2000 in 2007 (with banding)



Appendix E: Methodology to compute 3 factor Fama French (1993) alphas

We obtain the market factor, High-minus-Low Book to Market Factor (HML), and Small-minus-Big (SMB) factor, U.S. 1-month T-bill rate as the risk free rate from Kenneth French's website.

For each earnings announcement, we estimate betas by regressing daily excess returns on these factors over the past 12 months preceding the months before the earnings announcement:

$$r_{c,t} - r_{f,t} = \alpha + \beta_m * (r_{m,t} - r_{f,t}) + \beta_{HML} * HML_t + \beta_{SMB} * SMB_t$$

where $r_{c,t}$ is the daily company return, $r_{m,t}$ is the daily market return and $r_{f,t}$ is the daily risk free rate. As recommended by Levi and Welch (2016), we shrink the resulting beta estimates toward their theoretical average value:

$$\beta_{j,t}^{shrunk} = 0.7 * \beta_{j,t}$$

for $j \in \{ HML, SMB\}$ and

$$\beta_{j,t}^{shrunk} = 0.7 * \beta_{j,t} + 0.3 * 1$$

for the market factor.

Finally, we compute the three factor alpha as:

$$Alpha_{c,t} = r_{c,t} - r_{f,t} - \beta_m * (r_{m,t} - r_{f,t}) - \beta_{HML} * HML_t - \beta_{SMB} * SMB_t$$