PASSIVE ASSET MANAGEMENT, SECURITIES LENDING AND STOCK PRICES

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Abstract

How does the shift to passive investments affect securities prices? We propose and analyze a security lending channel in which passive funds serve as primary providers of lendable shares to make short selling possible. We show that stocks with high level of passive ownership exhibit greater supply of lendable shares which results in larger short positions, lower lending fees and longer durations of security loans. The effect of passive investors on security lending is significantly larger than the effect of other lenders such as actively managed funds and other institutional asset managers. Consistent with the literature on short-sale constraints, we find that constrained stocks with more passive ownership exhibit lower cross-autocorrelations with negative market returns and more negative skewness in stock returns. To mitigate identification concerns, we confirm our main findings using Russell index reconstitution that generates quasi-random variation in passive ownership. Our study suggests that passive investors make market prices more efficient by relaxing short-sale constraints.

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1. Introduction

Modern portfolio theory and the efficient market paradigm[1] has resulted in a large increase in assets managed by passive investors (index mutual funds and ETFs) when compared to assets managed by active mutual funds. For example, 15% of total assets in mutual funds were managed passively in 2007, which went up to 25% by the end of 2018.[2] Over the same period, assets managed by active mutual funds fell from 85% to 65%. The shift to passive management was especially dramatic in U.S. equity funds wherein the proportion of assets managed passively was over 40% in 2017.[3] One of the principal reasons for this shift is that investors in index mutual funds pay significantly smaller fees and many active mutual funds do not generally earn significantly higher net-of-fee returns for their investors than comparable passive funds.[4]

In this paper, we investigate another benefit of passive funds by studying the equilibrium effects of their security lending activities[5]. We suggest that passive funds participate aggressively in stock lending programs wherein they lend out the shares in their investment portfolio to arbitrageurs (for example, hedge funds) who are seeking to short the stock. Consequently, the shift to passive investing generates a significantly greater supply of lendable stock resulting in larger aggregate short positions, lower lending fees and longer security loan durations. Accordingly, short-sale constraints are relaxed as stocks can be borrowed more easily, at lower prices and for longer time periods. As a result, the security lending channel suggests that passive

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[1] See Fama (1970).
[2] See 2018 Investment Company Fact Book available at www.icifactbook.org.
[3] See Cremers, Fulkerson and Riley (2018)
[4] Jensen (1968), Carhart (1997), Sharpe (1991), French (2008), Eugene and French (2010) and Lewellen (2011) find that the average active manager cannot outperform her benchmark net of fees. Some papers have found positive returns to "conditional skill," i.e., response to news events, industry specialization, education, etc. (see Daniel, Grinblatt, Titman and Wermers (1997), Kosowski, Timmermann, Wermers and White (2006), Kacpercsyk, Sialm and Zheng (2005), Kacperczyk, Van Nieuwerburgh and Veldkamp (2014), Pastor, Stambaugh and Taylor (2017)).
[5] We refer to index mutual funds and index ETF as passive funds throughout this paper. We refer to passive ownership as a combined ownership of index mutual funds and ETFs.

funds can improve market efficiency. By making short-selling possible, passive investors can complement the information acquisition efforts of active investors who are willing to short-sell stocks. As a consequence, markets can exhibit faster price discovery by incorporating negative information into stock prices.[6]

To test the above arguments, we proceed along the following steps. First, we examine the effects of passive fund ownership on the supply of lendable stock to short-sellers. Employing within-stock variation in fund holdings, we find that stocks with higher levels of passive ownership exhibit higher lending supply. The increase in lending supply results in higher levels of short interest accompanied by lower lending fees and longer duration of securities loans. These effects are economically meaningful - a one-standard-deviation increase in passive ownership increases lending supply by nearly half a standard deviation, and has similar large economic effects on other security loan outcomes such as lending fee and loan durations.

Second, we examine whether passive funds have a larger impact than other securities lenders who are large institutional investors such as actively managed mutual funds, pension funds, banks, endowments and insurance companies (Asquith, Pathak and Ritter (2005)). To answer this question, we examine the differential impact of securities lenders separating between holdings of passive funds, active funds and other 13F institutional investment managers. We find that the effect of passive funds is larger by factor of two-to-three relative to actively managed funds, and by factor of two-to-six relative to non-mutual fund lenders. For example, a one percent increase in passive ownership leads to an increase of 0.8 percent in lending supply, a

[6] Many empirical papers have shown that short selling helps to predict stock returns. See Desia, Hemang, Thiagarajan and Balachandran (2002), Jones and Lamont (2002), Ofek, Richardson and Whitelaw (2004), Asquith, Pathak and Ritter (2005), Cohen, Diether and Malloy (2007), Diether, Lee and Werner (2009), Boehmer, Huszar and Jordan (2010), Engelberg, Reed and Ringgenberg (2012), Engelberg, Reed and Ringgenberg (2018) and Muravyev, Pearson and Pollet (2018).

reduction of four basis points in lending fees, and an increase of 1.4 days in loan duration. On the other hand, a one percent increase in active fund ownership leads to an increase of 0.25 percent in lending supply, a reduction of two basis points in lending fees and an increase of 0.6 days in loan duration. These differences are statistically significant and establish a clear hierarchy: passive indexers appear to participate the most in their custodian's lending programs, followed by actively managed funds and non-mutual funds. As a result, passive fund ownership has the strongest effects on lending outcomes and the resulting relaxation of short-sale constraints.

These findings lead to a natural question: how does the favorable lending environment generated by passive funds affect securities prices? We address this question employing the measures of price impact developed in the literature on short-selling ((Bris, Goetzmann and Zhu (2007), Sigurdsson and Saffi (2011)). We find that the price impact of increased passive ownership is similar to the effects of lifting short-sale constraints. Our first measure of price impact is the cross-autocorrelation between lagged market returns and stock returns conditional on market returns being negative. In this case, market inefficiency is the delay in price adjustment due to negative information. Diamond and Verrecchia (1987) theorize that the presence of short-sale constraints makes stock prices to not fully incorporate past negative information. We hypothesize that if stocks with higher passive ownership levels benefit from faster price discovery, then they would be expected to exhibit lower cross-autocorrelations with lagged market returns conditional on market returns being negative. Our second measure of price impact is the skewness of stock returns. The empirical research on short-sale constraints have shown that when these constraints are lifted, large negative price movements become less likely, and stock returns exhibit more negative skewness (Chang, Cheng and Yu (2007), Xu (2007)).

The increase supply of lendable stock will generate impact stock prices only when short-sale constraints are binding. However, D'Avolio (2002) and Asquith, Pathak and Ritter (2005) find that borrowing is not difficult for the overwhelming majority of stocks Accordingly, we expect to observe stronger price effects for stocks that are hard to borrow and where the short-sale constraints are likely to be severe. As in D'Avolio (2002) and Geczy, Musto and Reed (2002), we use lending fees as our proxy for the severity of short-sale constraints. We split the sample into two types of stocks based on their lending fees: general collateral (GC) stocks whose lending fees are less than 2%, and special hard-to-borrow stocks, whose lending fees are larger than 2%. Our hypothesis is that the effect of increased lending supply on informational efficiency, generated by passive ownership, is more pronounced for the special hard-to-borrow stocks.

Our empirical results are consistent with this hypothesis. Special stocks with higher level of passive ownership have significantly lower downside cross-autocorrelation and significantly less skewness of daily returns. For GC stocks the effect of passive ownership on our measures of price impact is not statistically significant. This evidence is supportive of the idea that passive ownership improves market efficiency though the increased lending of securities to short-sellers.

For the above tests, we use regression specifications with stock fixed-effects which control for any stock-specific, time-invariant variables that affect both lending supply and lending demand. We also control for number of time-varying variables such as market capitalization, liquidity and market-to-book ratios as these variables have been shown to affect both lending supply and lending demand (D'Avolio (2002)). However, identification still remains an important concern as certain factors that determine demand for shorting are unobserved. For example, ownership by passive investors can be correlated with other factors such as the firm's

investment opportunities that might be observed by short-sellers but are not observed by the econometrician and can directly affect security loan characteristics.

To examine the robustness of our results to these concerns, we use an instrumental variables methodology that is based on the reconstitution of Russell 1000 and Russell 2000 indices.[7] As firms cannot control small variations in their market capitalization, index assignment near the thresholds are quite random. This random reassignment leads to significant differences in index weights around the thresholds resulting in exogenous variation in index ownership and mitigating concerns related to unobserved heterogeneity across stocks.[8] In addition, reconstitution of Russell indices generate predictable price effects and therefore might generate predictable effects on unobserved shorting demand. For example, inclusion in the Russell 2000 generates a predictable price increase of five percent (Chang, Hong, Liskovich (2015)) and therefore is highly unlikely to increase shorting demand. At the same time, Russell 2000 stocks near the threshold have significantly higher level of passive ownership resulting in increased lending supply. Therefore, any positive effect of Russell 2000 inclusion on short interest is more likely to be attributed to increased supply, and not to changes in demand.

While the sample of firms examined in Russell index assignments is much smaller than the full sample of firms, resulting in our statistical tests having less power, we check if our results hold for this austere set of ex-ante comparable stocks. Instrumenting passive ownership by assignment to Russell 2000 in a given year, we find that passive ownership increases lending

[7] Our methodology is based on the approach of Apple, Gormley and Keim (2016) who use inclusion in Russell 2000 index as an instrument for ownership by passive funds. We calculate the inclusion thresholds using a new methodology developed by Rapach, Ringgenberg and Zhou (2018) because our sample starts at 2007 after Russell implemented the new index assignment regime.

[8] Several studies that have used this index reassignment methodology are Chang, Hong, Liskovich (2015), Boone and White (2015), Crane, Michemaud, and Weston (2016), Schmidt and Fahlenbrach (2017), and Rapach, Ringgenberg and Zhou (2018)).

supply, the equilibrium level of short interest and loan duration, as well as reduces lending fees. The effects of passive ownership on fees and loan duration are economically large but not statistically significant. When we examine the effects of passive ownership on market efficiency in the sample of Russell index assignments, we find that passive ownership facilitates the incorporation of negative information into stock prices as implied by lower cross-autocorrelations with negative market returns.

This paper proceeds as follows. Section 2 explains our contributions to the related literature. Section 3 describes our data and variables. Section 4 reports our main empirical results. Our supplemental results based on the Russell index reconstitution are reported in Section 5, and Section 6 presents our conclusions.

2. Relevant Literature and Our Contribution

Our primary contribution is to show that passive investors play an important role in relaxing short-sale constraints. A number of studies have analyzed supply and demand in the market for securities lending (D'Avolio (2002), Asquith, Pathak and Ritter (2005), Cohen, Dietner and Malloy (2007), Blocher, Reed and Wesep (2013). These studies focus on an equilibrium framework analyzing the combined effect of shorting supply and demand. Blocher and Whaley (2016) study the profitability of security lending among various types of passive funds. In this paper, we focus on the effects of passive investors on the expansion of lending supply, and on the consequent effects on short-sales constraints as implied by quantities, prices and loan durations. While Blocher and Whaley (2016) show that the security lending by indexers is profitable to fund families and affects fund holdings, we argue that this activity is highly beneficial for lifting short-sales constraints for arbitrageurs which results in more efficient stock prices.

Our second contribution is to illustrate that the identity of a security lender matters for the supply effects on lending market outcomes. Following Asquith, Pathak and Ritter (2005), the literature on lending supply generally does not emphasize the heterogeneity of institutional ownership and the differential impact of various lending institutions. In this paper, we pay particular attention to compositional effects of supply by analyzing the effect of different security lenders, and find that passive indexers have the largest impact on relaxing short-sales constraints.

Our third contribution is to propose a new channel through which a shift to passive investing can affect securities prices. The theoretical literature in this area focuses on the effects of passive investing through generating price pressure (Basak and Pavlova (2013)), and through affecting the informational content of prices due to reduced active investing (Bond and Garcia (2017), Baruch and Zhang (2018), Garleanu and Pedersen (2018)). Overall, the theories of asset management typically do not consider the implications of increased passive investing for securities lending and short-sale constraints. The empirical literature on the price impact of passive investors evolves around the price pressure effects on volatility, autocorrelations, correlation with index prices movements and trading costs (Ben-David, Franzoni and Moussawi (2018), Israeli, Lee and Sridharan (2016), Choi (2017), Coles, Heath and Ringgenberg (2018)). Most of these papers focus on exchange-traded funds (ETF) with Coles, Heath and Ringgenberg (2018) being an exception (who focus on all passive investors including index mutual funds). Unlike these studies, we focus on a different channel through which passive investors can affect security prices. As our study is organized around the effects of passive ownership on the relaxation for short-sale constraints, we depart from the literature on price pressure and focus on the specific measures of price impact as suggested by the literature on short-sales constraints (see,

for example, Hong and Stein (2003), Geszy, Musto and Reed (2002), Bris, Goetzman and Zhu (2007), Chang, Cheng and Yu (2007), Saffi and Sigurdson (2010)).

Our final contribution is to illustrate the causal effect of passive ownership on short-sale constraints as well as on the aftermath price impact. Methodologically, we present the instrumental variables framework suggested by Apple, Gormley and Keim (2016) who study the effects of passive investors on corporate governance employing Russell indices reconstitutions. To formulate our identification strategy, we combine this framework with the sample section procedure offered by Coles, Heath and Rinngerberg (2018). In this setting we complement the nascent literature on the causal effects of passive investing on stock prices as well as the literature that studies the effects of passive investing on other outcomes such as firm value and CEO power (Schnidt and Fahlenbrach (2017)) and product market competition (Azar, Schmalz and Tecu (2018)).

3. Data and Variables

We combine stock-level mutual fund ownership data together with security lending data from Markit, accounting and pricing data from CRSP and Compustat as well as Russell index membership. We describe the construction of the main sample and variables in this section. We also create a significantly smaller Russell assignment sample that is described in Section 5.

3.1 Fund Holdings

We follow the procedure similar to Iliev and Lowry (2015) and Apple, Gormley and Keim (2016). We start with the CRSP Mutual Fund database and classify funds as passive if CRSP indicates that the fund is an index fund. All the rest of the funds are classified as active. Next we match fund classification to the mutual fund quarterly holdings from Thomson Reuters

Mutual Fund Holdings S12 database. We calculate stock ownership within each category by aggregating the holdings of all passive and active funds for each stock-quarter observation. The fund holdings are defined as proportion of shares held by the fund relatively to the total number of shares outstanding. Shares outstanding within each stock-quarter is calculated by using the information on shares outstanding from CRSP stock data.

We next turn to Thomson Reuters Institutional Ownership S34 database to obtain the holdings of all 13F institutional investors. Having this information, we calculate non-mutual fund ownership as the difference between total institutional ownership and the ownership of passive and active funds. The non-passive ownership is defined as the difference between total institutional ownership and the ownership of passive funds.

3.2 Security Lending Data

We obtain security lending data from Markit. This daily dataset includes the key security lending indicators from the vast majority of the U.S. stocks over the period of 2007-2017. We focus on four key variables: "Active Lendable Quantity" which is a measure of lending supply, "Quantity on Loan" which is a measure of short interest, "Indicative Fee" which is a measure of lending fees, and "Average Tenure" which measures the average loan duration.

For each daily stock observation, we first calculate lending supply and short interest as a proportion of shares reported by Markit relative to total number of outstanding shares. Shares outstanding within each stock-quarter is calculated using daily shares outstanding from CRSP stock data. We next average both quantity variables within each stock-quarter to match with quarterly holdings data. Lending fees and loan maturity are computed in a similar way using averaging of daily Markit data within each stock-quarter.

3.3 Price Impact Measures and Accounting Data

We have hypothesized that passive investors help to relax short-sales constraints. Accordingly, we employ measures of price impact suggested by the literature on shorting. In particular, we hypothesize that ownership by passive investors affect stock prices in the same manner as lifting short-sale constraints.

Our first measure of price impact is the downside cross-autocorrelation between lagged market returns and stock returns (Hou and Moskowitz (2005), Bris, Goetzman and Zhu (2007), Saffi and Sigurdsson (2011)). For each stock-quarter we calculate the downside cross-auto correlation using daily stock returns and lagged market return as follows:

$$\rho_{i,t}^{-} = corr\left(r_{i,d,t}, r_{d-1,t}^{M-}\right), \quad (1)$$

where $r_{i,d,t}$ is the return on stock *i* in quarter *t* on day *d,* and $r_{d-1,t}^{M-}$ is market returns on day *d-1* in quarter *t* conditional on market returns being negative. We follow Hou and Moskowitz (2005) by using the CRSP value-weighted stock market index to obtain daily market returns. The larger is the correlation of stock returns with past negative market returns, the larger is the delay in price response to negative information.

Using a similar approach, we also compute upside cross-autocorrelations using positive market returns and the difference between the downside and the upside autocorrelations as follows:

$$\rho_{i,t}^{+} = corr\left(r_{i,d,t}, r_{d-1,t}^{M+}\right), \;\; \rho_{i,t}^{Diff} = \;\; \rho_{i,t}^{-} - \rho_{i,t}^{+}. \quad (2)$$

These measures help to quantity the asymmetry in price adjustment. As short-sale constraints are not expected to affect the incorporation of positive information in prices, it is

useful to separately analyze upside and downside autocorrelations as well as the difference between them. As correlations are bounded by -1 and 1, we apply the $\ln[(1+\rho)/(1-\rho)]$ transformation to both of measures of cross-autocorrelations.

Our second measure of price impact is skewness of stock returns. We assume that equity prices are approximately distributed log normally; we apply log-transformation to returns and calculate the skewness of daily returns within each stock-quarter observation. Bris, Goetzman and Zhu (2007), Chang, Cheng and Yu (2007) and Saffi and Sigurdsson (2011) find that lifting short-sales constraints is associated with less skewness in stocks returns. This empirical finding is consistent with the theoretical predictions of Xu (2007). We adopt the positive association between short-sales constraints and skewness when testing the effects of ownership by passive investors on individual stock returns.

Finally, we merge holdings data to securities lending data as well as the pricing information from CRSP and accounting variables from Compustat to obtain the final dataset. The definitions of our variables are provided in Appendix.

3.4. Summary statistics

Table 1 presents our summary statistics. We observe that passive investors own 6% of shares outstanding for the average U.S. stock. At the same time, the average level of active fund ownership is 18%, and the average level of non-mutual fund ownership is 45%. While passive funds are becoming more popular, they still own significantly less shares of the average stock relative to other institutional investors.

*** Table 1***

The security lending data implies that much of the lending supply is not utilized by the

short-sellers; specifically, the average supply of lendable shares equals to 19% while the average aggregate short position equals to only 3%. The lending fees exhibit a high degree of variability, wherein the average fee is 2% but the median fee is only 0.05%. These results are consistent with Asquith, Pathak and Ritter (2005) who suggest that borrowing is not too difficult for most stocks. We also find that the average loan duration for U.S. stocks is 80 days.

We observe that individual stock returns are positively skewed and exhibit negative downside cross-autocorrelation. Finally, the average stock has a market-to-book ratio of three and a bid-ask spread of 1%.

4. Empirical Results

4.1 Effect of Passive Fund Ownership on Security Lending

We begin by investigating the relationship between the ownership of passive funds and security lending outcomes. Figure 1 illustrates the relationships between passive ownership and the security lending variables, i.e., lending supply, short interest, lending fees and loan duration. We observe a strong positive correlation between passive ownership, lending supply and short interest as well as substantial negative correlation between passive ownership and lending fees. The effects are accompanied by longer loan durations. The graphical results indicate that stocks with higher passive ownership are cheaper to borrow, exhibit larger aggregate short positions and are borrowed for longer time periods.

Figure 1

We next conduct formal tests by regressing the security lending variables on passive ownership using the following specification:

$$y_{i,t} = \alpha_i + \alpha_t + \beta \cdot Passive_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t} \qquad (3)$$

where $y_{i,t}$ is a security lending outcome for stock i in quarter t, $Passive_{i,t}$ is a level of passive ownership of stock i in quarter t, α_i is stock fixed effect, α_t is a quarter fixed effect and $X_{i,t}$ is a vector of stock-specific control variables (namely, ln (market capitalization), ln (book value of assets), market-to-book and bid-ask spread).

Table 2 confirms the stylized facts previously shown in Figure 1. Panel A presents the evidence for the quantity variables: lending supply and equilibrium short interest. Column (1) presents the baseline specification only with quarter-fixed effects suggesting that an increase of one percent in passive ownership is associated with a two percent increase in the equilibrium level of short interest. Column (2) introduces the control variables and the estimated elasticity slightly declines to 1.83. This column also shows that larger and more liquid stocks have higher levels of lending supply. Adding stock fixed-effects in column (3) and employing within stock variation in passive ownership reduces the elasticity to 0.78. In column (4) we control for ownership of non-passive funds (actively managed funds and other 13F institutions) and the estimated elasticity remains at the same level. The effect is economically sizable – a one standard deviation increase in passive ownership is associated with an increase in half-standard deviation in lending supply.

*** Table 2***

We hence examine whether the supply increase driven by passive ownership results in a higher level of short interest. The results are reported in columns (5) – (9). As can be seen, the coefficient on passive ownership is always positive and significant at the one percent level. The most restrictive specification in column (8) indicates that a one percent increase in passive ownership results into an increase of 18 basis points in the level of short interest. These results

indicate that for the average stock, 25% of the additional supply produced by passive investors (18 basis points out of 78 basis points) is utilized by short-sellers.

We proceed and investigate the effects of increased lending supply on securities market conditions. Panel B repeats the analysis and studies the effects passive ownership on lending fees and security loan maturities. The baseline specification (column (1)) indicates that an increase of one percent in passive ownership is associated with a reduction of 31 basis points in lending fees. Introducing additional control variables as well as stock fixed-effects leads to a considerable decline in the estimated coefficient to three basis points. However, this effect is still economically meaningful as moving from the 25^{th} percentile (one percent) to the 75^{th} percentile (10 percent) of the passive ownership results in 27 basis points lower lending fees.

We then examine the effect of passive ownership on security loan duration. Columns (5) – (8) of Panel B demonstrate that higher level of passive ownership results in longer duration of stock loans. According to the most restrictive specification in column (8), a change of one-standard deviation in passive ownership results in the increase of seven days in average stock loan duration.

In sum, the results presented in Figure 1 and Table 2 suggest that stocks with higher levels of passive ownership face weaker short-sale constraints due to increased lending supply.

4.2 Differential Impact of Passive Investors and Other Securities Lenders

Having established the baseline effects of passive funds on security lending, we hence examine if passive funds have a larger economic impact than other securities lenders. The size of lendable assets by types of beneficial owners is not precisely known (Balkanova, Copeland and McCaughrin (2015)). However, the typical security lender is a large institutional investor

managing a low-levered portfolio of securities. Mutual funds, pension funds, endowments and insurance companies represent the majority of lenders (Balkanova, Caglio, Keane and Porter (2016). This leads us to examine the differential impact of various institutions on securities lending and ask if passive funds have a larger impact relative to other lenders.

To address this question, we split institutional ownership of a given stock into three categories: ownership by passive funds, ownership by active funds and ownership by non-mutual fund 13F institutions such as pension funds, endowments, banks and insurance companies. We use the following regression model:

$$y_{i,t} = \alpha_i + \alpha_t + \beta_1 \cdot Passive_{i,t} + \beta_2 \cdot Active_{i,t} + \beta_3 \cdot NonMF_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t} \quad (4)$$

where $y_{i,t}$ is a security lending outcome for stock *i* in quarter t, $Passive_{i,t}$ is the level of passive ownership of stock *i* in quarter *t*, $Active_{i,t}$ is the level of active ownership of stock *i* in quarter *t*, $NonMF_{i,t}$ is the ownership by non-mutual fund institutions of stock *i* in quarter *t*, α_i is stock fixed-effects, α_t is quarter fixed-effect and $X_{i,t}$ is a vector of stock-specific control variables (namely, ln(market capitalization), ln(book value of assets), market-to-book- and bid-ask spreads).

Table 3, Panel A presents the results. The first two columns show that passive funds have a significantly larger effect on lending supply relatively to both active funds and non-mutual funds. Specifically, an increase of one percent in passive ownership results in an increase of 0.76% in lending supply, while an increase of one percent in active fund ownership contributes 0.25% to lending supply. Non-mutual funds have the smallest impact as an increase of one percent in their ownership results in 0.17% increase in lending supply.

*** Table 3***

The dominating effects of passive investors on security lending can be seen throughout the rest of the outcomes. Passive funds have twice the effects on lending fees and loan durations relative to active funds. They also have larger effects on equilibrium short interest relative to both actively managed funds and non-mutual funds. Panel B formally evaluates the differences in the magnitude of the coefficients and confirms the importance of passive funds. In particular, the difference between coefficients of passive vs. active funds is statistically significant at one percent level for lending supply and loan duration. It is also statistically significant at the 10 percent level for short interest and lending fees. Non-mutual funds appear to have the least impact, having substantially smaller coefficients when compared to both passive and active funds.

Overall, the findings in this section establish a clear hierarchy among various institutional investors in their impact on securities lending. Passive funds appear to participate the most in their lending programs followed by active funds and by other institutional asset managers.

4.3 Effect of Passive Fund Ownership on Stock Prices

4.3.1 Cross-autocorrelations

Having established the effects of passive investors on securities lending, we turn to pricing implications. We generally demonstrate that the price impact of the increased passive ownership is similar to the effects of lifting short-sale constraints. Figure 2a provides the initial descriptive evidence presenting the relationship between passive ownership and downside cross-autocorrelations. We observe that when passive ownership within a stock increases, downside cross-autocorrelations decline. This descriptive evidence suggests that stocks with high level of passive ownership exhibit faster price discovery conditional on negative information.

The increase supply of lendable shares will generate stronger impact on stock prices when short-sale constraints are more severe. Capitalizing on this idea, we expect to observe stronger price effects for the stocks that are harder to borrow. We follow D'Avolio (2002) and Gezcy, Musto and Reed (2003) using the lending fee as a proxy for the severity of the short-sale constraints. In our regression analysis, we split the sample into the following two types of stocks based on their lending fees: "general collateral" (GC) stocks with a fee of less than 2% and "specials", hard-to-borrow stocks, with a lending fee larger than 2%.[9] Our hypothesis is that the effect of increased lending supply on informational efficiency, generated by passive ownership, is more pronounced for the specials.

Table 4, Panel A presents the regression results using econometric specifications based on equation (4). Column (1) shows that for an increase in passive ownership within a given stock results into lower downside autocorrelation with this effect being statistically significant at the five percent level. Column (2) shows that this effect is especially large in the sample of special stocks whereas column (3) shows that this effect is weak and statistically insignificant in the sample of general collateral stocks. Columns (4) – (6) analyze the upside cross-autocorrelations and show that the effect of ownership of passive funds on the speed of incorporation of positive information into stock prices is both economically and statistically insignificant. Columns (7) - (9) report the results for the difference between the upside and the downside cross-autocorrelations and show that the asymmetric effect is especially pronounced among specials.

*** Table 4***

[9] The 2% cutoff implies that roughly 10% of stocks are defined as specials consistent with D'Avolio (2002). Our results are robust to alternative definitions of special stocks.

These results confirm that price discovery conditional on negative information is faster for constrained stocks when passive ownership is higher. Consistent with the short-selling literature, the effect of passive ownership on market efficiency is asymmetric in that the speed of incorporation of positive information is not affected.

4.3.2 Skewness

We now analyze the effect of passive ownership on the skewness of stock returns. Figure 2b presents the relationship between the passive ownership and skewness. We observe that when passive ownership increases, skewness steadily declines. Consistent with the predictions by Xu (2007) and the empirical literature on shorting, increased passive ownership is associated with less skewness in individual stock returns - which is in accordant with the relaxation of short-sale constraints.

Table 4, Panel B confirms the result through multivariate tests. Column (1) shows that higher levels of ownership by passive investors result in less skewness in stock returns. Columns (2) and (3) present the effects separately for special stocks and for GC stocks. As predicted, the magnitude of the effect of passive ownership is twice larger for specials. Both coefficients are statistically significant at the one percent level.

Overall, our results provide consistent evidence that increased passive ownership generates price impact which is similar to the impact of relaxation of short-sale constraints. We confirm that passive investors improve the incorporation of negative information into stock prices and reduce the likelihood of large negative returns.

5. Russell Indices Reconstitution Experiment

While our results are robust to the inclusion of a rich set of controls as well as taking advantage of within stock variation, identification still remains an important concern. Specifically, certain stock–specific time-varying parameters that determine demand for shorting, such as valuations of marginal investors and short-sellers, are unobserved. For example, ownership by passive investors can be correlated with other factors such as firm's investment opportunities that might be observed by short-sellers but are not observed by econometrician and can directly affect security loan characteristics. In this section, we develop an identification strategy that draws from the literature on Russell indices reconstitution and the effects of passive ownership.

5.1 Sample construction

Our sample construction procedure follows Coles, Heath and Ringgenberg (2018). Markit provides data on security lending starting in 2007 and in the same year Russell implemented a new assignment regime - "banding". First, stocks are sorted based on market capitalizations and then two bands around the stock ranked 1000^{th} are generated. Each band's width is equal to 2.5% of the total May market capitalization of the entire Russell 3000 index. The stocks within the band do not change their index assignment from the last year.

Consider the following theoretical example. After following the Russell banding procedure, the two following thresholds around the 1000 rank were created: an upper threshold of 850 and a lower threshold of 1250. In this example, all stocks ranked in between 835-1250 are not predicted to change their index assignment. The stock ranked above 835 are predicted to be assigned to Russell 1000 only if they were assigned to Russell 2000 in the previous year. The stocks ranked below 1250 are predicted to be reassigned to Russell 2000 only if they were included in Russell 1000 in the previous year. Effectively, the banding procedure generates two

cutoffs instead of one (a rank of 1000) and creates an assignment process that is relatively difficult to manipulate.

Following Coles, Heath and Ringgenberg (2018) we focus on the sample of potential switchers with a bandwidth of 100 around the cutoffs. In the above example, for the upper cutoff of 835 we first select 100 stocks around the cutoff (stocks ranked 785 – 885) and then we keep only the stocks that were assigned to Russell 2000 in the previous year. Similarly, for the lower cutoff of 1250, we select 100 stocks around the cutoff (stocks ranked 1200 – 1300) and then we keep only the stocks that were assigned to Russell 1000 in the previous year. This procedure generates a sample 836 of stocks that are likely to be ex-ante comparable based on their market capitalizations.

Table 5 presents the descriptive statistics for this sample. The variables of interest are calculated for the 3rd quarter in any given year as this quarter exactly follows the annual June reconstitution. For the average stock, 9% are owned by passive funds and 19% are owned by active funds. The overall level of institutional ownership is 78%. All these variables are higher than the larger sample of stocks used in the analysis of the previous sections. These differences come from the fact that the cutoff sample stocks are relatively large due to being highly ranked members of the Russell indices and therefore exhibit much higher level of institutional ownership.

*** Table 5***

Table 6 presents the differences in means in our variables between Russell 1000 and Russell 2000 stocks. We can see that the passive ownership for Russell 2000 stocks is 2% higher than for Russell 1000 stocks and this difference is statistically significant at the one percent level.

The differences in ownership by other types of institutional investors are not statistically significant. These results are consistent with Apple, Gormley and Keim (2016) who did not find any significant effects of index inclusion on ownership by non-passive institutional investors.

*** Table 6***

As can be seen, the increased ownership by passive funds for Russell 2000 stocks translates into a number of effects on security lending outcomes. The lending supply is increased by two percent, the level of short interest goes up one percent, the lending fee declines by 3 basis points and the loan maturity declines by 8 days. The downside cross-autocorrelation declines as well. These effects are broadly consistent with the previously documented evidence of the increased supply generated by passive funds and its consequences for the security lending market. These results also suggest a potential identification strategy that can be utilized using the index reconstitution event. In particular, one can use inclusion in Russell 2000 as an instrument for passive ownership to identify the effects passive investors on securities lending. The next section presents the development of our identification strategy in further detail.

5.2 Methodology

We follow Apple, Gormley and Keim (2016) to identify the effects of passive ownership on securities lending and market efficiency. In particular, we use the inclusion into Russell 2000 as an instrument for ownership of passive funds. As the stocks are ranked based on their market capitalization and the sampling is based on the two different cutoffs, the rank and the cutoff (which changes from year to year) can directly affect the level of passive ownership irrespective of index assignment. Therefore, we include both stock ranks and year fixed- effects interacted

with the assignment cutoffs in our specifications. In particular, we estimate the following first stage regression:

$$Passive_{i,t} = \beta \cdot Russell2000_{i,t} + f(Rank_{i,t}) \cdot UpperCutoff_{i,t} + \gamma_t \cdot UpperCutoff_{i,t} + \varepsilon_{i,t} \quad (5)$$

where $Passive_{i,t}$ is the amount of passive ownership for stock *i* in year *t*, $Russell2000_{i,t}$ is an indicator variable equal to one if the stock is included in Russell 2000 in year *t*, $UpperCutoff_{i,t}$ is an indicator variable equal to one if the stock *i* belongs to the upper cutoff sample in year *t* and γ_t is a year fixed effect. $f(Rank_{i,t})$ is a polynomial control function of rank of stock *i* in year *t*. Finally, we cluster our standard errors at the individual stock level.

Our second stage estimation mirrors the specification from the first stage and estimates the effects of passive ownership on security lending and efficiency variables. In particular, we implement the following regression model:

$$y_{i,t} = \beta \cdot \widehat{Passive}_{i,t} + f(Rank_{i,t}) \cdot UpperCutoff_{i,t} + \gamma_t \cdot UpperCutoff_{i,t} + \varepsilon_{i,t} \quad (6)$$

where $y_{i,t}$ is an outcome of interest for stock *i* in year *t* and $\widehat{Passive}_{i,t}$ is the predicted level of passive ownership for stock *i* in year *t* from the first stage estimation.

Our methodology is based on two identification assumptions. First, inclusion in Russell 2000 should affect the level of passive ownership after controlling stock's rank and its cutoff position in any given year. This condition is verified below through the first stage estimation. Second, inclusion in Russell 2000 should not directly affect our outcomes of interest except through its impact on ownership by passive funds. As we argue that the effect of passive ownership operates through the increase of supply of lendable shares, our primary concern is the

effect of inclusion on shorting demand in the next three months following index inclusion. It has been well known that index inclusions generate predictable price increase (Chang, Hong and Liskovich (2014)). As arbitrageurs might prefer to *reduce* their short positions around index inclusion, the demand effect cannot contribute to the *increase* in short interest. However, there are index front running strategies based on price reversal such as shorting the stock close to the inclusion day and closing the position a number of days late. These strategies can contribute to the increase in shorting around the inclusion but are unlikely to affect the securities lending market over the longer term such as the entire 3rd quarter. In addition, the effects of arbitrageurs who would like to trade on the consequent decline might counteract the effects of the arbitrageurs willing to trade on the initial price increase. As a result, the net effect on the shorting demand can be significantly minimized. In sum, our exclusion restriction seems reasonable, given that a shift in shorting demand based on inclusion-based strategies is unlikely to produce the effects that we document. Moreover, the opposing trading strategies can nullify each other such that their net effect is likely to be negligible.

5.3. First Stage

Table 7 presents the first stage regressions using first, second and third-order polynomials for the rank function. The results confirm that Russell 2000 membership is strongly associated with an increase in passive ownership. Consistent with the descriptive results, the inclusion in Russell 2000 is translated into an increase of 2% in ownership by passive funds which amounts to a half of sample standard deviation. This effect is consistent across the polynomials of different orders.

*** Table 7***

5.4 Effects of Passive Ownership on Securities Lending

Table 8 presents the effects of passive ownership on security lending outcomes employing the instrumental variables approach. Panel A focuses on quantities and columns (1) - (3) show the effect of passive ownership on lending supply. Our identification strategy confirms that more ownership by passive investors results in greater supply of shares to short-sellers. The effect is economically meaningful such that an increase in one standard deviation in passive ownership is associated with an increase of one standard deviation in lending supply. Columns (4) – (6) confirm the effects of passive ownership on the size of the short positions. This effect is also both economically and statistically significant.

*** Table 8***

The effect of passive ownership on lending fees and loan maturity are shown in Panel B. Columns (1) - (3) show that more ownership by passive investors generally lowers the lending fees. While the coefficient is economically sizable and is even larger than the coefficient obtained in the full sample, it is not statistically significant at conventional levels. Columns (4) - (6) presents the results for loan duration. The coefficient on passive ownership is comparable in size to the one obtained in the full sample, but it is also not statistically significant.

In sum, our instrumental variables approach yields results are generally consistent with those obtained using the fixed-effects methodology in a much larger sample. As our Russell reconstitution-based methodology can be applied to only a significantly smaller sample of stocks, our statistical tests have less statistical power to detect the effects of passive investors on lending fees and loan duration.

5.5 Effects of Passive Ownership On Cross-Autocorrelations and Skewness

Table 9 presents the results for the impact of passive ownership on stock prices. Panel A shows the results for cross-autocorrelation variables and confirms our previously documented findings. Higher levels of passive ownership result into faster incorporation of negative information in stock priced as measured by downside cross-autocorrelations with past market returns (columns (1) – (3)). Columns (4) - (6) show that the effect of passive investors on upside cross-autocorrelation is twice smaller in magnitude and is not consistently statistically significant across our polynomial specifications. Panel B shows the results for skewness of daily stock returns. While the coefficient is positive, it is not statistically significant.

*** Table 9***

In sum, the instrumental variables approach appears to generate evidence that is generally consistent with the evidence presented in the fixed-effect approach in the larger sample. Specifically, passive investing improves the speed at which negative information is incorporated in the stock prices.

6. Conclusion

In this paper, we propose and analyze a security lending channel through which passive investors can affect stock prices and market efficiency. We suggest that passive funds operate as primary lenders of shares to arbitrageurs and by doing so relax short-sale constraints. We empirically confirm the effects of passive investors by showing that their security lending activities expand the supply of lendable stock leading to larger short positions, lower lending fees and longer maturities of security loans. As a result, stocks with more passive ownership exhibit faster price discovery.

Our findings yield two main implications. First, recent research has argued the increase in passive investing can make prices less efficient as these investors do not actively seek out and

utilize security-specific information when making investment decisions and generate price pressure (Israeli, Lee and Sridharan (2017), Ben-David, Franzoni and Moussawi (2018)). However, our study suggests that passive investors complement information-seeking efforts of active investors who employ short-selling strategies. While our results do not resolve the ongoing debate, they cast doubt on the idea that passive investing only reduces the amount of information incorporated in prices and generates price inefficiencies. In fact, the relaxation of short-sales constraints leads to more information being embedded in securities prices.

Second, our study argues for the inclusion of security lending activity in theoretical models of passive and active investing. The recent advances in these area focus on price pressure and information acquisition, and do not take into account the effects of passive investing on short-sale constraints (Basak and Pavlova (2013), Bond and Garcia (2017), Pedersen and Garleanu (2018)). The incorporation of these effects into the theories of asset management can lead to a better understanding of the aggregate effect of passive investing on financial markets.

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Figure 1

This figure presents the relationships between passive ownership and security lending outcomes: lending supply, short interest, lending fee and loan duration. The figure uses binned-scatter plots with 20 bins. Detailed definitions of variables can be found in Appendix.

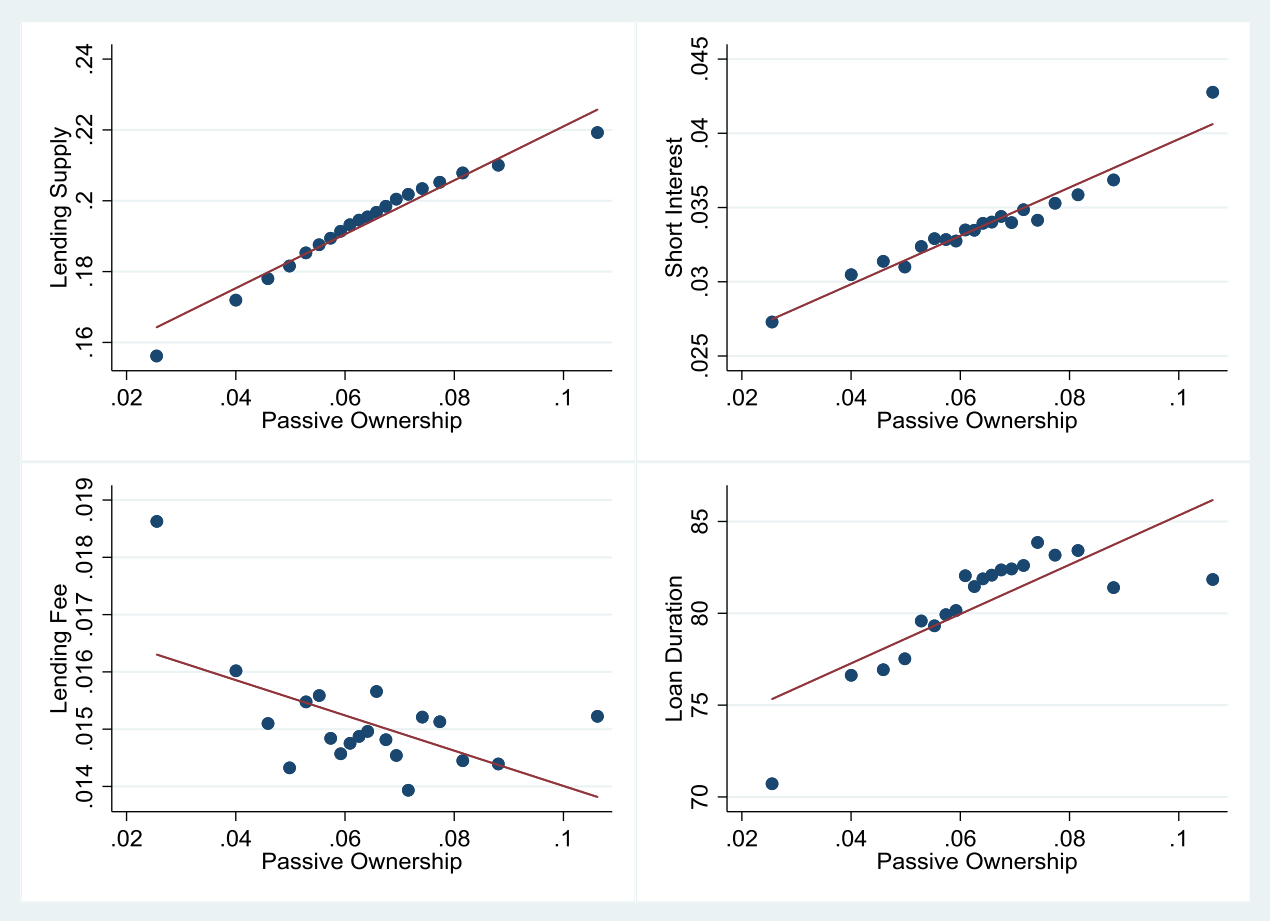

Figure 2

This figure presents the relationships between passive ownership, downside cross-autocorrelations and skewness of daily returns. The figure uses binned-scatter plots with 20 bins. Detailed definitions of variables can be found in Appendix.

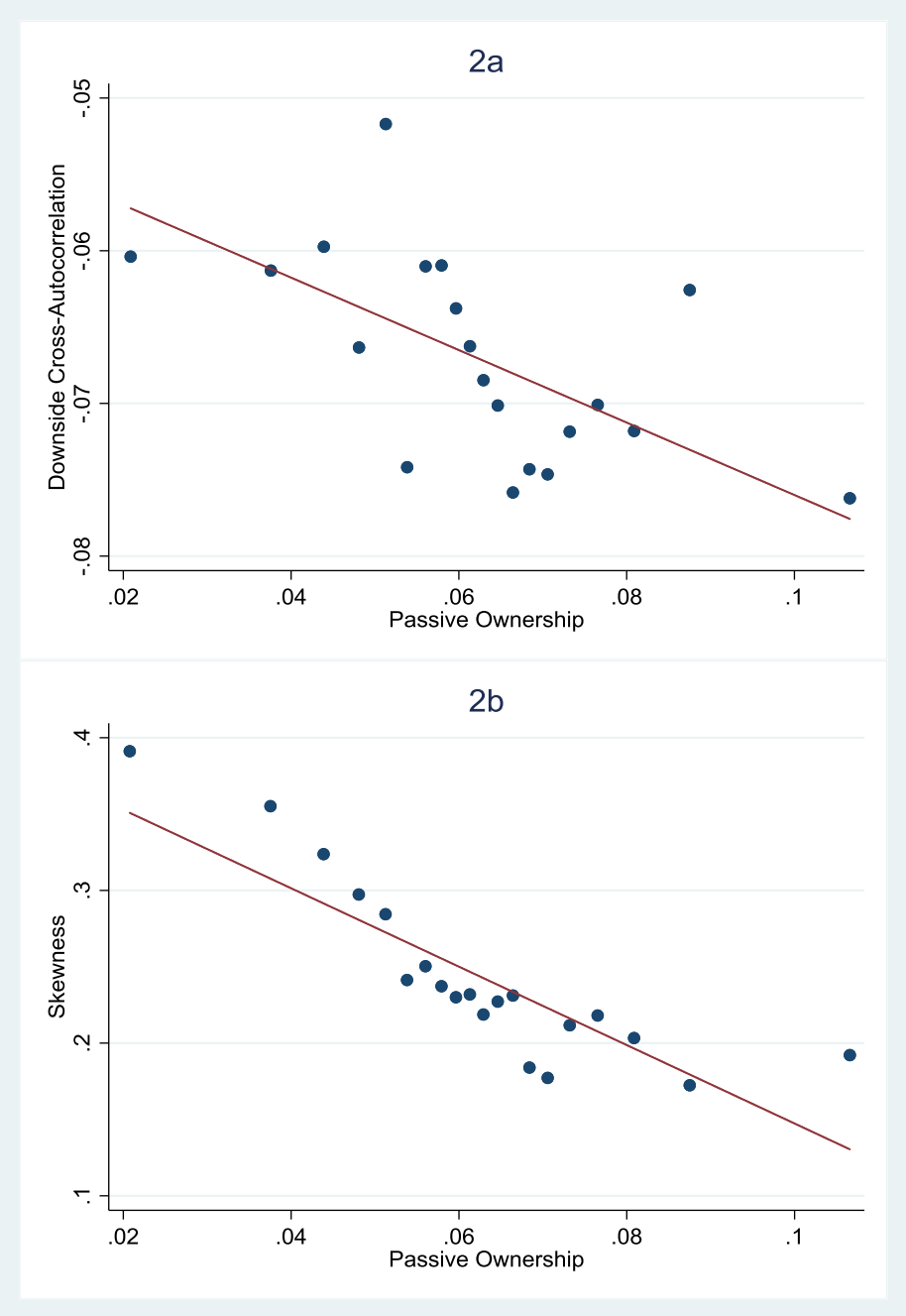

Table 1: Summary Statistics, Full Sample

This table presents summary statistics for our 2007-2017 quarterly panel of stocks. Detailed definitions of variables and data collection process can be found in Appendix. Ownership variables are calculated using end-of-the-quarter ownership as reported by Thomson Reuters Mutual Fund Holding database. The definitions of ownership types are based on CRSP Mutual Fund database. The security lending variables are from Markit and represent daily averages within each stock-quarter observation. The price impact and control variables are calculated using CRSP and Compustat.

Stock-quarter level variables	N	Mean	St Dev	Median	Min	Max
Ownership variables						
Passive fund ownership (fraction)	121,405	0.06	0.05	0.06	0.00	0.55
Active fund ownership (fraction)	121,405	0.11	0.09	0.10	0.00	0.87
Total mutual fund ownership (fraction)	121,405	0.18	0.12	0.17	0.00	0.89
Non-mutual fund ownership (fraction)	121,109	0.45	0.20	0.48	0.00	0.99
Total institutional ownership (fraction)	121,405	0.62	0.27	0.69	0.00	1.00
Non-passive ownership (fraction)	121,109	0.56	0.25	0.61	0.00	1.00
Security lending variables						
Lending supply (fraction)	121,383	0.19	0.11	0.20	0.00	0.42
Short interest (fraction)	121,326	0.03	0.04	0.02	0.00	0.24
Lending fee (fraction)	121,307	0.02	0.06	0.00	0.00	1.20
Loan duration (days)	121,326	80.53	67.86	63.52	3.17	463.86
Price impact variables						
Downside cross-autocorrelation	121,232	-0.06	0.44	-0.05	-13.57	15.72
Upside cross-autocorrelation	121,237	0.00	0.38	-0.01	-9.57	10.46
Downside minus upside	121,209	-0.06	0.57	-0.05	-13.14	15.15
Skewness	121,289	0.24	1.32	0.19	-7.34	7.78
Control variables						
Log(market value)	121,305	20.37	1.95	20.20	13.61	27.48
Log(book value)	112,549	19.71	1.83	19.53	6.91	26.59
Market-to-book	113,533	3.00	3.82	1.83	0.30	27.29
Bid-ask spreads (fraction)	121,305	0.01	0.01	0.00	0.00	0.31

Table 2: Effects of Passive Fund Ownership On Security Lending Market, Full Sample

This table reports the results from regressing security lending outcomes on passive ownership and a set of control variables. Detailed definitions of variables can be found in Appendix. Panel A reports the results on quantity variables. Column (1) reports the baseline specification for lending supply including year fixed effects, column (2) adds controls and column (3) adds stock fixed effects. Column (4) adds ownership of non-passive institutional investors as an additional control variable. Columns (5) - (8) repeat the specifications from columns (1) - (4) using short interest as dependent variable. Panel B reports the results for fees (columns (1) - (4)) and loan duration (columns (5) - (8)). *, **, and *** denote statistical significance at 10%, 5% and 1% levels respectively. Standard errors clustered by stock are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A:Quantities								
	y = Lending supply				y = Short interest			
Passive fund ownership	2.12***	1.83***	0.82***	0.78***	0.29***	0.35***	0.20***	0.18***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
Non-passive ownership				0.18***				0.11***
				(0.00)				(0.00)
Log(market value)		0.01***	0.01***	0.00		0.00***	-0.01***	-0.01***
		(0.00)	(0.00)	(0.00)		(0.00)	(0.00)	(0.00)
Log(book value)		0.00**	0.02***	0.01***		-0.00***	0.01***	0.00***
		(0.00)	(0.00)	(0.00)		(0.00)	(0.00)	(0.00)
Market-to-book		-0.00***	0.00***	0.00***		-0.00***	0.00***	0.00***
		(0.00)	(0.00)	(0.00)		(0.00)	(0.00)	(0.00)
Bid-ask spread		-1.23***	-0.32***	-0.17***		-0.78***	-0.41***	-0.33***
		(0.07)	(0.04)	(0.03)		(0.03)	(0.03)	(0.02)
Observations	121,383	112,515	112,279	112,098	121,326	112,471	112,237	112,060
R^2	0.62	0.65	0.88	0.90	0.12	0.18	0.57	0.61
Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stock fixed effects	No	No	Yes	Yes	No	No	Yes	Yes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel B:Fee and Loan Maturity								
	y = Lending fee				y = Loan Duration			
Passive fund ownership	-0.31***	-0.20***	-0.04***	-0.03***	159.52***	325.77***	146.03***	140.21***
	(0.01)	(0.01)	(0.01)	(0.01)	(14.30)	(14.88)	(21.51)	(21.43)
Non-passive ownership				-0.02***				28.53***
				(0.00)				(4.48)
Log(Market value)		0.00***	-0.01**	-0.00***		-7.67***	-18.63***	-20.24***
		(0.00)	(0.00)	(0.00)		(0.66)	(1.15)	(1.14)
Log(Book value)		-0.00***	-0.00	-0.00		1.02	3.62***	2.96***
		(0.00)	(0.00)	(0.00)		(0.65)	(0.99)	(0.98)
Market-to-book		-0.00***	-0.00*	-0.00*		0.16	0.22	0.21
		(0.00)	(0.00)	(0.00)		(0.21)	(0.21)	(0.20)
Bid-ask spread		-0.06	-0.10**	-0.12***		-396.53***	129.94*	156.72**
		(0.04)	(0.04)	(0.04)		(67.78)	(67.64)	(68.54)
Observations	121,307	112,455	112,221	112,044	121,326	112,471	112,237	112,060
R^2	0.06	0.11	0.58	0.58	0.03	0.05	0.32	0.32
Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stock fixed effects	No	No	Yes	Yes	No	No	Yes	Yes

Table 3: Differential Impact of Institutional Investors on Security Lending

This table reports the results from regressing security lending outcomes on ownership of various institutional investors. Detailed definitions of variables can be found in Appendix. Panel A reports the regression results. Column (1) reports the baseline specification for lending supply including stock and quarter fixed effects and column (2) adds ownership by non-mutual fund institutional investors. Columns (3) and (4) repeat the specifications using short interest as a dependent variable. Columns (5) and (6) report the results for lending fees and columns (7) and (8) report the results for loan duration. Panel B reports the p-values of test for the differences between every pair of coefficients in Panel A. *, **, and *** denote statistical significance at 10%, 5% and 1% levels respectively. Standard errors clustered by stock are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Regressions								
	y = Lending supply		y = Short interest		y = Lending fee		y = Maturity	
Passive fund ownership	0.77***	0.76***	0.16***	0.16***	-0.04***	-0.04***	138.39***	137.98***
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(19.69)	(19.66)
Active fund ownership	0.19***	0.25***	0.11***	0.14***	-0.01***	-0.02***	58.75***	65.27***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(6.99)	(7.16)
Non-mutual fund ownership		0.17***		0.10***		-0.02***		20.56***
		(0.00)		(0.00)		(0.00)		(4.42)
Observations	112,279	112,098	112,237	112,060	112,221	112,044	112,237	112,060
R^2	0.89	0.90	0.59	0.62	0.58	0.58	0.34	0.35
Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stock fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Panel B: p-values of Tests for Differences Between Coefficients								
H_o: Active>Passive		0.00		0.07		0.07		0.00
H_o: Non-mutual fund>Passive		0.00		0.00		0.09		0.00
H_o: Non-mutual fund>Active		0.00		0.00		0.77		0.00

Table 4: Effects of Passive Fund Ownership On Cross-Autocorrelation and Skewness

This table reports the results from regressing price impact variables on ownership of passive funds. Detailed definitions of variables can be found in Appendix. Panel A reports the results for cross-autocorrelations. Column (1) reports the results for downside cross-autocorrelation for the entire sample of stocks, column (2) shows the results for specials (lending fee>2%) and column (3) reports the results for general collateral stocks (lending fee <2%). Columns (3) - (6) repeat the specifications for upside cross-autocorrelations. Columns (7) – (9) repeat the specification for the difference between the upside and the downside autocorrelations. Panel B reports the same specifications for skewness. *, **, and *** denote statistical significance at 10%, 5% and 1% levels respectively. Standard errors clustered by stock are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Cross-Autocorrelation	Downside			Upside			Downside Minus Upside		
	Full Sample	Special	GC	Full Sample	Special	GC	Full Sample	Special	GC
Passive fund ownership	-0.06**	-0.77**	-0.12	-0.02	-0.02	-0.03	-0.04	-0.75*	-0.09
	(0.03)	(0.30)	(0.07)	(0.06)	(0.25)	(0.06)	(0.08)	(0.40)	(0.09)
Observations	112,008	11,996	99,595	112,008	11,996	99,595	112,008	11,996	99,595
R^2	0.25	0.28	0.42	0.19	0.38	0.44	0.20	0.20	0.13
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stock fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

	(1)	(2)	(3)
Panel B: Skewness	Skewness		
	Full Sample	Special	GC
Passive fund ownership	-1.72***	-3.14***	-1.69***
	(0.22)	(0.90)	(0.23)
Observations	112,106	12,012	99,616
R^2	0.08	0.19	0.08
Controls	Yes	Yes	Yes
Quarter fixed effects	Yes	Yes	Yes
Stock fixed effects	Yes	Yes	Yes

Table 5: Summary Statistics, Cutoff Sample

This table presents summary statistics for our 2007-2017 annual panel of stocks for the cutoff sample. For each year the variables are calculated over the third quarter. Detailed definitions of variables can be found in Appendix. The ownership variables are calculated using end-of-the-quarter ownership as reported by Thomson Reuters Mutual Fund Holding database. The definitions of ownership types are based on CRSP Mutual Fund database. The security lending variables are from Markit and represent daily averages within each stock-quarter observation. The price impact variables are calculated using CRSP stock database and Compustat.

Stock-3rd quarter level variables	N	Mean	St Dev	Median	Min	Max
Ownership variables						
Passive fund ownership (fraction)	801	0.09	0.05	0.09	0.00	0.32
Active fund ownership (fraction)	800	0.19	0.10	0.18	0.00	0.63
Total mutual fund ownership (fraction)	800	0.28	0.12	0.28	0.00	0.76
Non-mutual fund ownership (fraction)	631	0.53	0.16	0.55	0.03	0.97
Total institutional ownership (fraction)	630	0.78	0.21	0.85	0.01	1.00
Non-passive ownership (fraction)	631	0.62	0.19	0.75	0.03	0.99
Security lending variables						
Lending supply (fraction)	801	0.26	0.09	0.27	0.02	0.45
Short interest (fraction)	801	0.07	0.06	0.04	0.00	0.36
Lending fee (fraction)	801	0.01	0.03	0.00	0.00	0.51
Maturity (days)	801	76.68	48.87	65.88	11.17	270.26
Price impact variables						
Downside cross-autocorrelation	801	-0.12	0.43	-0.10	-2.09	1.26
Upside cross-autocorrelation	801	0.04	0.38	0.04	-1.00	1.30
Downside minus upside	801	-0.18	0.60	-0.15	-4.53	2.48
Skewness	801	0.19	1.42	0.08	-5.44	6.93

Table 6: Differences in Means Between Russell 1000 and Russell 2000 Stocks, Cutoff Sample

This table presents the differences in means between Russell 1000 and Russell 2000 stocks within our 2007-2017 annual panel of stocks for the cutoff sample. For each year the variables are calculated over the third quarter. Detailed definitions of variables can be found in Appendix. *, **, and *** denote statistical significance at 10%, 5% and 1% levels respectively.

Stock-3rd quarter level variables	R1000	R2000	R2000 vs R1000
Ownership variables			
Passive fund ownership	0.08	0.10	0.02***
	(0.05)	(0.05)	(0.00)
Active fund ownership	0.19	0.18	-0.00
	(0.10)	(0.10)	(0.01)
Non-mutual fund ownership	0.54	0.53	-0.02
	(0.16)	(0.16)	(0.01)
Security lending variables			
Lending supply	0.25	0.27	0.02***
	(0.09)	(0.09)	(0.01)
Short interest	0.06	0.07	0.01**
	(0.06)	(0.06)	(0.00)
Lending fee	0.010	0.007	-0.003*
	(0.036)	(0.015)	(0.002)
Maturity	71.91	80.12	8.21**
	(49.36)	(48.58)	(3.49)
Price impact variables			
Downside Cross-Autocorrelation	-0.10	-0.14	-0.05**
	(0.42)	(0.43)	(0.02)
Upside Cross-Autocorrelation	0.07	0.02	-0.05
	(0.40)	(0.37)	(0.03)
Downside-Minus-Upside	-0.18	-0.18	-0.001
	(0.56)	(0.62)	(0.043)
Skewness	0.22	0.17	-0.05
	(1.39)	(1.44)	(0.10)
Observations	318	492	

Table 7: First Stage: Impact of Russell 2000 membership on Passive Fund Ownership

This table reports the results from our first stage regressions for the relationship between Russell 2000 index assignment and passive ownership. Detailed definitions of variables can be found in Appendix. Column (1) reports the results from the specification with first order polynomial. Columns (2) and (3) report the results using the specification with second and third order polynomials. *, **, and *** denote statistical significance at 10%, 5% and 1% levels respectively. Standard errors clustered by stock are in parentheses.

	(1)	(2)	(3)
	y = Passive fund ownership		
Russell 2000	0.02***	0.02***	0.02***
	(0.00)	(0.00)	(0.00)
Observations	787	787	787
R^2	0.51	0.51	0.51
Year x Cutoff fixed effects	Yes	Yes	Yes
Polynomial Order, N	1	2	3

Table 8: Impact of Passive Ownership on Security Lending: 2SLS Regressions

This table reports the results from our instrumental variables regressions for the relationship between passive ownership and securities lending outcomes. Detailed definitions of variables can be found in Appendix. Panel A reports the results for quantities. Columns (1) – (3) report the results for lending supply using polynomials of different orders. Columns (4) – (6) repeat the specifications for short interest. Panel B presents the results for lending fees (columns (1) – (3)) and loan duration (columns (4) – (6)). *, **, and *** denote statistical significance at 10%, 5% and 1% levels respectively. Standard errors clustered by stock are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Quantities						
	y = Lending Supply			y = Short Interest		
Passive fund ownership	2.05***	2.23***	2.23***	0.89**	0.93**	0.94**
	(0.37)	(0.37)	(0.40)	(0.35)	(0.37)	(0.40)
Observations	797	797	797	797	797	797
R^2	0.37	0.34	0.34	0.08	0.06	0.06
Year x Band fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Polynomial Order, N	1	2	2	1	2	3

	(1)	(2)	(3)	(4)	(5)	(6)
Panel B: Fee and Loan Maturity						
	y = Lending Fee			y = Loan Duration		
Passive fund ownership	-0.12	-0.12	-0.11	-51.71	-76.39	-57.39
	(0.11)	(0.12)	(0.12)	(273.92)	(272.35)	(281.38)
Observations	797	797	797	797	797	797
R^2	0.06	0.06	0.06	0.07	0.06	0.07
Year x Band fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Polynomial Order, N	1	2	3	1	2	3

Table 9: Impact of Passive Ownership on Stock Prices: 2SLS Regressions

This table reports the results from our instrumental variables regressions for the relationship between passive ownership and securities prices. Detailed definitions of variables can be found in Appendix. Panel A reports the results for cross-autocorrelations. Columns (1) – (3) report the results for downside cross-autocorrelation using polynomials of different orders. Columns (4) – (6) repeat the specification for upside cross-autocorrelation and columns (7) – (9) present the results for the difference between the upside and the downside cross-autocorrelations. Panel B presents the results for skewness. *, **, and *** denote statistical significance at 10%, 5% and 1% levels respectively. Standard errors clustered by stock are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Cross-Autocorrelation									
	Downside			Upside			Downside Minus Upside		
Passive fund ownership	-4.36**	-4.62**	-5.42**	-3.09*	-2.71	-2.30	-0.98	-1.65	-2.84
	(1.96)	(1.97)	(2.24)	(1.77)	(1.81)	(1.85)	(2.39)	(2.46)	(2.64)
Observations	797	797	797	797	797	797	797	797	797
R^2	0.17	0.15	0.09	0.25	0.27	0.28	0.29	0.27	0.25
Year x Band fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Polynomial Order, N	1	2	3	1	2	3	1	2	3

	(1)	(2)	(3)
Panel B: Skewness			
	Skewness		
Passive fund ownership	4.19	1.92	2.29
	(7.41)	(7.62)	(7.98)
Observations	797	797	797
R^2	0.00	0.03	0.03
Year x band fixed effects	Yes	Yes	Yes
Polynomial Order, N	1	2	3

Appendix: Definition of Variables

Variable name	Source	Definition
Ownership variables		
Passive fund ownership	Thomson Reuters S12 Mutual Fund Holdings	A percentage of shares outstanding held by passively managed funds
Active fund ownership	Thomson Reuters S12 Mutual Fund Holdings	A percentage of shares outstanding held by actively managed funds
Total mutual fund ownership	Thomson Reuters S12 Mutual Fund Holdings	A percentage of shares outstanding held by mutual funds
Total institutional ownership	Thomson Reuters S34 Institutional Holdings	A percentage of shares outstanding held by institutional investors
Non-mutual fund ownership	Thomson Reuters S34 Institutional Holdings	A difference between total institutional ownership and total mutual fund ownership
Non-passive ownership	Thomson Reuters S34 Institutional Holdings	A difference between total institutional ownership and passive fund ownership
Security lending variables		
Lending supply	Markit	A percentage of shares actively available for lending, as indicated by "Active Lending Supply" in Markit
Short interest	Markit	A percentage of shares on loan as indicated by "Quantity on Loan" in Markit
Lending fee	Markit	A lending fee as indicated by "Indicative Fee" in Markit
Loan duration	Markit	A duration of the average loan for a given security as indicated by "Average Tenure" in Markit
Price impact variables		
Downside cross-autocorrelation	CRSP	A correlation between stock returns in time *t* and CRSP value-weighted index returns in time *t-1*, conditional on index return being negative.

Variable name	Source	Definition
Upside cross-autocorrelation	CRSP	A correlation between stock returns in time *t* and CRSP value-weighted index returns in time *t-1*, conditional on index return being positive.
Downside minus upside cross-autocorrelation	CRSP	A difference between downside cross-autocorrelation and upside cross-autocorrelation
Skewness	CRSP	A skewness of daily log-returns.
Other variables		
Log(market value)	CRSP	A natural logarithm of market capitalization
Log(book value)	Compustat	A natural logarithm of book value of equity
Market-to-book	CRSP, Compustat	A ratio of market capitalization to book value of equity
Bid-ask spread	CRSP	A closing daily spread scaled by price
R2000	Russell Investments	Indicator equals one of firm is in the Russell 2000