Do ETFs Have a Bright Side?
Predictive Content of Arbitrage Trading

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ABSTRACT

Prevailing empirical evidence shows ETF ownership impairs price informativeness. The migration of individual investors from stock to ETF ownership, however, simply shifts the secondary market venue for noise trading. APs correct mispricing in ETF shares from noise trading in ETFs through arbitrage trading. Using the ratio of absolute ETF mispricing to dollar trading volume on stocks underlying ETFs as a liquidity proxy for arbitrage trading, we show APs propagate noise trading in ETF shares onto underlying stocks which creates space for acquiring and trading on private information. Future excess returns are higher on stocks where arbitrage trading is more significant.

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SPDR S&P 500 ETF Trust (SPY), first introduced in 1993 by State Street Global Advisors, is the oldest and largest U.S. listed and domiciled equity ETF as of 2019. Between 1993 and August 2019, assets under management (AUM) by index funds which track broad US equity indexes grew to $4.27 trillion, compared to only $4.25 trillion in U.S. listed actively managed equity funds.[1] ETFs allow passive investments in a wide range of stocks by uninformed investors who would otherwise be constrained by transactions costs to invest only in a limited number of transparent and liquid stocks. ETF listing exchanges calculate indicative NAVs at 15-second intervals during exchange trading hours, and ETF shares trade continuously during exchange hours.

Prevailing empirical evidence shows ETF ownership impairs price informativeness (Israeli, Lee, and Shridharan, 2017; Ben-David, Franzoni, and Moussawi, 2018; Madhavan and Sobcyzk, 2014). But the migration of individual investors from stocks to ETFs largely represents a shift in the secondary market venue for noise trading. Roughly 30% of U.S. equity trading volume is attributable to the primary activities of Authorized Participants (APs) in ETF shares (Boroujerdi and Fogertey, 2015; and Pisani, 2015). Herein lies our main research question of interest. If APs correct mispricing in ETF shares from noise trading in ETFs, does arbitrage trading improve price informativeness?

Composite securities like ETFs are not redundant when uninformed investors have to trade to meet immediate liquidity needs, but prices are not fully revealing when some investors are informed. To avoid trading against informed investors, uninformed investors will choose to meet their liquidity needs through ETF rather than individual ownership of stocks (Gorton and Pennachi, 1993; and Subrahmanyam, 1991). As Stambaugh (2014) suggests, high noise trading implies a high capacity for profitable active management. The conjunction of noise trading and active asset management will enhance information efficiency. Stock mispricing from noise-trading by individual investors sparked a growth in actively managed mutual funds (Pastor, Stambaugh and Taylor, 2015). The decline in noise trading from contractions in individual ownership of stocks and correction in stock mispricing from informed trading by active asset managers, however, intensified competition for assets among active asset managers. The popularity of ETFs mirrors a shifting trend away from active managed to passive "indexed" investments prompted by significant cuts in management fees by fund sponsors to appeal to individual investors.

[1] *WSJ* "Where ETFs are headed in 2019" reports that $295 billion flowed into US domiciled ETFs in 2018 alone; 66.8% into stock funds and the remainder to fixed-income funds. 0.3% flowed out of alternative investment funds. *WSJ* "Index Funds Are the New Kings of Wall Street" reports that as of August 2019, assets under management in index equity funds with $4.27 trillion exceed actively managed equity funds with $4.25 trillion. https://www.wsj.com/articles/index-funds-are-the-new-kings-of-wall-street-11568799004?mod=searchresults&page=1&pos=4.

Our study makes two important contributions to the literature. Exploring the spillover effects of ETFs on underlying stocks, our study is the first, to the best of our knowledge, to disentangle arbitrage trading associated with the primary activities of APs from liquidity buffers associated with ETF ownership. Second, taking ETF ownership into account and using a novel measure of liquidity provided by the primary activities of APs, we show arbitrage trading induced by noise trading in ETFs enhances price discovery and informativeness.

We document three key findings. First, arbitrage trading corrects most of the deviations of ETF share price from NAV associated with noise trading in ETF shares. The volume of shares purchased or sold by APs in exchange for ETF shares feeds liquidity back onto underlying stocks which facilitates acquisition and trade on private information by active investors. Due to risk and trading costs that limit arbitrage, however, some ETF share mispricing will remain.

Second, we show ETF share mispricing uncorrected by APs makes space for active investors to become informed about systematic market factors and exploit their informational advantage by trading in ETFs and underlying stocks. The incentive to trade on systematic market factors will depend on the divergence between ETF share price and NAV. Market makers (APs and non-APs) increase spread on stocks underlying ETFs to protect against informed trading on systematic market factors. Consistent with Cong and Xu (2016), we also show informed trading on systematic market factors increases volatility as well as co-movement and synchronicity in underlying stock returns but does not significantly affect secondary market liquidity of underlying stocks.

Third, ETFs are not side contracts. Share lockup affects the demand and supply of underlying stocks. Informed trading in ETF shares and underlying stocks on systematic market factors accelerates the assimilation of future market information into stock prices. Analogous to Glosten, Nallareddy, and Zou (2019), we show informed trading on systematic market factors attenuates post-earnings announcement drifts in cumulative abnormal returns.

To disentangle the liquidity buffer effects of ETF ownership noted in prior literature from the liquidity trading effects associated with the primary activities of APs in this study, we use absolute mispricing to characterize the mispricing of stocks underlying ETFs implied in deviations of ETF share price from NAVs. Multiple ETFs own stocks in common and stock ownership differs across ETFs. We estimate absolute mispricing as the product of absolute deviation in ETF share price from NAV and relative ETF ownership summed across ETFs who own the same stock. Relative ETF ownership on an underlying stock is simply the number of shares owned by an ETF as a fraction of the total number of shares owned by all ETFs.

Expressing absolute mispricing as a percentage of the underlying stock price, we compute the liquidity provided by arbitrage trading as the ratio of absolute mispricing percentage to the aggregate dollar volume of underlying stock purchased or sold by APs across ETFs who own the underlying stock. The feedback liquidity provided by arbitrage trading is high when small dollar volume transactions are sufficient to moderate large absolute mispricing in stocks underlying ETFs.

Our results confirm that arbitrage trading by APs transfers excess liquidity in the secondary markets for ETFs onto the secondary markets of stocks underlying ETFs. Arbitrage trading make secondary markets in stocks underlying ETFs more resilient. The lower likelihood of trading against informed investors and decrease in stock return volatility reduces Corwin-Schultz (2012) bid-ask spreads. Controlling for ETF ownership and arbitrage trading, two-way stock and month fixed effects regressions show a one standard deviation increase in arbitrage trading raises stock liquidity by 2.96% and decreases stock return volatility and spread by 2.00% and 1.89 bps, respectively. Arbitrage trading increases negative autocorrelations in ETF-owned stock returns, though statistically significant only when the concentration of ETF ownership is high. Consistent with higher firm-specific information efficiency, returns on stocks underlying ETFs are less correlated with market returns when arbitrage trading is high. A one standard deviation increase in arbitrage trading lowers market return beta on a 5-factor model by 0.107.

Share lockup from higher ETF ownership reduces liquidity and increases stock return volatility. Two-way stock and month fixed effects regressions show a one standard deviation rise in ETF ownership decreases stock liquidity by 1.69%, increases stock return volatility by 1.94%, and consistent with lower firm-specific information efficiency, increases market return beta on a 5-factor model by 0.029.

ETFs attract a new class of active investors who trade on systematic market factors. Informed trading on systematic market factors in ETFs and underlying stocks increase stock return volatility and spread but do not adversely affect secondary market liquidity in underlying stocks. A one standard deviation rise in absolute mispricing increases stock return volatility by 0.94% and spread by 0.88%. Returns on stocks underlying ETFs exhibit lower positive autocorrelation and are more correlated with market returns when absolute mispricing is high. A one standard deviation in absolute mispricing increases market return beta on a 5-factor model by 0.037.

Lower transactions costs from the primary activities of APs to correct deviations in ETF share price from NAV stimulates investment in acquisition and trade on firm-specific information which enhances price discovery and informativeness. Like ETF ownership, arbitrage trading is persistent.

Sorting stocks into quintile portfolios by ETF ownership and arbitrage trading, the likelihood that stocks in top quintile of ETF ownership and arbitrage trading remain in the top quintiles in the subsequent month are 94.56% and 79.03% respectively.

Active investors in stocks with high arbitrage trading are better informed about future stock returns. High levels of arbitrage trading predict higher future excess stock returns. Compared to stocks in the bottom quintile of arbitrage trading, stocks in the top quintile yield higher average lead one-month 5-factor and 4-factor alpha of 0.688% and 0.469%, and DGTW excess return of 0.440%. Moreover, excess returns on high-low quintile portfolios persist up to lead four months when ETF ownership concentration is low. Two-way stock and month fixed effect regressions confirm stocks with high arbitrage trading have higher excess returns in the subsequent four months. A one standard deviation increase in arbitrage trading predicts an average lead one-month increase in 5-factor alpha of 0.444% 4-factor alpha of 0.368%, and DGTW return of 0.641%.

Lastly, we examine cumulative abnormal returns around earnings announcements. We find that cumulative abnormal returns (CARs) in the three-day window around earnings announcement date and in the 60-day post-earnings announcement period are greater on stocks with high arbitrage trading. A one standard deviation rise in arbitrage trading predicts a higher average lead $CAR(-1,+1)$ of 0.246% and higher average lead $CAR(3,60)$ of 1.512%. Moreover, informed trading on systematic market factors in ETFs and underlying stocks attenuate post-earnings announcement drifts in CAR (Glosten et al., 2019). A one standard deviation rise in absolute mispricing decreases $CAR(3,60)$ by 0.166%. CARs reflect the private information of informed investors made public through earnings disclosures.

II. Empirical Hypotheses and Data Constructs

A. Literature Review

Empirical evidence to date shows ETF ownership impairs price discovery and informativeness. Israeli, Lee, and Shridharan (2017) find that bid-ask spreads and stock return volatility increase with higher ETF ownership. Future earnings are more markedly discounted, and stock returns are more correlated with market returns when ETF ownership is high. The intraday liquidity, short-sale option, convenience, and low transactions cost of ETF shares attract high frequency traders and short-horizon investors. Liquidity and turnover are higher and bid-ask spreads are lower on ETFs than underlying stocks (Ben-David, Franzoni, and Moussawi, 2018; Madhavan and Sobcyzk, 2014). Moreover, Ben-David et al. (2018) find that short-run reversals in price changes from daily ETF fund flows indicate trading in ETFs do not reflect fundamental information. Stocks with higher ETF ownership exhibit higher return volatility, and significantly greater negative autocorrelations in stock returns suggest poorer liquidity in secondary markets for underlying stocks.

In these studies, however, the secondary market liquidity provided by the primary activities of APs are neither considered nor clearly differentiated.

B. Hypotheses

As shown in Figure I, ETFs create liquidity buffers which insulate secondary markets in stocks underlying ETFs from noise trading by short-horizon uninformed investors who are attracted by and migrate to ETFs. Excess volatility in ETF share price from NAV trigger arbitrage trading by APs in stocks underlying ETFs. The transfer of noise trading in ETF shares onto stocks underlying ETFs through arbitrage trading is a liquidity feedback channel.

< Insert Figure I here. >

Liquidity Buffer

Shares of ETF-owned stocks are held in trust. The contraction in the supply of shares available for trading will reduce liquidity and increase return volatility in secondary markets. The higher likelihood of trading against informed investors and increased risk of holding inventory will prompt market makers to increase spread on stocks underlying ETFs. Higher costs of trading will discourage acquisition and trade on firm-specific information. Correlations in stock and market returns will increase with ETF ownership. Stock prices will be less information efficient when ETF ownership is high.

Liquidity Trading   The migration of individual investors from underlying stocks to ETFs by and large represents a shift in the secondary market venue for noise trading. The primary activities of APs in response to deviations in ETF share price from NAV will diffuse uncorrelated demand shocks in ETF shares onto underlying stocks, which increases liquidity and decreases price volatility in secondary markets.[2] The increase in liquidity and decrease in return volatility mitigates the cost of trading against informed investors and risk of holding inventory. Market makers will decrease spread in stocks underlying ETFs. Lower trading costs will encourage acquisition and trade on firm-specific information. The correlation between stock and market returns will decrease with arbitrage trading. Stock prices will be more information efficient when arbitrage trading is high.

Further, divergences of ETF share price from NAV will also attract active investors who choose to become informed about systematic market factors and who exploit their informational advantage

[2]Additionally, when uninformed investors can choose from many competing ETFs, systematic trading in ETF shares from correlated demand shocks declines. Deviations in ETF share price from NAV will be largely idiosyncratic.

by trading in ETFs and underlying stocks. Market makers (APs and non-APs) will increase spread to protect against active investors who trade on systematic market factors. Informed trading on systematic market factors will increase volatility, co-movement and synchronicity in stock returns, and attenuate return drifts.

Concentration of ETF Ownership

As the number of ETFs increase, ETF ownership will increase from overlapping stock holdings. ETF ownership will be more concentrated on stocks owned by a few ETFs and more diffused on stocks widely held by ETFs. Mispricing in stocks underlying ETFs will average out across ETFs when ETF ownership is high but diffuse. Higher concentration of ETF ownership will heighten the impact of arbitrage trading and ETF ownership on secondary markets in stocks underlying ETFs. For stocks with lower ETF ownership concentration, arbitrage trading will diminish systematic correlations in stocks underlying ETFs from common ownership across ETFs.

C. ETF Sample

Morningstar Direct[SM] is our primary source of ETF holdings data. We identify all U.S. domiciled equity ETFs listed on U.S. stock exchanges with U.S. common stock holdings over the 160-months from June 2004 to September 2017. Morningstar Direct[SM] data includes voluntary (monthly) as well as required (quarterly) disclosures of portfolio holdings. Our sample begins in June 2004 to coincide with the U.S. Securities and Exchange Commission (SEC)'s rule change, which for the first time, requires ETF sponsors to report portfolio holdings on a quarterly rather than semiannual basis.[3] Prior to June 2004, most ETF sponsors reported quarterly holdings. The ruling requiring quarterly reporting prompted most ETF sponsors to report not just quarterly but monthly. Starting in June 2004, Morningstar Direct[SM] reports most ETF stock holdings data monthly. Our sample ends September 2017 owing to limited data availability. We use ETF CUSIPs to match our sample of ETFs to the CRSP mutual fund holdings database.

We include sector and international equity ETFs that hold domestic U.S. stocks in our sample but exclude leveraged ETFs and exchange traded notes (ETNs). Leveraged ETFs use futures and other derivatives to achieve leveraged exposure to U.S. equities, and ETNs involve fund sponsor risks that render them unsuitable for analysis in this study. To avoid survivorship bias, we allow the entry and

[3]Under the Investment Company Act of 1940, the SEC adopted a rule in May 2004 that required all registered management investment companies to file a complete schedule of its portfolio holdings on a quarterly basis. Final rule: shareholder reports and quarterly portfolio disclosure of registered management investment companies. SEC File No. S7-51-02 https://www.sec.gov/rules/final/33-8393.htm#IIB4. Subsequently, SEC File No. S7-08-15. https://www.sec.gov/rules/final/2016/33-10231.pdf required the reporting and disclosure of information by registered investment companies to be monthly effective January 2017.

exit of ETFs in our sample. Our final sample consists of 1,080 unique ETFs, ranging from 101 in June 2004 to 773 in September 2017[4].

D. Stock Sample

We obtain daily and monthly closing share prices, volume, shares outstanding, returns, and other data on all common stocks in the CRSP database, but retain only those stocks traded on the NYSE, AMEX, or NASDAQ. Consistent with prior literature, we eliminate stocks with excessively low share prices (below $5) or equity market capitalization (less than $10 million at month end).

Table I reports summary statistics on the total number of CRSP common stocks traded on the NYSE, AMEX, or NASDAQ, and the number of CRSP stocks that meet our screens on minimum share price and equity market capitalization. Column 2 shows the average number of CRSP stocks decreases by 27.0% from a high of 5,350 to a low of 3,904 over the sample period. Columns 3 and 4 show the average number of CRSP stocks that meet our screen is 81.8% of CRSP stocks. The low percentage of 71.2% in 2009 reflects a decline in share prices below $5 and contraction in market capitalization for many firms during the financial crisis. Columns 5 and 6 show the number of stocks owned by ETFs average 3,430 which is 92.6% of our sample of stocks, rising from a low of 86.1% in 2004 to a high of 98.1% in 2015. From 2013 onward, stocks owned by ETFs represent at least 97% of our stock sample.

< Insert Table I here. >

E. ETF Ownership

We construct a monthly time series of ETF ownership on each stock. In month t, $n_{ij}(t)$ denotes shares of stock i owned by ETF j, and $shrout_i(t)$, the total shares outstanding of stock i. The aggregate ETF ownership of stock i in month t, $own_i^{ETF}(t)$ is:

$$own_i^{ETF}(t) = \sum_j n_{ij}(t)/shrout_i(t) \quad (1)$$

We use a Herfindahl-Hirschman Index (HHI) to describe the concentration of ETF ownership. HHI is computed as the square of relative ETF ownership summed across all ETFs $j \epsilon N$ who own stock i at the end of month t.

$$HHI_i^{ETF}(t) = \sum_{j \epsilon N} \left[relown_{ij}^{ETF}(t)\right]^2 \quad (2)$$

and relative ETF ownership, $relown_{ij}^{ETF}(t)$, is the number of stock shares owned by an ETF as a

[4]In Appendix Table AII, we report the top 10 ETF advisory firms by number of funds, the distribution of average fund size (in millions of dollars) and number of unique stocks owned across ETFs over the entire sample period, and for the end (September 2017) and the beginning (June 2004) months.

percentage of the aggregate number of stock shares owned by ETFs at month end.

$$relown_{ij}^{ETF}(t) = n_{ij}(t)/\sum_{j\epsilon N} n_{ij}(t) \quad (3)$$

A small (high) HHI indicates a diffuse (concentrated) distribution of ETF share ownership in the stock. In each month, dummy variable High HHI equals 1 when ETF ownership concentration in the stock is above median, and 0, otherwise. Similarly, Low HHI dummy equals 1 when ETF ownership concentration in the stock is equal or below median, and 0, otherwise.

Table I reports annual averages of monthly ETF ownership on stocks held by ETFs, as well as average quarterly active and index mutual fund ownership on stocks both held and not held by ETFs. We use the CRSP Mutual Funds holdings database to construct stock level mutual fund ownership. Following the literature, for mutual funds with multiple share classes, we ascribe the characteristics of the largest share class to the fund. We eliminate ETFs from mutual funds using an ETF identifier, and separate active from index mutual funds using both an index fund identifier and fund names. Active (index) mutual fund ownership is the aggregate number of shares owned by active (index) mutual funds at the end of quarter q, expressed as a percentage of total shares outstanding for stock i. We use quarter end active (index) mutual fund ownership for the three months in the quarter.

Column 7 shows the mean ETF ownership of stocks held by ETFs rose markedly from 2.1% to 9.9% concurrent with an increase in the percentage of CRSP stocks held by ETFs from 86.1% to 98.1%. The number and percentage of shares outstanding held by ETFs grew steadily with the large influx of net money flows into ETFs.

Active and index mutual fund ownership of stocks underlying ETFs are reported in Columns 8 and 9, and non-ETF held stocks, in Columns 12 and 13. We draw four observations. First, active mutual funds have significant ownership interests in stocks underlying ETFs, averaging 16.1% over the sample period. Second, among ETF held stocks, active mutual fund ownership grew faster than ETF ownership in the first five years of our sample period reaching a peak of 18.7% in 2009, which is more than three times ETF ownership. Thereafter, active mutual fund ownership declined, and by 2017 active mutual fund ownership of 15.2% is less than two times ETF ownership, reflecting a secular shift from active to passive investments. Third, index mutual fund ownership, which average 5.0% over the sample period, also grew steadily from 3.5% at the start to 7.2% at the end of the sample period. Index mutual fund ownership comes close but never exceeds ETF ownership. Fourth, mutual funds also have meaningful ownership interests in non-ETF held stocks. The ownership of non-ETF held stocks by active and index mutual funds average 1.93% and 0.55% over the sample period, from a high of 3.2% and 1.1% at the start to 1.0% and 0.24% at the end of the sample period. The average number of non-ETF held stocks is441 over the sample period which exhibits a similar decline from 799 stocks at the start to 149 at the end of the sample period.

F. Arbitrage Trading

We introduce a new measure of arbitrage trading to describe the liquidity provided by APs.[5] We define vol_i^{ETF} as the sum of purchases and sales of shares in stock i across contiguous months[6] aggregated across ETFs who own the stock.[7]

$$vol_i^{ETF}(t) = share\ purchases_i(t) + |share\ sales_i(t)| \tag{4}$$

where positive $n_i(t) - n_i(t-1)$ denotes monthly aggregate purchases, and negative $n_i(t) - n_i(t-1)$ denotes monthly aggregate sales, of shares in stock i.

We compute average absolute mispricing in an ETF-owned stock i in month t, $|misprice_{it}^{ETF}|$, as the product of the monthly average absolute daily deviation of ETF share price from NAV, $|prc_{jt}^{ETF} - NAV_{jt}^{ETF}|$, and relative ETF ownership percentage, $relown_{ij}^{ETF}(t)$, summed across all ETFs $j\epsilon N$ who own stock i in month t.

$$|misprice_{it}^{ETF}| = \sum_{j\epsilon N}\{|prc_{jt}^{ETF} - NAV_{jt}^{ETF}| * relown_{ij}^{ETF}(t)\} \tag{5}$$

We define arbitrage stock returns as $|misprice_{it}^{ETF}|/prc_{it}$, and the liquidity provided by arbitrage trading at_{it}^{ETF} as:

$$at_{it}^{ETF} = \frac{|misprice_{it}^{ETF}|/prc_{it}}{vol_{it}^{ETF}} \tag{6}$$

In (6), vol_{it}^{ETF} is denominated in millions of shares. Arbitrage trading captures the correlation between the volatility in arbitrage stock return and the aggregate sum of purchases and sales of stocks underlying ETFs by APs. The liquidity provided by arbitrage trading is high when the primary activities of APs to constrain absolute deviations in ETF share price from NAV only require small dollar volumes of stocks underlying ETFs to be purchased or sold. Large values of at_{it}^{ETF} indicate that small dollar trading volumes in stocks underlying ETFs are sufficient to moderate volatility in arbitrage stock

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[5]See "What is the Creation/Redemption Mechanism?" at https://www.ETF.com. APs are broker dealers or financial institutions who buy and sell constituent stocks to create and redeem ETF shares. When increased demand causes ETF share prices to trade at premiums to its Net Asset Value (NAV), APs purchase a basket of stocks in exchange for new ETF shares of equal NAV. Conversely, when decreased demand causes ETF share prices to trade at discounts to its NAV, APs purchase ETF shares in exchange for a basket of stocks of equal NAV. The arbitrage profit of APs that result from the creation and redemption of ETF shares constrains the deviations of ETF share prices from NAV.

[6] We interpolate missing monthly stock holding observations by assuming ETF stock purchases and sales are distributed evenly across missing months based on average holdings for current and prior months. A missing observation is recorded when an ETF fails to report holdings for 6 consecutive months.

[7]The monthly volume of shares purchased across ETFs is $\sum_j(n_{ij}(\tau) - n_{ij}(\tau-1)|n_{ij}(\tau) - n_{ij}(\tau-1) \geq 0)$ and monthly volume of shares sold across ETFs is $\sum_j(n_{ij}(\tau) - n_{ij}(\tau-1)) - \sum_j(n_{ij}(\tau) - n_{ij}(\tau-1)|n_{ij}(\tau) - n_{ij}(\tau-1) \geq 0)$.

returns.[8] To adjust for skewness, we use $ln(at_{it}^{ETF})$ to proxy for the liquidity provided by arbitrage trading.

We should point out that APs do not receive any compensation from ETF fund sponsors and have no legal obligation to create or redeem ETF shares.[9] APs derive their compensation acting as broker-dealers in ETF shares and on a typical day will respond to premiums or discounts in ETF share price from NAV either through the purchase and sale of ETF shares from inventory or through short-term long-short positions in ETF shares and derivative contracts. APs will manage their inventories by creating or redeeming ETF shares when it is in their economic interest given market conditions. On average, daily trading volume in ETF shares is 4 times the volume of ETF shares created or redeemed, and on a given day, there is no creation or redemption of ETF shares by APs in 91% of domestic equity ETFs. Average daily trading in domestic equity ETF shares in secondary markets represent 91% of total primary and secondary market activity. Most domestic equity ETFs and ETFs with more than $790 million in AUM do not have significant daily creations or redemptions of ETF shares because APs are also registered market makers. Further, there are a large number of broker-dealers and other market makers who are not APs but provide two-sided quotes on ETF shares and augment the liquidity of ETF shares traded on secondary markets. Using absolute mispricing and daily changes in ETF shares outstanding as proxies for the creation and redemption of ETF shares will considerably overstate arbitrage trading particularly in smaller ETFs where number of active APs involved in at least one transaction involving the creation or redemption of ETF shares over a 6-month period is low.

< Insert Figure II here. >

Over the sample period 2004:06 to 2017:09, the rise in median ETF ownership and fall in median liquidity provided by arbitrage trading indicates a bifurcation in the concentration of ETF ownership from a sharp rise in the number of ETFs. Figure II Panel A shows a concave cross-sectional relationship between the liquidity provided by arbitrage trading and ETF ownership. In Figure II Panel B, the liquidity provided by arbitrage trading increases with declining ETF ownership when the concentration of ETF ownership is above median. When the concentration of ETF ownership is below median, the liquidity provided by arbitrage trading increases with expanding ETF ownership. Similarly, in each month, we sort stocks into a high and low N ETF portfolios by the number of ETFs

[8]In contrast, Amihud (2002) illiquidity is high when small changes in traded dollar volume are sufficient to cause (rather than moderate) high stock return volatility.
[9]See Rochelle Antoniewicz and Jane Heinrichs, Investment Company Institute, The Role and Activities of Authorized Participants of Exchange-Traded Funds (Mar. 2015), available at http://www.ici.org/pdf/ppr_15_aps_etfs.pdf.

who own the same stock. If the number is above median, High N ETF dummy equals 1, and 0, otherwise. If the number is below the median, Low N ETF dummy equals 1, and 0, otherwise. The arbitrage trading-ETF ownership relation in the low N ETF portfolio is like that for the high HHI portfolio, and in the high N ETF portfolio is like that for the low HHI portfolio.

G. Secondary Market Impact Variables

Stock Return Volatility and Illiquidity

For each stock, return volatility is measured as the standard deviation of daily stock returns $r_{i,t}$ in a month. To examine the effect of arbitrage trading and ETF ownership on liquidity, we use a daily Amihud (2002) stock illiquidity measure, $illiq_{i,d}$, to capture the correlation between absolute stock return and traded dollar volume.

$$illiq_{i,d} = |r_{i,d}|/dvol_{i,d} \tag{7}$$

where $r_{i,t}$ and $dvol_{i,d}$ denote the daily return and dollar volume traded on day d of stock i expressed in millions of dollars. Higher values of $illiq_{i,d}$ indicate lower liquidity. A small change in traded dollar volume is sufficient to cause a large change in absolute stock return.

To avoid potential contamination from outliers, we eliminate the top and bottom 1%, and for each stock, we compute monthly liquidity, $illiq_{i,t}$, as daily illiquidity averaged over days in the month. We use changes in the natural log of monthly Amihud illiquidity, $\Delta ln(illiq_{i,t}) = ln(illiq_{i,t}/illiq_{i,t-1})$, to proxy for monthly changes in illiquidity.

Bid-Ask Spread

As a proxy for trading cost, we use Corwin and Schultz (2012) to compute a stock's daily spread $S_{i,d}$ as:

$$S_{i,d} = \frac{2(e^{\alpha}-1)}{1+e^{\alpha}} \quad \alpha = \frac{\sqrt{2\beta}-\sqrt{\beta}}{3-2\sqrt{2}} - \sqrt{\frac{\gamma}{3-2\sqrt{2}}} \quad \gamma = [\,Ln\,(\frac{H^{O}_{d,d+1}}{L^{O}_{d,d+1}})\,]^2 \quad \beta = \sum_{j=0}^{1}\,[\,Ln\,(\frac{H^{O}_{d+j}}{L^{O}_{d+j}})\,]^2 \tag{8}$$

setting negative daily spreads to zero. Observed daily high–low price ratios have a stochastic time-varying component which reflects the variance in intraday stock return and a time-invariant fixed bid-ask spread. The Corwin-Shultz measure captures the time-invariant "true" bid-ask spread. Monthly spread is estimated as daily spread averaged over days in the month, and we require at least 12 daily observations in a month to calculate monthly spread.

Noise Trading

To proxy for noise trading, we use an AR1 process on daily stock returns to estimate the autocorrelation $\rho_{i,t}$ for each stock i over days in month t. We compute the k-settlement period variance ratio, $vratio_{i,t}$, as the variance of k-period returns divided by k times the variance of single-period returns, to assess the transitory component of stock prices over a fixed window of interest.

$$vratio_{i,t} = \frac{var(ret_{i,t,:t+k})}{k* var(ret_{i,t,:t+1})} = \frac{k*var(ret_{i,t,:t+1})+k(k-1)\rho_{i,t}var(ret_{i,t,:t+1})}{k* var(ret_{i,t,:t+1})}$$
$$= 1 + (k-1)\rho_{i,t} \quad (9)$$

where $ret_{i,t,:t+k}$ is the k-settlement period return, $ret_{i,t,:t+1}$ is the single-period return, and $\rho_{i,t}$ is the one-period autocorrelation in single-period return. A variance ratio less than 1 substantiates return reversals associated with the price pressure effects of demand imbalances from noise trading. Decreases in variance ratios below 1 indicate higher levels of noise trading.

As in Ben-David et al. (2018), we set $k = 5$ to represent weekly stock returns.[10] APs place orders to create or redeem shares with ETF fund sponsors during or at end of day. The settlement date is typically trade date plus three days ($T + 3$). If an AP fails to deliver the securities to the fund sponsor on $T + 3$, the AP must post collateral until delivery occurs. However, as market makers, APs have up to six days after trade date ($T + 6$) to settle with counterparties. APs may delay settlement because it could be cheaper to cover a short ETF position or sell a long ETF position through stock trades in the secondary securities market rather than creation or redemption of ETF shares with fund sponsors. Rule 204 of SEC regulation SHO issued in July 2009 on short-sales states "… subject to certain conditions, fails to deliver resulting from long sales or certain bona fide market making activity must be closed out by no later than the beginning of regular trading hours on the third settlement day after settlement date ($T + 6$)."[11]

Market Return Beta

Market return betas are estimated beta coefficients on market returns generated from monthly time-series regressions of daily excess returns using a Fama and French (2015) 5-factor and Carhart (1997) 4-factor model. We use market betas to estimate the covariance of stock with market returns.

III. Descriptive Statistics and Attributes of Stocks Owned by ETFs

Table II Panel A reports summary descriptive statistics for variables used in our analysis. Variable definitions are summarized in Appendix Table I. Our final sample contains 521,252 stock-month

[10]Results are essentially the same for 4 and 6 settlement days.

[11]The SEC report generated from the National Securities Clearing Corporation's (NSCC) Continuous Net Settlement (CNS) system does not properly capture the additional 3 days that market makers have before their trades are considered fails under Regulation SHO. A legitimate market maker trade in an ETF that settled in 4 days would show up as a "failure" under the conventional reporting scheme where all equity trades settling after 3 days are marked as fails. Supposedly higher failure-to-deliver rates in ETF shares may merely represent greater market making activity in portfolios versus comparable volume single-name equities.

observations from June 2004 to September 2017. Averaged over sample period, the natural log of arbitrage trading has a mean (median) of -7.82 (-8.00), and standard deviation of 2.67. During our sample period, ETF ownerships are comparable to index mutual fund ownerships, much smaller than active mutual fund ownership. ETF ownership has a mean (median) of 4.8% (4.0%), with a standard deviation of 4.0%. Mean (median) active mutual fund ownership is 15.1% (14.4%), with a standard deviation of 11.5%, and mean (median) index mutual fund ownership is 4.6% (4.2%) with a standard deviation of 3.4%.

< Insert Table II here. >

Table II Panel B reports average ETF ownership, active and index mutual fund ownership, as well as absolute mispricing by quintiles of arbitrage trading. Stocks are sorted into quintiles at the end of each month by arbitrage trading and quintiles are linked over the sample period. Stocks in the highest quintile of arbitrage trading have the lowest ETF and active (index) mutual fund ownership, and stocks in the lowest quintile have the higher ETF and active (index) mutual fund ownership. The average difference in ETF ownership between high and low quintiles of arbitrage trading of -4.17% is significant at the 1% level. The average differences in active and index mutual fund ownership between high and low quintiles of arbitrage trading of -11.75% and -2.49% respectively are both significant at the 1% level. The average difference in absolute mispricing between high and low quintiles of arbitrage trading of 0.02% is significant at the 1% level.

Table II Panel C reports the percentage of stocks sorted into quintile portfolios by arbitrage trading and ETF ownership that are constituent stocks in the DJ30 and S&P500. ETF ownership is highest in the middle quintile portfolio; 31.26% of the stocks are in the S&P500, and 1.45%, in the DJ30. The primary activities of APs are more significant, however, in ETFs that do not have constituent stocks in the S&P500 and DJ30. In the bottom quintile portfolio of stocks sorted by arbitrage trading, 63.94% are in the S&P500 and 2.55% are in the DJ30.

< Insert Table III. >

Table III reports the characteristics of ETF-owned stocks sorted each month into quintile portfolios by arbitrage trading and ETF ownership, as well as into ETF ownership concentration (HHI) portfolios by above and below median ETF ownership. Summary portfolio statistics on variables used in our analysis are computed at the end of each month and linked over the sample period to form a time-series. For brevity, we only report the top and bottom quintile portfolios of stocks sorted by arbitrage trading and ETF ownership.

Noise trading by uninformed investors in ETFs is more likely to trigger arbitrage trading by APs when the underlying stocks are associated with informationally opaque firms, and ETF ownership of underlying stocks is low and highly concentrated. Stocks in the top arbitrage trading quintile portfolio are relatively small market capitalization stocks, with low growth and low profitability, low price, and low CRSP turnover. Compared to stocks in the lowest arbitrage trading quintile portfolio, stocks in the top arbitrage trading quintile portfolio also exhibit significantly lower liquidity, higher average volatility, and higher Corwin-Schultz bid-ask spread.

Absolute mispricing is greater on stocks where arbitrage trading is high. Difference of 0.023% in absolute mispricing between the top and bottom arbitrage trading quintiles is significant at 1% level. Though insignificant, absolute mispricing is greater on stocks where ETF ownership is high but HHI is low.

In the next section we examine the impact of arbitrage trading and ETF ownership. Dependent variables and regressors are winsorized[12] and normalized by their standard deviations over the sample period, except for abnormal returns and cumulative abnormal returns. Definitions of control variables can be found in Appendix Table I Variable Definitions.

IV. Secondary Market Impact of Arbitrage Trading and ETF Ownership

A. Stock Return Illiquidity and Volatility

Two-way stock and month fixed effects regressions on changes in illiquidity and stock return volatility are reported in Table IV Panels A and B, respectively. For half of the model specifications, we control for one-month lag in dependent variables and for the other half, we control for three months of lags. Errors are clustered by stock and month. Coefficients on size, book-to-market, momentum, CRSP turnover, inverse price, and profitability are reported in Appendix Table III.

< Insert Table IV here. >

<u>Illiquidity</u>

Column 1 in Table IV Panel A supports the liquidity trading hypothesis on arbitrage trading. Primary activities of APs, which propagate noise trading in ETF shares by uninformed investors onto underlying stocks, increases secondary market liquidity. A one standard deviation increase in arbitrage trading results in a positive change in secondary market liquidity of 2.96% (=0.058*0.511), where 0.511 is the standard deviation of changes in illiquidity reported in Table II Panel A. An increase in arbitrage trading from the median to the 75th percentile, will raise secondary market liquidity by 1.89% (=0.058*0.511*(7.996-6.292)/2.668). Results are statistically significant at the 1% level and robust to

[12]Winsorized by the top and bottom 1% when values can be positive or negative, and winsorized by top 1% when values racan only be positive.

control for three months of lags reported in Column 2.

Further, Column 1 supports the liquidity buffer hypothesis on ETF ownership. The lockup of ETF-owned shares in trust reduces the supply of ETF-owned stocks available for trade in secondary markets. The reduction in float decreases stock liquidity. A one standard deviation increase in ETF ownership results in a negative change in secondary market liquidity of 1.69% (=0.033*0.511). An increase in ETF ownership from the median to the 75^{th} percentile will lower secondary market liquidity by 1.32% (=0.033*0.511*(7.13%-3.98%)/4.02%). Results are statistically significant at the 1% level and robust to control for three months of lags in reported in Column 2.

In column 3 and 4, we add absolute mispricing as a control variable to the model specifications in column 1 and 2 respectively. Our prior findings remain qualitatively the same. As Cong et al. (2016) note, informed trading on systematic market factors in ETFs and underlying stocks will not necessarily have an adverse effect on the liquidity of underlying stocks.

Concentration in ETF ownership accentuates the statistically significant positive effects of arbitrage trading and negative effects of ETF ownership on secondary market liquidity. In Columns 5 and 6, the liquidity provided by arbitrage trading is 26% (=(0.072/0.057)-1) to 71% (=(0.058/0.034)-1) higher when concentration in ETF ownership is below median. In contrast, the decline in liquidity from a one standard deviation increase in ETF ownership is 83% (=(0.042/0.023)-1) to 86% (=(0.082/0.044)-1) higher when concentration in ETF ownership is above median.

Across all model specifications, active mutual fund ownership increases the secondary market illiquidity of ETF owned stocks. In Columns 1 and 2, which control for one-month and three months of lags in delta illiquidity, a one standard deviation in active mutual fund ownership will increase illiquidity by 1.02% (=0.020*0.511) to 1.48% (=0.029*0.511). An increase in correlated trading by active mutual fund managers some of whom are also likely to be better informed can propagate price pressures that crowd out trades by individual investors. Chordia, Roll, and Subrahmanyam's (2000) find that institutional trading is a significant source of commonality of liquidity among stocks. The sensitivity of the stock's liquidity to aggregate liquidity shocks increases with institutional ownership (Kamara, Lou, and Sadka, 2008). Stocks held in common by active mutual funds who tend to trade in the same direction from correlated net fund flows will induce strong co-movements in liquidity (Koch, Ruenzi, Starks, 2016).

<u>Return Volatility</u>

The effects of arbitrage trading and ETF ownership on stock return volatilities also support the liquidity trading and liquidity buffer hypotheses. As conjectured, the decrease in the monthly volatility of daily stock returns from arbitrage trading and increase from ETF ownership corroborates the increase in secondary market liquidity from arbitrage trading and decrease from ETF ownership. In Column 7 of Table IV Panel B, a one standard deviation rise in arbitrage trading decreases average stock return volatility by 2.00% (=0.032*0.015/0.024), where 0.024 and 0.015 are the mean and standard deviation of stock return volatility reported in Table II. A one standard deviation rise in ETF ownership increases average stock return volatility by 1.94% (=0.031*0.015/0.024). Results are statistically significant at the 1% level and robust to control for three months of lags in return volatility reported in Column 8.

Additionally, as Cong et al. (2016) show, we find informed trading in ETFs and underlying stocks on systematic market factors increases return volatility in underlying stocks. A one standard deviation rise in absolute mispricing increases average return volatility by 0.94% (=0.015*0.015/0.024) controlling for a one-month lag in volatility in Column 9, and by 0.88% (=0.014*0.015/0.024) controlling for three months of lags in volatility in Column 10. Moreover, the impact of arbitrage trading and ETF ownership on volatility are unchanged when we account for absolute mispricing.

When arbitrage trading is differentiated from ETF ownership, the liquidity buffer impact of ETF ownership is considerably smaller than those reported in Ben-David et al. (2018) which confounds arbitrage trading with ETF ownership. We compare our results in Column 8 to theirs in Table IV Panel A which control for three months of lags in return volatility. In our Column 8, a one standard deviation rise in ETF ownership increases average return volatility by 1.44% (=0.023*0.015/0.024). In Column 8 of Ben-David et al. (2018) Table IV Panel A, a one standard deviation rise in ETF ownership increases average return volatility on S&P500 stocks by 5.36% (=0.077*0.0140/0.0201) and by 3.57% (=0.053*0.0176/0.0261) on Russell 3000 stocks.

Columns 11 and 12 in Table IV Panel B corroborate the effect of ETF ownership concentration on liquidity in Columns 5 and 6. The percentage decrease in stock return volatility from increased arbitrage trading is more pronounced on low HHI stocks, and an increase from ETF ownership is more pronounced on high HHI stocks.

B. Bid-Ask Spread and Noise Trading

If the migration from stocks to ETFs are largely dominated by individual investors, deviations in ETF share price from NAV resulting from demand shocks in ETF shares are unlikely to embed fundamental information. The diffusion of uninformed demand shocks in ETF shares onto underlying stocks through the primary activities of APs will be seen by market makers as noise trading. For market makers, the likelihood of trading against informed investors is diminished. Taken together with a lower cost of holding inventory from higher secondary market liquidity and lower return volatility, a lower adverse selection cost will prompt market markers to reduce spread on ETF-owned stocks in secondary markets.

In contrast, the reduction in effective float from higher ETF ownership decreases secondary market liquidity, increases return volatility and increases the likelihood that market makers will trade against informed investors. The higher cost of holding inventory and adverse selection cost will prompt market markers to raise spread on ETF-owned stocks in secondary markets. A higher cost of trading from ETF ownerships will restrain noise trading in ETF-owned stocks on secondary markets.

Two-way stock and month fixed effects regressions on spread and variance ratio (noise trading) are reported in Table V Panels A and B. For half of the model specifications, we control for one-month lag in dependent variables and for the other half, we control for three months of lags. Errors are clustered by stock and month. Coefficients on size, book-to-market, momentum, CRSP turnover, inverse price, and profitability are reported in Appendix Table III.

<Insert Table V here.>

Corwin-Schultz Spread

The impact of arbitrage trading on Corwin-Schultz average daily spread in a month supports the liquidity trading hypothesis. As conjectured, in Column 1 of Table V Panel A, a one standard deviation increase in arbitrage trading decreases spread by 1.89 bps (=0.035*54.051), where 54.051 is the standard deviation in spread reported in Table II. A median to the 75th percentile increase in arbitrage trading decreases spread by 1.21 bps (=0.035*54.051*(7.996-6.292)/2.668), or 1.37% (=1.21/88.205) of average spread reported in Table II. The increase in spread is statistically significant at the 1% level and robust to control for three months of lags reported in Column 2.

Though statistically insignificant, a one standard deviation rise in ETF ownership increases spread by 0.594 bps (=0.009*54.051). A median to the 75th percentile rise in ETF ownership increases spread by 0.47 bps (=0.009*54.051*(7.13%-3.98%)/4.02%), or 0.466% (=2.29/88.205) of average spread reported in Table II.

In Columns 3 and 4, the impact of arbitrage trading on Corwin-Schultz spreads are unchanged controlling for absolute mispricing. Further, as Cong et al. (2016) show, market makers will protect themselves against informed trading on systematic market factors in ETFs and underlying stocks. A one standard deviation rise in absolute mispricing increases spread by 0.973 bps (=0.018*54.051) or 1.10% (=0.973/88.205) of its mean. Results are significant at the 1% level and robust to control for three months of lags in spread, and as shown in Appendix Table IV, is unchanged when we use residual absolute mispricing, which is orthogonal to arbitrage trading, instead.

In Column 5, the impact of ETF ownership on spread is statistically significant when the ownership of ETF stocks is narrowly concentrated among a few ETFs. When HHI is above median, a one standard deviation increase of ETF ownership increases spread by 0.973 bps (=0.018*54.051). A median to the 75th percentile increase in ETF ownerships increases spread by 0.762 bps (=0.018*54.051*(7.13%-3.98%)/4.02%) or 0.86% (=0.762/88.205) of its mean, significant at the 5% level. In Column 6, results are similar and significant at the 10% level controlling for three months of lags in spread.

Noise Trading

Returns are mean reverting when trading is prompted by non-fundamental information driven demand shocks. Negative autocorrelations reflect return reversals from episodes of buying or selling pressure on price associated with noise trading. Variance ratios less than 1 reflect return reversals.

In Table V Panel B, the concurrence of negative and positive coefficients on arbitrage trading in Columns 7 and 13, and similarly in Columns 8 and 14, indicate decreases in variance ratio come from variance ratios below 1. As conjectured, noise trading increases with arbitrage trading. In Column 7, a one standard deviation rise in arbitrage trading decreases variance ratio as a percentage of its average by 2.63% (=0.019*0.916/0.662), where 0.662 and 0.916 are the mean and standard deviation of the variance ratio reported in Table II. A median to the 75th percentile rise in arbitrage trading decreases variance ratio as a percentage of its average reported in Table II by 1.83% (=(0.019/0.662)* (7.996-6.292)/2.668). In Column 8, results are similar and significant at the 5% level controlling for three months of lags in variance ratio.

Higher return reversals substantiate the diffusion of uninformed demand shocks in ETF shares onto underlying stocks through arbitrage trading is predominantly in the form of noise trading. Moreover, taken together with Columns 9 and 15, Columns 11 and 17 suggest increases in noise trading from arbitrage trading are greater on stocks when the concentration of ETF ownership is high, that is, when stocks are narrowly owned by a few ETFs.

Further, as conjectured, the reduction in liquidity and higher cost of trading from share lockup discourages noise trading. In Columns 7 and 8, as well as Columns 9 and 10, ETF ownership has no significant impact on variance ratios controlling for one-month or three months of lags in variance ratio. However, ETF ownership has a significantly negative effect on variance ratios when the concentration of ownership is high. The negative coefficients on ETF ownership when HHI is high in Columns 11 and 17, and similarly in Columns 12 and 18, indicate decreases in variance ratios from higher ETF ownership when variance ratios are above 1. Positive autocorrelations in returns will be less evident on ETF-owned stocks that are narrowly held by ETFs. Though insignificant, the positive and negative coefficients on ETF ownership when HHI is low in Columns 11 and 17, and similarly in Columns 12 and 18, show noise trading decreases with ETF ownership when underlying stocks are widely held by ETFs.

Moreover, high absolute mispricing will attenuate positive autocorrelation in returns when there are informed investors who trade on systematic market factors in ETFs and underlying stocks. Columns 11 and 12 in conjunction with Columns 17 and 18, shows a one standard deviation in absolute mispricing decreases drift in returns by 0.92% (=-0.010*0.916), significant at the 5% level. As shown in Appendix Table IV, the effects of informed trading on systematic market factors in ETFs and underlying stocks are robust when we use residual absolute mispricing, which is orthogonal to arbitrage trading, instead.

C. Market Return Beta

The decrease in bid-ask spread and increase in noise trading from higher arbitrage trading predicts lower market return betas. Conversely, the increase in bid-ask spread and decrease in noise trading from higher ETF ownership predicts higher market return betas.

Two-way stock and month fixed effects regressions on market return betas estimated from Carhart (1997) 4-factor and Fama-French (2015) 5-factor model are reported in Table VI. Errors are clustered by stock and month. Coefficients on size, book-to-market, momentum, CRSP turnover, inverse price, and profitability are reported in Appendix Table III.

< Insert Table VI here. >

As conjectured, arbitrage trading decreases the market return betas of ETF-owned stocks, significant at the 1% level. In Column 1 of Table VI, a one standard deviation increase in arbitrage trading decreases Carhart (1997) 4-factor market return beta by 0.105 (=0.094*1.117) where 1.117 is the standard deviation of 4-factor market return beta reported in Table II. A median to the 75th percentile rise in arbitrage trading decreases the 4-factor market return beta by 0.067 (=0.094*1.117*(7.996-6.292)/2.668), or 7.60% (=0.067/0.882) of its average reported in Table II. In Column 2, results are significant at the 1% level and robust to control for three months of lags in market return beta.

In contrast, ETF ownership increases the market return betas of ETF-owned stocks, significant at the 1% level. As conjectured, in Column 1, a one standard deviation rise in ETF ownership increases Carhart (1997) 4-factor market return beta by 0.037 (=0.033*1.117). A median to the 75th percentile rise in ETF ownership increases 5-factor market return beta by 0.029 (=0.033*1.117*(7.13%-3.98%)/4.02%) representing 3.27% (=0.029/0.882) of its average. Results are significant at the 1% level and robust to control for three months of lags in Column 2. Results on arbitrage trading and ETF ownership are essentially unchanged when absolute mispricing is considered.

Moreover, as Cong et al. (2016) show, informed trading on systematic market factors will increase co-movement and synchronicity in underlying stock returns. In Columns 3 and 4, a one standard deviation rise in absolute mispricing will increase market return beta on a 4-factor model by 0.047 (=0.042*1.117) and 0.041 (=0.037**1.117), and 5-factor model by 0.043 (=0.038*1.133) and 0.040 (=0.035*1.133) respectively, controlling for one-month lag and three months of lags in market return beta. Results are significant at the 1% level, and as shown in Appendix Table IV, are robust when we use residual absolute mispricing, which is orthogonal to arbitrage trading, instead.

Columns 5 and 6 show the decrease in market return beta from arbitrage trading is more pronounced on low HHI stocks, and an increase from ETF ownership is more pronounced on high HHI stocks. Results are statistically significant at the 1% level and robust to control for three months of lags. Moreover, the impact of arbitrage trading and ownership on 4-factor market return betas estimated from Fama-French (2015) 5-factor model in Columns 11 and 12 are essentially the same.

Overall, our findings support the liquidity buffer and liquidity trading hypotheses. The share lockup from ETF ownership creates a liquidity buffer which decreases secondary market liquidity and increases stock return volatility. At the same time, the migration of investors from stocks to ETFs strengthens liquidity trading. Shocks in uninformed investor demand for ETF shares induce deviations in ETF share prices from NAVs which trigger arbitrage trading. The purchases and sales of ETF-owned stocks in secondary markets creates a liquidity trading feedback channel which transmits liquidity shocks in ETF shares onto underlying stocks and decreases stock return volatility. Moreover, absolute mispricing uncorrected by arbitrage trading prompts informed trading on systematic market factors.

In the next section, we show arbitrage trading creates space for informed trading in stocks underlying ETFs which enhances price discovery. Excess returns, which reflect the economic gains on costly private information, will be greater on stocks where arbitrage trading is high.

V. Does Arbitrage Trading Signal Private Information?

A. Persistence of Arbitrage Trading

To assess persistence, we sort stocks by arbitrage trading into quintiles each month. The percentage of stocks that either remain or change to another quintile in the subsequent month are computed each month. We construct a transition matrix for arbitrage trading by averaging the percentage changes across months in the sample period. The average percentage of stocks that remain in the same quintile are along the diagonal, and the percentage of stocks that change quintiles are in the off diagonals.

< Insert Table VII here. >

The transition matrix for arbitrage trading and a similarly constructed transition matrix for ETF ownership are reported in Table VII. The dominant diagonal shows that arbitrage trading exhibits a significant predictable component. The likelihood that stocks with top quintile of arbitrage trading in the prior month will remain in the top quintile of arbitrage trading in the current month is 79.03%. Changes in ETF ownership decay more slowly.

B. Future Excess Returns

We use three excess return proxies. From time-series regressions of daily stock returns, we estimate an average daily alpha using a Fama and French (2015) 5-factor model as well as Carhart (1997) 4-factor model. Average daily alphas are compounded to obtain average monthly alphas. Daniel, Grinblatt, Titman and Wermers (1997) returns are estimated as monthly stock returns minus returns on a benchmark portfolio of stocks sorted by size and book-to-market to which the stock belongs. We link the estimated average monthly buy-and-hold excess returns to form a time-series of monthly excess returns.

Given the persistence of arbitrage trading, we examine excess returns in lead one to four months following the formation of quintile portfolios from stocks sorted by arbitrage trading each month. To compute quintile portfolio excess returns, we compute the value-weighted portfolio monthly 5-factor and 4-factor alphas and DGTW excess returns across stocks in the portfolio. We link the monthly quintile portfolio returns across months in the sample period to form a time-series of excess returns.

< Insert Table VIII here. >

Results corroborate our conjecture that excess returns will be greater on ETF-owned stocks where uninformed trading on ETF shares stimulate high levels of arbitrage trading by APs. As evident in Table VIII Panel A, high-low quintile portfolios sorted on arbitrage trading yield significant average lead one month 5-factor and 4-factor alphas of 0.688% and 0.469%, and DGTW excess return of 0.440%. Moreover, 47.7% and 94.5% of the high-low 5-factor alpha and DGTW return in lead month come mainly from the long side – that is, the difference between high and middle quintile portfolios. Further, average 5-factor alphas and DGTW returns on high-low quintile portfolios decline but continue to be statistically significant in lead two to four months following portfolio formation. Lead four-month 5-factor alpha and DGTW returns are 37.1% (=0.255/0.688) and 42.0% (=0.185/0.440) of their lead one-month returns. Average excess returns are higher on ETF-owned stocks where the acquisition of firm-specific information spurred by arbitrage trading is more significant.

Table VIII Panel B reports two-way sorts of stocks. First, into above and below median ETF ownership concentration portfolios, and second, into quintile portfolios by arbitrage trading. Results substantiate findings in Tables IV and V that arbitrage trading heightens the private information content of stocks where ETF ownership concentration (HHI) is low. When HHI is low, average lead one-month excess return spread on high-low quintile portfolios sorted on arbitrage trading are higher; on 5- and 4-factor alphas by 0.54% (=1.004-0.466) and 0.18% (=0.686-0.502), and on DGTW return by 0.382% (=0.583-0.201). Moreover, average high-low excess return spreads decline but continue to be economically significant through lead four months. For stocks with below median HHI, average lead four-month 5- and 4-factor alphas and DGTW return are 51.3% (=0.515/1.004), 34.8% (=0.239/0.686) and 43.1% (=0.251/0.583) of lead one-month returns.

We corroborate these findings in stock-month fixed effects regressions of excess returns on arbitrage trading reported in Table IX. Regressors are normalized by their standard deviations over the whole sample. Errors are clustered by stock and month. Coefficients on size, book-to-market, momentum, CRSP turnover, inverse price, and profitability are reported in Appendix Table III.

< Insert Table IX here. >

In the top panel of Table IX, a one standard deviation rise in arbitrage trading induces an average lead one-month increase in 5-factor alpha of 0.391%, 4-factor alpha of 0.394%, and DGTW return of 0.530%, all significant at the 1% level. Further, in line with the persistence of arbitrage trading, average excess returns decline but continue to be significant through lead four months.

Bottom panel confirms that the private information incentive of arbitrage trading is more pronounced on stocks where ETF ownership concentration (HHI) is low. A one standard deviation rise in arbitrage trading increases average lead one-month 5- and 4-factor alpha by 0.111% (=0.619-0.508) and 0.112% (=0.614-0.502), and DGTW return by 0.116% (=0.707-0.591).

Regardless of ETF ownership concentration, low ETF ownership reduces the private information incentive of arbitrage trading. Low ETF ownership decreases the marginal effect of a one standard deviation rise in arbitrage trading on average lead one-month 5- and 4-factor alpha by 0.460% and 0.449%, and DGTW return by 0.359% when HHI ownership is high, and similarly, by 0.361% and 0.365%, and DGTW return by 0.220% (=0.065+0.155) when HHI ownership is low.

High ETF ownership forecasts significantly lower future excess returns as evidenced by the top panel. High ETF ownership, however, increases the private information incentive of arbitrage trading but significantly only when HHI is low. The marginal effects of a one standard deviation rise in arbitrage trading on average lead one-month 5- and 4-factor alpha are higher by 0.073% and 0.060%, and DGTW return by 0.065%, when HHI is low and ETF ownership is in the top quintile.

Overall, results support our conjecture that noise trading in ETF shares stimulate high levels of arbitrage trading by APs which spurs active investors to acquire and trade on costly firm-specific information. Higher average future excess returns substantiate the private information of active investors in stocks underlying ETFs.

B. Earnings Announcements

We examine secondary market trading in ETF-owned stocks around earnings announcements. We use cumulative abnormal returns (CAR) to proxy for the information content of earnings surprises. CARs are computed from daily returns in excess of returns on a benchmark portfolio to which the stock belongs over a three-day window around earnings announcement date denoted as $CAR(-1,+1)$ as well as from the third day after earnings announcement date to the earlier of sixty days or day prior to subsequent earnings announcement date, denoted as $CAR(3{,}60)$. Benchmark portfolios are constructed following the method on French's website. At June end of each year t, stocks are sorted into 2×3 benchmark portfolios by size (ME) and book-to-market equity (BE/ME). Median ME on NYSE stocks and the 30th and 70th percentiles of BE/ME on NYSE stocks, computed as book equity in the fiscal year end in $t-1$ divided by ME in December of $t-1$, are used as breakpoints. Regression results using CAR as dependent variable is reported in Table X. All regressions control for stock and month fixed effects and cluster by stocks and months.

< Insert Table X here. >

In Table X, significant coefficients on arbitrage trading confirms that more private information is made public at earnings announcements on ETF-owned stocks where arbitrage trading prior to earnings announcements is high. Privately informed investors in ETF-owned stocks anticipate earnings surprises in the subsequent quarter. From Columns 1 and 3, a one standard deviation rise in arbitrage trading predicts a higher average lead $CAR(-1,+1)$ of 0.246% and higher average lead $CAR(3{,}60)$ of 1.512%, both significant at the 1% level.

Results in Columns 2 and 4 corroborates our prior finding that arbitrage trading motivates more informed trading when ETF ownership concentration is low. Around the three-day earnings announcement window, a one standard deviation rise in arbitrage trading predicts a higher average lead $CAR(-1,+1)$ of 0.325% when ETF ownership concentration (HHI) is low and 0.231% when

HHI is high. Similarly, over the post earnings announcement window, a one standard deviation in arbitrage trading predicts average lead $CAR(3,60)$ of 1.831% when HHI is low and 1.544% when HHI is high.

Moreover, regardless of ETF ownership concentration, ETF ownership reduces the private information incentive of arbitrage trading. Low ETF ownership decreases the marginal effect of a one standard deviation rise in arbitrage trading on average lead $CAR(-1,+1)$ by -0.027% when HHI is high and -0.017% when HHI is low. Similarly, low ETF ownership decreases the marginal effect of a one standard deviation rise in arbitrage trading on average lead $CAR(3,60)$ of -0.266% when HHI is high but an increase of 0.068 when HHI is low. However, only the decrease on $CAR(3,60)$ when HHI is high is significant.

Further, as evident in Columns 5, 7, and 9, as well as Columns 6, 8, and 10, stocks with high arbitrage trading yield significant average excess returns in the three quarters following the first leading earnings announcement. The acquisition of costly private information in ETF-owned stocks spurred by arbitrage trading is intrinsically fundamental and long-term in nature.

< Insert Figure III here. >

Figure III shows that private information made public at earnings announcements is more significant on stocks where arbitrage trading is high. On high quintile portfolios of stocks sorted by arbitrage trading, significant lead average $CAR(-1,+1)$ of 0.74% around earnings announcement dates is greater than lead average $CAR(-1,+1)$ of 0.17% on low arbitrage trading quintile portfolios, and suggests earnings surprises reflect positive fundamental news on high quintile stocks.

The observed overshoot and reversal exhibited in lead average $CAR(3,60)$ over the post-earnings announcement period points to secondary market overreactions to earnings surprises in high arbitrage trading stocks. In ETF-owned stocks where arbitrage trading is high, the overshoot in the first quarter from initial lead average $CAR(-1,+1)$ of 0.74% is eliminated in the three months following earnings announcement. In ETF-owned stocks where arbitrage trading is low, lead average $CAR(-1,+1)$ of 0.17% is an underreaction of uninformed investors to earnings surprises at earnings announcement date. The underreaction stays through the first month, continues to drift down in the third month, and is practically reversed in sign after sixty days to a negative lead average of -0.14% over the earnings announcement period.

Overall, our findings support the thesis that arbitrage trading creates space for informed trading in ETF-owned stocks which enhances price discovery. Arbitrage trading signals the future return expectations of privately informed investors in ETF-owned stocks.

V. Conclusion

Since its introduction in 1993, the popularity and growing market share of ETFs raise concerns among academics, practitioners, and policymakers about potential market distortions. Prevailing empirical studies show increased ETF ownership reduces secondary market liquidity and increases stock return volatility. ETF ownership creates a liquidity buffer which impairs price informativeness. Herein, we pose the ensuing research question: do ETFs have a bright side? Can the primary activities of APs to correct mispricing in ETF shares from noise trading in ETFs enhance price informativeness?

We document two important empirical findings. First, using a novel measure of liquidity provided by the primary activities of APs, we show noise trading in ETF shares stimulate high levels of arbitrage trading which spurs active investors to acquire and trade on costly firm-specific information. Arbitrage trading is more pronounced where ETFs ownership on underlying stocks is low and concentrated among a few ETFs, and underlying stocks are associated with more informationally opaque firms. Arbitrage trading signals the private information of active investors in stocks underlying ETFs. High levels of arbitrage trading predict higher future excess stock returns. Further, we find cumulative abnormal returns (CARs) in the three-day window around earnings announcement date and in the 60-day post-earnings announcement period are greater on stocks with high arbitrage trading. CARs reflect the private information of informed investors made public through future earnings disclosures.

Second, we show absolute mispricing uncorrected by APs makes space for active asset managers to become informed about systematic market factors and exploit their informational advantage by trading in ETFs and underlying stocks. Informed trading on systematic market factors attenuates post-earnings announcement drifts in cumulative abnormal returns.

In sum, our study provides an empirical steppingstone for future research on the spillover impact of arbitrage trading on systemic risk and corporate policies that takes ETF ownership into account.

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Table I
ETF Stocks and Fund Ownership

Over the sample period June 2004 to September 2017, columns 2 to 4 report summary statistics on the average total number of CRSP stocks, as well as the average number and percentage of CRSP stocks in our sample that meet a minimum share price of $5 and market capitalization of $10 million. In columns 5 to 9, the average number and percentage of stocks in our sample owned by ETFs and the stock ownerships of ETFs as well as active and index mutual funds. In columns 10 to 13, the average number and percentage of stocks in our sample not owned by ETFs and the stock ownerships of active and index mutual funds.

				Average No. of Stocks Held by ETFs					Average No. of Stocks Not Held by ETFs			
						Average Ownership					Average Ownership	
Sample Period	All CRSP Stocks	Stock Sample	% of CRSP Stocks	No. of Stocks	% of Stock Sample	ETF	Active Mutual Fund	Index Mutual Fund	No. of Stocks	% of Stock Sample	Active Mutual Fund	Index Mutual Fund
2004:06-2004Q4	5,350	4,335	81.03%	3,733	86.11%	2.08%	14.93%	3.50%	799	18.43%	3.15%	1.08%
2005Q1-2005Q4	5,323	4,419	83.02%	3,862	87.40%	2.08%	15.55%	3.09%	1,175	26.59%	2.95%	0.84%
2006Q1-2006Q4	5,236	4,459	85.16%	3,885	87.13%	2.59%	16.33%	4.17%	794	17.81%	2.36%	0.76%
2007Q1-2007Q4	5,197	4,422	85.09%	3,816	86.30%	3.07%	16.17%	4.47%	801	18.11%	2.22%	0.79%
2008Q1-2008Q4	4,864	3,884	79.85%	3,429	88.29%	3.83%	17.12%	4.01%	597	15.37%	1.74%	0.66%
2009Q1-2009Q4	4,587	3,266	71.20%	3,025	92.62%	5.00%	18.69%	4.93%	354	10.84%	1.79%	0.81%
2010Q1-2010Q4	4,394	3,431	78.08%	3,269	95.28%	5.20%	16.99%	5.17%	270	7.87%	2.15%	0.92%
2011Q1-2011Q4	4,206	3,388	80.55%	3,254	96.04%	5.28%	16.60%	4.80%	241	7.11%	2.12%	0.35%
2012Q1-2012Q4	4,062	3,234	79.62%	3,125	96.63%	5.97%	16.14%	5.26%	198	6.12%	1.38%	0.31%
2013Q1-2013Q4	4,031	3,367	83.53%	3,292	97.77%	6.38%	15.83%	5.43%	240	7.13%	1.66%	0.32%
2014Q1-2014Q4	4,092	3,530	86.27%	3,438	97.39%	6.78%	15.39%	5.76%	236	6.69%	1.93%	0.29%
2015Q1-2015Q4	4,107	3,478	84.68%	3,413	98.13%	7.55%	15.63%	5.81%	174	5.00%	1.36%	0.13%
2016Q1-2016Q4	4,033	3,363	83.39%	3,292	97.89%	8.48%	15.47%	6.29%	143	4.25%	1.17%	0.18%
2017Q1-2017Q3	3,904	3,261	83.53%	3,188	97.76%	9.90%	15.16%	7.21%	149	4.57%	1.00%	0.24%
2004:06-2017Q3	4,528	3,703	81.78%	3,430	92.64%	5.30%	16.14%	4.99%	441	11.90%	1.93%	0.55%

Table II
Summary Statistics

Panel A reports summary statistics on variables used in this study. Panel B reports average ETF stock ownership, average active and indexed mutual fund stock ownership sorted into quintiles by ETF stock arbitrage trading by month. Panel C reports average percentage of Dow Jones 30 and S&P 500 stocks in portfolios sorted by arbitrage trading, HHI of ETF ownership and ETF ownership. Arbitrage trading on stock i in month t is computed as $ln(|price - NAV|/vol_{ETF})$ where $(price - NAV)$ is an ETF ownership weighted sum of daily absolute deviations of ETF share price from net asset value averaged across days in the month, and vol_{ETF} is the purchase and sale of stock by ETFs who own the stock summed across all ETFs in the month expressed in millions of dollars. ETF ownership is the total number of shares owned by ETFs at month end as a percentage of total shares outstanding. Mutual fund ownership of stock i in month t is estimated similarly. Daily Amihud illiquidity $illiq_{i,d} = |r_{i,d}|/dvol_{i,d}$ is absolute daily return divided by daily trading volume in millions of dollars, and monthly Amihud illiquidity is daily Amihud illiquidity averaged across days in the month. Volatility is computed as the standard deviation of daily stock returns over the month. Spread is average daily spread $S_{i,t} = \Sigma_d S_{i,d}/d$ expressed in bps, calculated following Corwin and Schultz (2012) with adjustments setting negative daily spread to zero and averaged each month. $S_{i,d} = 2(e^{\alpha} - 1)/(1 + e^{\alpha})$, $\alpha = [\sqrt{2\beta} - \sqrt{\beta}]/[3 - 2\sqrt{2}] - [\gamma/(3 - 2\sqrt{2})]^{0.5}$, $\gamma = [\,Ln\,(H^{O}_{d,d+1}/L^{O}_{d,d+1})\,]^2$, and $\beta = \sum_{j=0}^{1} [\,Ln\,(H^{O}_{d+j}/L^{O}_{d+j})\,]^2$. The variance ratio for stock i in the month is calculated as $1 + 5 * \rho_{i,t}$, where $\rho_{i,t}$ is estimated from an AR(1) process of daily returns $ret_{i,d}$ each month. 4-factor market beta is the market factor coefficient estimated from monthly time-series regressions of daily excess stock returns on a four-factor Carhart (1997) model. 5-factor market beta is the coefficient on the market factor estimated from monthly time-series regressions of daily excess stock returns using the five-factor Fama and French (2015) model. Cumulative abnormal returns (CAR) around earnings announcement are computed as daily returns in excess of daily returns on a benchmark portfolio to which the stock belongs over a three-day window around earnings announcement date and from the third day to earlier of 60 days or day prior to subsequent earnings announcement date. At June end of each year t, stocks are sorted into 2×3 benchmark portfolios by size (ME) and book-to-market equity (BE/ME). Median ME on NYSE stocks and the 30th and 70th percentiles of BE/ME on NYSE stocks, computed as book equity in the last fiscal year end in $t - 1$ divided by ME in December of $t - 1$, are used as breakpoints. Relative market capitalization is the market value of equity computed as closing price multiplied by total shares outstanding expressed as a percentage of aggregate market value of equity at month end. Book-to-market is book equity to shareholders' equity calculated following Daniel and Titman (2006). Rolling 12-month return is the cumulative monthly return in the preceding 12-month period. CRSP turnover is French (2008) adjusted CRSP volume divided by shares outstanding. Inverse price is the reciprocal of month end closing price. Profitability is the total revenue minus cost of goods sold scaled by total assets following Novy-Marx (2013).

PANEL A: Variable Description

	N	Mean	Standard Deviation	Percentile 25th	Percentile 50th	Percentile 75th
Arbitrage trading	521,252	-7.824	2.668	-9.661	-7.996	-6.292
ETF Ownership	521,252	4.81%	4.02%	1.63%	3.98%	7.13%
$\|Mispricing\|$	521,252	0.09%	0.09%	0.04%	0.06%	0.11%
Active Mutual Fund Ownership	521,252	15.09%	11.52%	4.59%	14.36%	23.33%
Index Mutual Fund Ownership	521,252	4.61%	3.44%	1.70%	4.23%	7.05%
$\Delta ln(Amihud\ Illiquidity)$	521,252	-0.014	0.511	-0.313	-0.004	0.299
Volatility	521,252	0.024	0.015	0.014	0.020	0.030
Spread (bps)	521,252	88.205	54.051	50.718	75.081	111.117
Variance Ratio	521,252	0.662	0.916	0.030	0.666	1.299
$\|Variance\ Ratio - 1\|$	521,252	0.790	0.586	0.318	0.673	1.144
4-factor Market Beta	521,252	0.882	1.117	0.325	0.901	1.448
5-factor Market Beta	521,252	0.885	1.133	0.328	0.901	1.453
Carhart 4-Factor Alpha	521,252	1.35%	11.81%	-4.88%	0.31%	6.05%
Fama-French 5-Factor Alpha	521,252	1.44%	12.26%	-5.05%	0.31%	6.28%
DGTW Return	521,252	0.43%	9.61%	-4.87%	-0.05%	5.02%
$CAR(-1,+1)$	521,252	0.18%	8.23%	-3.50%	0.11%	3.96%
$CAR(3,60)$	521,252	-0.02%	17.84%	-8.48%	0.08%	8.79%
$RMCAP$ (bps)	521,252	2.569	6.970	0.138	0.447	1.593
Book-to-Market Ratio	521,252	0.608	0.416	0.305	0.521	0.808
Rolling 12-month Return	521,252	16.95%	38.68%	-4.46%	14.51%	35.27%
CRSP Turnover	521,252	12.96%	13.92%	3.57%	8.90%	16.99%
Inverse Price	521,252	0.062	0.046	0.026	0.047	0.085
Profitability	521,252	0.279	0.259	0.068	0.246	0.417

PANEL B: Average ETF and Mutual Fund Ownership of Portfolios Sorted by Arbitrage Trading

		Arbitrage Trading						
		Low	2	3	4	High	Hi – Lo	t-stat
ETF Ownership	Mean	6.25%	7.29%	6.77%	4.83%	2.08%	-4.173%	-18.93
	Std Dev	2.64%	3.15%	2.94%	1.94%	0.90%		
	N	160	160	160	160	160		
$\lvert Mispricing \rvert$	Mean	0.07%	0.08%	0.09%	0.10%	0.10%	0.02%	3.04
	Std Dev	0.07	0.07	0.07	0.08	0.07		
	N	160	160	160	160	160		
Active Mutual Fund Ownership	Mean	19.43%	21.71%	19.48%	14.47%	7.68%	-11.753%	-77.93
	Std Dev	1.55%	1.59%	1.87%	1.60%	1.11%		
	N	160	160	160	160	160		
Index Mutual Fund Ownership	Mean	5.57%	5.91%	5.91%	4.88%	3.08%	-2.493%	-14.04
	Std Dev	2.03%	2.07%	1.82%	1.37%	0.96%		
	N	160	160	160	160	160		

PANEL C: Distribution of DJ30 and S&P500 Stocks

		Arbitrage Trading						
		Low	2	3	4	High	Hi – Lo	t-stat
DJ30	Mean	2.55%	0.01%	0.00%	0.00%	0.00%	-2.55%	-4.44
	Std Dev	0.53%	0.07%	0.00%	0.00%	0.00%		
	Median	2.54%	0.00%	0.00%	0.00%	0.00%		
S&P500	Mean	63.94%	10.88%	1.14%	0.35%	0.21%	-63.73%	-27.50
	Std Dev	8.48%	5.39%	3.25%	1.58%	0.22%		
	Median	65.20%	10.52%	0.35%	0.15%	0.18%		
		ETF Ownership						
		Low	2	3	4	High	Hi – Lo	t-stat
DJ30	Mean	0.02%	0.71%	1.45%	0.26%	0.03%	0.00%	0.01
	Std Dev	0.07%	0.66%	0.64%	0.51%	0.08%		
	Median	0.00%	0.51%	1.51%	0.00%	0.00%		
S&P500	Mean	0.82%	10.02%	31.26%	24.27%	7.68%	6.86%	4.19
	Std Dev	0.50%	9.28%	5.51%	4.59%	3.85%		
	Median	0.70%	4.83%	33.22%	24.94%	7.09%		

Table III
Characteristics of ETF Held Stocks

Table III reports summary statistics on the characteristics of ETF-owned stocks sorted each month into quintile portfolios by arbitrage trading and ETF ownership, as well as into above and below median portfolios by ETF ownership concentration (HHI). Arbitrage trading on stock i in month t is computed as $ln(|price - NAV|/vol_{ETF})$ where $(price - NAV)$ is the ETF ownership weighted sum of daily deviations of ETF share price from net asset value averaged across days in the month, and vol_{ETF} is the purchase and sale of stock by ETFs who own the stock summed across all ETFs in the month. From June 2004 to September 2017, stocks are sorted each month into quintiles by Arbitrage trading (left panel) or ETF ownership (right panel), and quintiles are linked over the sample period. Stocks are also sorted into one above median and one below median group each month by their HHI of ETF ownership (middle panel). Other variable definitions can be found in Table II and Appendix Table I.

		Arbitrage Trading			**HHI of ETF Ownership**			**ETF Ownership**		
		Low Quintile	High Quintile	Hi – Lo (t-stat)	Below Median	Above Median	Hi – Lo (t-stat)	Low Quintile	High Quintile	Hi – Lo (t-stat)
HHI of ETF Ownership	Mean	0.142	0.477	0.335	0.123	0.334	0.211	0.570	0.126	-0.444
	Std Dev	0.030	0.082	(48.32)	0.117	0.309	(43.79)	0.070	0.019	(-77.77)
	Median	0.132	0.457		0.017	0.058		0.557	0.121	
$\|Mispricing\|$	Mean	0.073%	0.096%	0.023%	0.090%	0.087%	-0.003%	0.090%	0.100%	0.010%
	Std Dev	0.069%	0.066%	(3.04)	0.074%	0.063%	(-0.35)	0.058%	0.080%	(1.27)
	Median	0.049%	0.077%		0.062%	0.070%		0.079%	0.067%	
$Relative\ MCAP\ (bps)$	Mean	11.129	0.218	-10.911	3.512	2.175	-1.337	0.844	1.156	0.313
	Std Dev	1.028	0.077	(-133.9)	0.997	0.901	(-3.92)	0.199	0.255	(12.25)
	Median	11.391	0.225		3.763	2.109		0.791	1.127	
Book-to-Market Ratio	Mean	0.499	0.763	0.264	0.558	0.634	0.076	0.760	0.608	-0.153
	Std Dev	0.081	0.166	(18.11)	0.089	0.132	(1.23)	0.169	0.095	(-9.95)
	Median	0.464	0.703		0.522	0.590		0.740	0.592	
Rolling 12-month Return	Mean	0.181	0.151	-0.029	0.150	0.188	0.038	0.196	0.139	-0.057
	Std Dev	0.158	0.177	(-1.55)	0.159	0.178	(1.88)	0.171	0.155	(-3.12)
	Median	0.198	0.156		0.157	0.199		0.215	0.150	
CRSP Turnover	Mean	0.196	0.055	-0.141	0.174	0.106	-0.068	0.062	0.175	0.113
	Std Dev	0.048	0.008	(-36.52)	0.036	0.016	(-4.46)	0.009	0.035	(39.45)
	Median	0.182	0.055		0.164	0.103		0.061	0.165	
Inverse Price	Mean	0.029	0.095	0.066	0.044	0.073	0.029	0.087	0.048	-0.039
	Std Dev	0.006	0.009	(78.73)	0.008	0.007	(4.35)	0.008	0.009	(-41.06)
	Median	0.029	0.094		0.045	0.072		0.085	0.046	
Profitability	Mean	0.294	0.256	-0.038	0.310	0.260	-0.049	0.252	0.301	0.049
	Std Dev	0.017	0.024	(-16.24)	0.014	0.019	(-1.52)	0.030	0.013	(18.97)
	Median	0.293	0.259		0.313	0.266		0.258	0.300	
$\Delta ln(Amihud\ Illiq)$ (bps)	Mean	-0.026	0.004	0.030	-0.011	-0.020	-0.009	-0.023	-0.008	0.015
	Std Dev	0.134	0.160	(1.80)	0.153	0.152	(-2.58)	0.153	0.159	(0.85)
	Median	-0.034	-0.010		-0.028	-0.034		-0.043	-0.027	
Volatility	Mean	0.019	0.027	0.009	0.022	0.026	0.004	0.027	0.023	-0.004
	Std Dev	0.008	0.008	(9.90)	0.008	0.008	(1.71)	0.007	0.008	(-5.17)
	Median	0.016	0.025		0.020	0.024		0.025	0.020	
Corwin-Schultz Spread (bps)	Mean	65.499	105.140	39.64	79.731	98.73	19.00	101.45	84.31	-17.14
	Std Dev	26.546	28.178	(12.95)	28.24	27.90	(2.12)	23.64	30.14	(-5.66)
	Median	56.358	96.638		70.87	88.83		96.12	73.45	
Variance Ratio	Mean	0.757	0.555	-0.202	0.732	0.666	-0.066	0.545	0.721	0.176
	Std Dev	0.273	0.160	(-8.06)	0.260	0.187	(-0.83)	0.135	0.278	(7.20)
	Median	0.763	0.567		0.741	0.674		0.557	0.711	
4-Factor Market Beta	Mean	1.014	0.656	-0.358	1.050	0.852	-0.198	0.555	1.075	0.520
	Std Dev	0.062	0.149	(-27.99)	0.044	0.099	(-1.85)	0.133	0.065	(44.57)
	Median	1.009	0.651		1.045	0.856		0.565	1.077	
5-Factor Market Beta	Mean	1.023	0.658	-0.365	1.052	0.852	-0.200	0.567	1.073	0.506
	Std Dev	0.065	0.141	(-29.80)	0.047	0.091	(-1.86)	0.122	0.066	(45.95)
	Median	1.027	0.663		1.051	0.859		0.578	1.073	

Table IV
Stock Illiquidity and Return Volatility

Table reports two-way stock and month fixed effects regressions of $\Delta ln(Amihud\ Illiquidity)$ and stock return volatility on arbitrage trading and ETF ownership. Daily Amihud illiquidity is estimated as $illiq_{i,d} = |r_{i,d}|/(Prc_{i,d} * Vol_{i,d}/10^6)$, and monthly Amihud illiquidity is daily Amihud illiquidity averaged across days in the month. $\Delta Ln(Amihud\ Illiquidity)$ is the change in natural log of monthly Amihud illiquidity from end of prior month. Volatility is the standard deviation of daily stock returns over the month. For stock i each month, dummy variable High HHI equals 1 if HHI of ETF ownership is above median, and 0 otherwise. Dummy variable Low HHI equals 1 if HHI of ETF stock ownership is below median, and 0 otherwise. Other variable definitions can be found in Table II and Appendix Table I. Errors are clustered by stock and month. [a], [b] and [c] denote 10%, 5% and 1% significant level, respectively. *p*-values are in parentheses. Coefficients on other control variables are reported in Appendix Table III.

	Panel A: $\Delta ln(Amihud\ Illiquidity)$						Panel B: Volatility					
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
ETF Arbitrage Trading	-0.058[c]	-0.040[c]	-0.064[c]	-0.045[c]			-0.032[c]	-0.025[c]	-0.037[c]	-0.028[c]		
	(0.000)	(0.000)	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)	(0.000)		
ETF Ownership	0.033[c]	0.058[c]	0.031[c]	0.059[c]			0.031[c]	0.023[c]	0.040[c]	0.028[c]		
	(0.000)	(0.000)	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)	(0.000)		
$\|Mispricing\|$			0.002	0.003	0.002	0.002			0.015[c]	0.014[c]	0.015[c]	0.014[c]
			(0.615)	(0.582)	(0.638)	(0.621)			(0.002)	(0.003)	(0.002)	(0.004)
$ETF\ AT \times High\_HHI$					-0.057[c]	-0.034[c]					-0.036[c]	-0.025[c]
					(0.000)	(0.001)					(0.000)	(0.000)
$ETF\ AT \times Low\_HHI$					-0.072[c]	-0.058[c]					-0.037[c]	-0.029[c]
					(0.000)	(0.000)					(0.000)	(0.000)
$ETF\ Own \times High\_HHI$					0.042[c]	0.082[c]					0.047[c]	0.035[c]
					(0.000)	(0.000)					(0.000)	(0.000)
$ETF\ Own \times Low\_HHI$					0.023[c]	0.044[c]					0.039[c]	0.026[c]
					(0.003)	(0.000)					(0.000)	(0.000)
Active Mutual Fund Own	0.020[c]	0.029[c]	0.019[c]	0.029[c]	0.018[c]	0.028[c]	-0.004	-0.001	-0.004	0.001	-0.004	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.267)	(0.796)	(0.399)	(0.830)	(0.361)	(0.905)
Index Mutual Fund Own	0.005	0.003	0.006	0.004	0.006	0.004	-0.013[c]	-0.007[a]	-0.014[c]	-0.007	-0.014[c]	-0.006
	(0.372)	(0.556)	(0.325)	(0.509)	(0.355)	(0.538)	(0.003)	(0.059)	(0.004)	(0.124)	(0.006)	(0.140)
1 Mo Lag	-0.318[c]	-0.413[c]	-0.322[c]	-0.420[c]	-0.323[c]	-0.420[c]	0.183[c]	0.152[c]	0.232[c]	0.177[c]	0.232[c]	0.177[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
2 Mo Lag		-0.247[c]		-0.251[c]		-0.252[c]		0.107[c]		0.125[c]		0.125[c]
		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)
3 Mo Lag		-0.110[c]		-0.112[c]		-0.112[c]		0.130[c]		0.163[c]		0.163[c]
		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)
Stock Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Month Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster by Stock and Month	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
NOBS	404,162	398,037	404,162	398,037	404,162	398,037	407,514	401,340	407,514	401,340	407,514	401,340
R^2	0.204	0.245	0.209	0.251	0.209	0.252	0.528	0.545	0.594	0.617	0.594	0.617

Table V
Spread and Noise Trading

Table reports two-way stock and month fixed effect regressions of spread and noise trading (variance ratio) on arbitrage trading (AT) and ETF ownership. Spread is computed following Corwin and Schultz (2012) with adjustments setting negative daily spread to zero and averaged by stock i over the number of days d in month t. We require at least 12 observations in a month. To proxy for noise trading, we use an AR1 process to estimate $\rho_{i,t}$ and compute a stock-month k-settlement period variance ratio $vratio_{i,t} = 1 + (k-1)\rho_{i,t}$. Variance ratios less than 1 indicate noise trading. For stock i in month t, HHI of ETF ownership is computed as the sum of squared ETF weights across all ETFs who own the stock, and ETF weights, as the number of shares held by the ETF as a percentage of total shares owned by all ETFs. In each month, dummy variable High HHI equals 1 if HHI of ETF ownership is above median, and 0 otherwise. Dummy variable Low HHI equals 1 if HHI of ETF ownership is below median, and 0 otherwise. Other variable definitions can be found in Table II and Appendix Table I. Errors are clustered by stock and month. [a], [b] and [c] denote 10%, 5% and 1% significant level, respectively. *p*-values are in parentheses. Coefficients on control variables are reported in Appendix Table III.

	Panel A Corwin-Schultz Spread					
	1	**2**	**3**	**4**	**5**	**6**
$ETF\ Arbitrage\ Trading$	-0.035[c]	-0.029[c]	-0.045[c]	-0.038[c]		
	(0.000)	(0.000)	(0.000)	(0.000)		
$ETF\ Ownership$	0.009	0.006	0.008	0.005		
	(0.189)	(0.296)	(0.258)	(0.367)		
$\|Mispricing\|$			0.018[c]	0.016[c]	0.018[c]	0.015[c]
			(0.001)	(0.004)	(0.001)	(0.004)
$ETF\ AT \times High\_HHI$					-0.045[c]	-0.038[c]
					(0.000)	(0.000)
$ETF\ AT \times Low\_HHI$					-0.042[c]	-0.036[c]
					(0.000)	(0.000)
$ETF\ Own \times High\_HHI$					0.018[b]	0.013[a]
					(0.038)	(0.076)
$ETF\ Own \times Low\_HHI$					0.009	0.006
					(0.229)	(0.352)
$Active\ Mutual\ Fund\ Ownership$	-0.009[c]	-0.006[b]	-0.010[c]	-0.006[b]	-0.010[c]	-0.006[b]
	(0.003)	(0.024)	(0.004)	(0.032)	(0.002)	(0.023)
$Index\ Mutual\ Fund\ Ownership$	-0.010[b]	-0.007[a]	-0.013[c]	-0.009[b]	-0.012[b]	-0.008[b]
	(0.014)	(0.067)	(0.006)	(0.028)	(0.012)	(0.045)
1 Month Lag	0.324[c]	0.253[c]	0.312[c]	0.240[c]	0.312[c]	0.240[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
2 Month Lag		0.134[c]		0.133[c]		0.133[c]
		(0.000)		(0.000)		(0.000)
3 Month Lag		0.101[c]		0.105[c]		0.105[c]
		(0.000)		(0.000)		(0.000)
Stock Fixed Effects	Y	Y	Y	Y	Y	Y
Month Fixed Effects	Y	Y	Y	Y	Y	Y
Cluster by Stock and Month	Y	Y	Y	Y	Y	Y
NOBS	407,494	401,284	407,494	401,284	407,494	401,284
R^2	0.636	0.651	0.651	0.666	0.651	0.666

	Panel B											
	Variance Ratio						***|Variance Ratio − 1|***					
	7	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
ETF Arbitrage Trading	-0.019^{b}	-0.017^{b}	-0.014	-0.013			0.019^{c}	0.019^{c}	0.017^{c}	0.017^{c}		
	(0.029)	(0.049)	(0.113)	(0.169)			(0.000)	(0.000)	(0.000)	(0.000)		
ETF Ownership	-0.006	-0.005	-0.005	-0.004			-0.002	-0.002	-0.002	-0.003		
	(0.477)	(0.490)	(0.555)	(0.579)			(0.673)	(0.627)	(0.563)	(0.512)		
|Mispricing|			-0.010^{b}	-0.010^{b}	-0.010^{a}	-0.010^{b}			0.002	0.002	0.002	0.002
			(0.047)	(0.034)	(0.051)	(0.036)			(0.426)	(0.440)	(0.403)	(0.414)
ETF AT × High_HHI					-0.022^{b}	-0.021^{b}					0.017^{c}	0.017^{c}
					(0.016)	(0.026)					(0.000)	(0.000)
ETF AT × Low_HHI					-0.004	-0.002					0.015^{c}	0.015^{c}
					(0.667)	(0.861)					(0.002)	(0.003)
ETF Own × High_HHI					-0.014	-0.014^{a}					-0.009^{b}	-0.010^{b}
					(0.111)	(0.093)					(0.043)	(0.038)
ETF Own × Low_HHI					0.005	0.006					-0.003	-0.003
					(0.538)	(0.462)					(0.529)	(0.497)
Active Mutual Fund Ownership	0.021^{c}	0.021^{c}	0.020^{c}	0.020^{c}	0.021^{c}	0.021^{c}	-0.007^{c}	-0.007^{c}	-0.002	-0.002	-0.007^{c}	-0.007^{c}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.003)	(0.465)	(0.405)	(0.005)	(0.006)
Index Mutual Fund Ownership	-0.009^{a}	-0.009^{a}	-0.010a	-0.010a	-0.009	-0.009	0.000	0.001		-0.003	-0.000	0.000
	(0.096)	(0.092)	(0.084)	(0.082)	(0.109)	(0.109)	(0.918)	(0.813)		(0.270)	(0.961)	(0.929)
1 Month Lag	0.015^{c}	0.015^{c}	0.015^{c}	0.015^{c}	0.015^{c}	0.015^{c}	-0.003	-0.003		-0.004^{b}	-0.002	-0.002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.206)	(0.176)		(0.049)	(0.444)	(0.387)
2 Month Lag		0.009^{c}		0.009^{c}		0.009^{c}		-0.003	-0.002	-0.002		-0.003
		(0.001)		(0.001)		(0.001)		(0.202)	(0.465)	(0.405)		(0.259)
3 Month Lag		0.009^{c}		0.010^{c}		0.010^{c}		-0.004^{a}		-0.003		-0.004^{b}
		(0.001)		(0.000)		(0.000)		(0.062)		(0.270)		(0.045)
Stock Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Month Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster by Stock and Month	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
NOBS	407,514	401,340	407,514	401,340	407,514	401,340	407,514	401,340	407,514	401,340	407,514	401,340
R^2	0.119	0.120	0.121	0.121	0.121	0.121	0.070	0.071	0.070	0.071	0.070	0.071

Table VI
Market Return Beta

Table reports two-way stock and month fixed effect regressions of market return betas on Arbitrage trading (AT) and ownership. Market return betas are estimated beta coefficients on market returns generated from monthly time-series regressions of daily excess returns using a Carhart 4-factor model (Column 1-4) or Fama-French 5-factor model (Column 5-8). For stock i in month t, HHI of ETF ownership is computed as the sum of squared ETF weights across all ETFs who own the stock, and ETF weights, as the number of shares held by the ETF as a percentage of total shares owned by all ETFs. In each month, dummy variable High HHI equals 1 if HHI of ETF ownership is above median, and 0 otherwise. Dummy variable Low HHI equals 1 if HHI of ETF ownership is below median, and 0 otherwise. Other variable definitions can be found in Table II and Appendix Table I. Errors are clustered by stock and month. ^{a}, ^{b} and ^{c} denote 10%, 5% and 1% significant level respectively. *p*-values are in parentheses. Coefficients on control variables are reported in Appendix Table III.

	Market Return Beta											
	Carhart 4-Factor Model						**Fama-French 5-Factor Model**					
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
ETF Arbitrage Trading	-0.094^{c}	-0.091^{c}	-0.108^{c}	-0.103^{c}			-0.092^{c}	-0.088^{c}	-0.104^{c}	-0.100^{c}		
	(0.000)	(0.000)	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)	(0.000)		
ETF Ownership	0.033^{c}	0.033^{c}	0.030^{c}	0.029^{c}			0.033^{c}	0.031^{c}	0.029^{c}	0.028^{c}		
	(0.000)	(0.000)	(0.001)	(0.001)			(0.000)	(0.000)	(0.001)	(0.001)		
$\|Mispricing\|$			0.042^{c}	0.037^{c}	0.041^{c}	0.037^{c}			0.038^{c}	0.035^{c}	0.038^{c}	0.035^{c}
			(0.000)	(0.000)	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)	(0.000)
$ETF\ AT \times High\_HHI$					-0.094^{c}	-0.090^{c}					-0.094^{c}	-0.089^{c}
					(0.000)	(0.000)					(0.000)	(0.000)
$ETF\ AT \times Low\_HHI$					-0.119^{c}	-0.113^{c}					-0.113^{c}	-0.108^{c}
					(0.000)	(0.000)					(0.000)	(0.000)
$ETF\ Own \times High\_HHI$					0.080^{c}	0.076^{c}					0.068^{c}	0.066^{c}
					(0.000)	(0.000)					(0.000)	(0.000)
$ETF\ Own \times Low\_HHI$					0.013	0.014					0.016^{a}	0.015^{a}
					(0.165)	(0.133)					(0.074)	(0.091)
Active Mutual Fund Own	0.010^{b}	0.009^{b}	0.010^{b}	0.009^{b}	0.007^{a}	0.006	0.012^{c}	0.012^{c}	0.012^{c}	0.011^{c}	0.010^{b}	0.009^{b}
	(0.020)	(0.036)	(0.028)	(0.046)	(0.091)	(0.133)	(0.003)	(0.004)	(0.004)	(0.006)	(0.015)	(0.019)
Index Mutual Fund Own	0.005	0.005	0.007	0.006	0.009	0.008	-0.001	-0.001	0.000	-0.000	0.002	0.001
	(0.362)	(0.377)	(0.264)	(0.294)	(0.139)	(0.165)	(0.865)	(0.827)	(0.958)	(0.970)	(0.685)	(0.764)
1 Month Lag Market Beta	0.039^{c}	0.037^{c}	0.038^{c}	0.037^{c}	0.037^{c}	0.036^{c}	0.032^{c}	0.031^{c}	0.031^{c}	0.030^{c}	0.031^{c}	0.030^{c}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
2 Month Lag Market Beta		0.034^{c}		0.033^{c}		0.032^{c}		0.029^{c}		0.028^{c}		0.028^{c}
		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)
3 Month Lag Market Beta		0.028^{c}		0.028^{c}		0.027^{c}		0.022^{c}		0.022^{c}		0.022^{c}
		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)
Stock Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Month Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster by Stock and Month	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
NOBS	407,476	401,274	407,476	401,274	407,441	401,220	407,441	401,220	407,441	401,220	407,476	401,274
R^2	0.099	0.101	0.100	0.102	0.099	0.101	0.099	0.101	0.099	0.101	0.099	0.102

Table VII
Persistence in Arbitrage Trading

Table reports on the persistence of stock Arbitrage trading and ownership. Stock arbitrage trading and ownership are defined in Table II and in the Appendix Table I. In Panel A, we report a transition matrix for stock Arbitrage trading in Panel B a transition matrix for stock ETF ownership. We sort stocks by Arbitrage trading (ownership) into quintiles in each month and compute the percentage of stocks that remain or change to another quintile in the subsequent month.

Panel A — **Arbitrage Trading Transition Matrix**

		Current Month End				
		1	**2**	**3**	**4**	**5**
	1	77.36%	18.63%	3.28%	0.78%	0.26%
	2	18.49%	55.85%	21.39%	3.80%	0.66%
Prior month End	**3**	3.43%	21.36%	53.21%	19.73%	2.33%
	4	0.94%	3.85%	19.73%	59.49%	16.12%
	5	0.45%	1.02%	2.94%	17.04%	79.03%

Panel B — **ETF Ownership Transition Matrix**

		Current Month End				
		1	**2**	**3**	**4**	**5**
	1	94.41%	5.29%	0.50%	0.21%	0.19%
	2	3.00%	90.42%	6.05%	0.64%	0.25%
Prior month End	**3**	0.39%	4.21%	87.81%	7.27%	0.66%
	4	0.23%	0.71%	6.03%	87.96%	5.50%
	5	0.19%	0.27%	0.67%	4.86%	94.56%

Table VIII
Forecast Returns on Quintile Portfolios of Stocks Sorted by Arbitrage Trading

Panel A reports the average value-weighted buy-and-hold returns in the months following the formation of quintile portfolios on stocks sorted by arbitrage trading. In Panel B, stocks are sorted first by ETF ownership concentration and second by arbitrage trading. In each month, dummy variable High HHI equals 1 if HHI of ETF ownership is above median, and 0 otherwise. Dummy variable Low HHI equals 1 if HHI of ETF ownership is below median, and 0 otherwise. High-Low is the difference in average monthly returns on Arbitrage trading quintile portfolios. Average monthly returns are expressed in percent. Other variable definitions can be found in Table II and Appendix Table I. Superscripts ^{a,b,c} denote two-tailed tests of statistical significance at the 10%, 5%, and 1% levels.

Panel A: One-Way Sort

Arbitrage	5-Factor Alpha				4-Factor Alpha				DGTW			
Trading	1 Mo	2 Mo	3 Mo	4 Mo	1 Mo	2 Mo	3 Mo	4 Mo	1 Mo	2 Mo	3 Mo	4 Mo
Low	0.340	0.228	0.197	0.180	0.335	0.234	0.202	0.186	0.039	-0.054	-0.082	-0.096
2	0.627	0.400	0.325	0.281	0.566	0.329	0.266	0.217	0.077	-0.094	-0.156	-0.185
3	0.700	0.477	0.387	0.346	0.650	0.441	0.330	0.295	0.063	-0.076	-0.131	-0.160
4	0.883	0.550	0.438	0.383	0.825	0.500	0.393	0.339	0.325	0.091	0.036	-0.011
High	1.028	0.665	0.506	0.435	0.805	0.434	0.261	0.180	0.479	0.264	0.162	0.089
High-Low	**0.688**^{c}	**0.436**^{c}	**0.309**^{c}	**0.255**^{c}	**0.469**^{c}	**0.200**^{b}	0.059	-0.006	**0.440**^{c}	**0.318**^{c}	**0.243**^{c}	**0.185**^{c}
t-stat	5.096	4.788	4.042	3.640	3.488	2.028	0.757	-0.083	3.660	3.537	3.140	2.690

Panel B: Two-Way Sort

Ownership Concentration	Arbitrage	5-Factor Alpha				4-Factor Alpha				DGTW			
HHI	Trading	1 Mo	2 Mo	3 Mo	4 Mo	1 Mo	2 Mo	3 Mo	4 Mo	1 Mo	2 Mo	3 Mo	4 Mo
Above Median	Low	0.404	0.310	0.279	0.261	0.398	0.308	0.273	0.250	0.087	-0.002	-0.036	-0.056
	2	0.537	0.377	0.317	0.276	0.458	0.303	0.240	0.197	0.050	-0.081	-0.136	-0.164
	3	0.615	0.385	0.303	0.263	0.559	0.305	0.245	0.211	0.031	-0.155	-0.202	-0.221
	4	0.594	0.349	0.284	0.241	0.541	0.323	0.258	0.222	-0.023	-0.141	-0.173	-0.223
	High	0.870	0.555	0.429	0.358	0.900	0.565	0.424	0.337	0.288	0.047	-0.047	-0.094
	High-Low	**0.466**^{c}	**0.245**^{b}	**0.150**^{a}	0.097	**0.502**^{c}	**0.257**^{c}	**0.151**^{a}	0.087	**0.201**^{a}	0.049	-0.011	-0.038
	t-stat	3.367	2.556	1.806	1.307	3.748	2.728	1.924	1.244	1.781	0.585	-0.151	-0.582
Below Median	Low	0.256	0.104	0.070	0.063	0.274	0.135	0.102	0.096	0.002	-0.112	-0.135	-0.136
	2	0.843	0.584	0.458	0.399	0.735	0.496	0.378	0.315	0.276	0.115	0.005	-0.037
	3	0.870	0.520	0.428	0.391	0.801	0.481	0.381	0.373	0.356	0.130	0.108	0.072
	4	1.004	0.582	0.467	0.413	0.830	0.398	0.267	0.169	0.481	0.228	0.185	0.126
	High	1.260	0.852	0.687	0.578	0.961	0.554	0.406	0.335	0.585	0.318	0.176	0.115
	High-Low	**1.004**^{c}	**0.748**^{c}	**0.617**^{c}	**0.515**^{c}	**0.686**^{c}	**0.419**^{c}	**0.304**^{b}	**0.239**^{b}	**0.583**^{c}	**0.429**^{c}	**0.311**^{c}	**0.251**^{c}
	t-stat	5.288	5.272	5.097	5.141	3.474	2.846	2.512	2.238	3.124	3.285	2.961	2.778

Table IX
Forecast Returns and Arbitrage Trading

Table reports two-way stock and month fixed effect regressions of stock excess returns on Arbitrage trading (AT) and ownership. Fama French 5-factor alpha is estimated from time-series regressions of daily stock returns on Fama and French (2015) model each month and compounded over days in a month. Carhart 4-factor alpha is estimated from time-series regressions of daily stock returns on Fama and French (1992) market, SMB and HML factors and Carhart (1997) UMD factor each month and compounded over days in a month. DGTW adjusted excess return is estimated following Daniel, Grinblatt, Titman and Wermers (1997), as stock monthly return minus the average return in the month on the DGTW benchmark portfolio to which the stock belongs. Average monthly excess returns are expressed in percent. Other variable definitions can be found in Table II and Appendix Table I. Errors are clustered by stock and month. [a], [b] and [c] denote 10%, 5% and 1% significant level respectively. *p*-values are in parentheses. Coefficients on control variables are reported in Appendix Table III.

	Fama-French 5-Factor Alpha				Carhart 4-Factor Alpha				DGTW			
	1	2	3	4	5	6	7	8	9	10	11	12
ETF Arbitrage Trading	0.391[c]	0.368[c]	0.362[c]	0.349[c]	0.394[c]	0.392[c]	0.390[c]	0.375[c]	0.530[c]	0.443[c]	0.418[c]	0.403[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ETF Ownership	-0.598[c]	-0.514[c]	-0.485[c]	-0.442[c]	-0.554[c]	-0.469[c]	-0.437[c]	-0.390[c]	-0.494[c]	-0.450[c]	-0.406[c]	-0.380[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
|Mispricing|	-0.074	-0.057	-0.069	-0.076[a]	-0.082	-0.075	-0.089[b]	-0.086[b]	-0.109[b]	-0.091[b]	-0.085[b]	-0.105[c]
	(0.228)	(0.280)	(0.133)	(0.073)	(0.177)	(0.116)	(0.040)	(0.040)	(0.012)	(0.013)	(0.010)	(0.000)
Active Mutual Fund Own	-0.044	-0.106[b]	-0.160[c]	-0.167[c]	-0.040	-0.105[b]	-0.158[c]	-0.171[c]	0.023	-0.039	-0.092[b]	-0.103[c]
	(0.453)	(0.035)	(0.000)	(0.000)	(0.499)	(0.039)	(0.001)	(0.000)	(0.672)	(0.425)	(0.031)	(0.008)
Index Mutual Fund Own	0.077	0.030	0.021	0.014	0.094	0.047	0.031	0.021	0.135[b]	0.090[b]	0.060	0.048
	(0.220)	(0.558)	(0.650)	(0.745)	(0.110)	(0.349)	(0.503)	(0.641)	(0.011)	(0.046)	(0.159)	(0.245)
NOBS	405,447	405,341	405,171	402,395	405,421	405,294	405,098	402,295	390,160	389,991	389,737	389352
R^2	0.030	0.052	0.073	0.093	0.031	0.053	0.075	0.095	0.033	0.062	0.089	0.114
|Mispricing|	-0.085	-0.066	-0.078[a]	-0.085[b]	-0.091	-0.084[a]	-0.097[b]	-0.093[b]	-0.119[c]	-0.100[c]	-0.094[c]	-0.113[c]
	(0.178)	(0.207)	(0.087)	(0.042)	(0.127)	(0.074)	(0.024)	(0.022)	(0.007)	(0.009)	(0.006)	(0.000)
ETF AT × High_HHI	0.508[c]	0.458[c]	0.442[c]	0.414[c]	0.502[c]	0.479[c]	0.467[c]	0.438[c]	0.591[c]	0.493[c]	0.462[c]	0.441[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ETF AT × Hi_HHI × Hi ETF Own	0.103	0.088	0.088[a]	0.087[a]	0.100	0.065	0.068	0.066	0.178[c]	0.170[c]	0.139[b]	0.132[c]
	(0.121)	(0.123)	(0.100)	(0.096)	(0.146)	(0.268)	(0.202)	(0.192)	(0.007)	(0.006)	(0.012)	(0.009)
ETF AT × Hi_HHI × Lo ETF Own	-0.357[c]	-0.265[c]	-0.244[c]	-0.211[c]	-0.349[c]	-0.261[c]	-0.245[c]	-0.223[c]	-0.181[c]	-0.161[c]	-0.145[c]	-0.138[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ETF AT × Low_HHI	0.619[c]	0.566[c]	0.551[c]	0.523[c]	0.614[c]	0.580[c]	0.568[c]	0.540[c]	0.707[c]	0.607[c]	0.572[c]	0.550[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ETF AT × Lo_HHI × Hi ETF Own	0.073[c]	0.057[c]	0.058[c]	0.057[c]	0.059[b]	0.039[a]	0.041[a]	0.038[a]	0.065[c]	0.058[c]	0.050[c]	0.047[c]
	(0.003)	(0.009)	(0.005)	(0.005)	(0.017)	(0.076)	(0.054)	(0.068)	(0.004)	(0.002)	(0.006)	(0.006)
ETF AT × Lo_HHI × Lo ETF Own	-0.288[c]	-0.256[c]	-0.244[c]	-0.218[c]	-0.306[c]	-0.287[c]	-0.272[c]	-0.248[c]	-0.155[a]	-0.146[b]	-0.141[b]	-0.125[b]
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.082)	(0.047)	(0.036)	(0.044)
Active Mutual Fund Own	-0.004	-0.075	-0.132[c]	-0.143[c]	-0.001	-0.074	-0.130[c]	-0.146[c]	0.043	-0.022	-0.076[a]	-0.088[b]
	(0.944)	(0.140)	(0.003)	(0.001)	(0.985)	(0.146)	(0.005)	(0.001)	(0.432)	(0.658)	(0.074)	(0.024)

Index Mutual Fund Own	0.012	-0.030	-0.033	-0.032	0.037	-0.007	-0.016	-0.016	0.071	0.034	0.010	0.004
	(0.855)	(0.557)	(0.475)	(0.463)	(0.534)	(0.889)	(0.729)	(0.712)	(0.163)	(0.440)	(0.800)	(0.926)
NOBS	405,447	405,341	405,171	402,395	405,421	405,294	405,098	402,295	390,160	389,991	389,737	389352
R^2	0.031	0.052	0.073	0.093	0.031	0.053	0.075	0.095	0.033	0.062	0.089	0.114
Stock Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Month Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster by Stock and Month	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table X
Cumulative Abnormal Returns Around Earnings Announcements

Table examines cumulative abnormal returns (CAR) surrounding earnings announcements through two-way stock and month fixed effect regressions on Arbitrage trading (AT) and ownership. Earnings announcement dates are from the IBES database. Cumulative abnormal returns are computed from daily returns in excess of daily returns on a benchmark portfolio to which the stock belongs over a three-day window around earnings announcement date $CAR(-1,+1)$ as well as from the third day to the earlier of sixty days or day prior to subsequent earnings announcement date $CAR(3,60)$. Stocks at June end of each year t are sorted into 2×3 benchmark portfolios by size (ME) and book-to-market equity (BE/ME). Median ME on NYSE stocks and the 30th and 70th percentiles of BE/ME on NYSE stocks, computed as book equity in the last fiscal year end in $t-1$ divided by ME in December of $t-1$, are used as breakpoints. Benchmark portfolio returns are the value-weighted daily returns across stocks in the portfolios. Other variable definitions can be found in Table II and Appendix Table I. $CARs$ are expressed in percent. Errors are clustered by stock and month. ^{a}, ^{b} and ^{c} denote 10%, 5% and 1% significant level respectively. *p*-values are in parentheses.

Quarterly Earnings Announcements	**1st**				**2nd**		**3rd**		**4th**	
	$\boldsymbol{CAR(-1,+1)}$		$\boldsymbol{CAR(3,60)}$		$\boldsymbol{CAR(3,60)}$					
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
$ETF\ Arbitrage\ Trading$	0.246^{c}		1.512^{c}		0.893^{c}		0.660^{c}		0.710^{c}	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
$ETF\ Ownership$	-0.047		-0.610^{c}		-0.221		-0.232		0.022	
	(0.586)		(0.005)		(0.306)		(0.333)		(0.914)	
$\|Mispricing\|$	-0.042	-0.045	-0.166^{a}	-0.176^{a}	-0.070	-0.072	-0.142^{a}	-0.146^{a}	-0.038	-0.033
	(0.242)	(0.215)	(0.090)	(0.067)	(0.458)	(0.443)	(0.098)	(0.084)	(0.706)	(0.739)
$ETF\ AT \times High\_HHI$		0.231^{c}		1.544^{c}		0.878^{c}		0.715^{c}		0.706^{c}
		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)
$ETF\ AT \times Hi\_HHI \times Hi\ ETF\ Own$		-0.057		0.218		0.088		0.042		0.079
		(0.428)		(0.150)		(0.509)		(0.776)		(0.571)
$ETF\ AT \times Hi\_HHI \times Lo\ ETF\ Own$		-0.027		-0.266^{b}		-0.199^{b}		-0.197^{a}		-0.153
		(0.533)		(0.019)		(0.043)		(0.064)		(0.125)
$ETF\ AT \times Low\_HHI$		0.325^{c}		1.831^{c}		1.082^{c}		0.781^{c}		0.766^{c}
		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)
$ETF\ AT \times Lo\_HHI \times Hi\ ETF\ Own$		-0.051^{a}		-0.015		-0.007		-0.049		-0.039
		(0.071)		(0.792)		(0.898)		(0.393)		(0.526)
$ETF\ AT \times Lo\_HHI \times Low\ ETF\ Own$		-0.017		0.068		0.162		0.032		0.235
		(0.832)		(0.739)		(0.407)		(0.885)		(0.210)
$Active\ Mutual\ Fund\ Own$	-0.120^{b}	-0.120^{a}	-0.492^{c}	-0.480^{c}	-0.174	-0.162	-0.453^{c}	-0.441^{c}	-0.144	-0.134
	(0.049)	(0.050)	(0.001)	(0.001)	(0.194)	(0.227)	(0.001)	(0.001)	(0.287)	(0.317)
$Index\ Mutual\ Fund\ Own$	-0.061	-0.061	0.184	0.104	-0.026	-0.012	0.009	-0.036	-0.190	-0.161
	(0.330)	(0.294)	(0.219)	(0.468)	(0.870)	(0.931)	(0.959)	(0.818)	(0.315)	(0.340)
Stock Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Month Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster by Stock and Month	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
NOBS	336,304	336,304	336,326	336,326	331,385	331,385	325,807	325,807	320,170	320,170
R^2	0.059	0.060	0.075	0.075	0.068	0.068	0.065	0.065	0.065	0.065

Figure I
Arbitrage Trading and ETF Ownership Effects

In Figure I, the upper forward loop shows the migration of noise traders to ETFs from individual stocks and concomitant reduction in the supply of stocks available for trading, creates a buffer which diminishes secondary market liquidity on ETF-owned stocks. Deviations of ETF share prices from net asset values (NAV) from uninformed demand shocks in ETF shares trigger arbitrage trading by authorized participants (APs). The lower feedback loop shows the exchange of ETF shares for baskets of stocks transmits liquidity shocks from ETF shares onto the underlying stocks which restores secondary market liquidity on ETF-owned stocks.

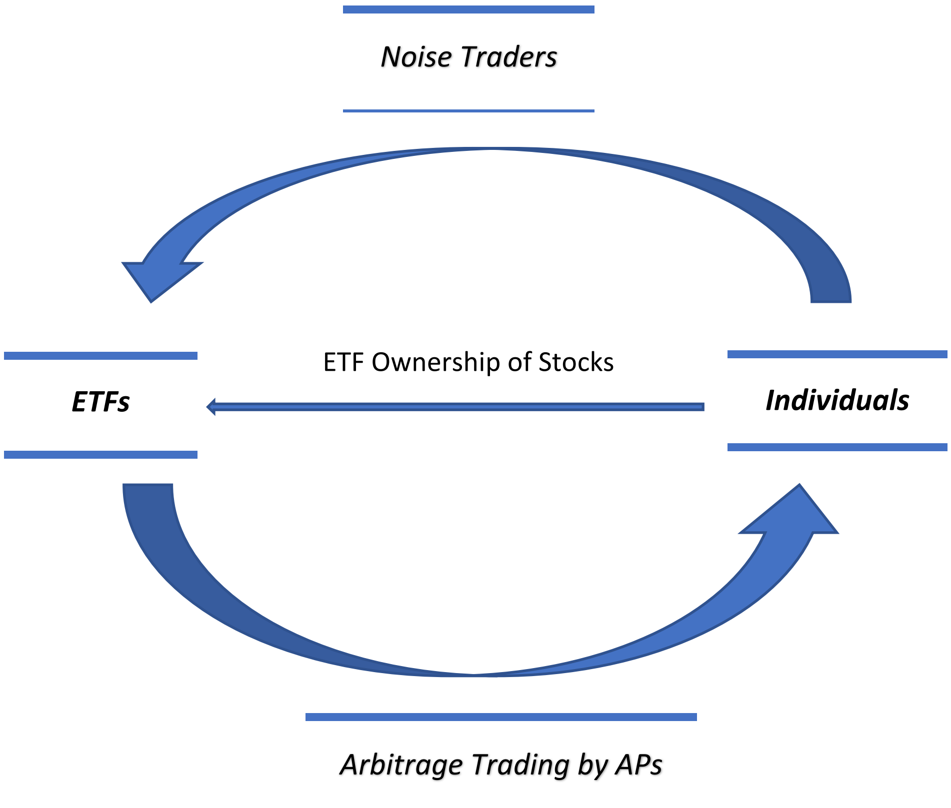
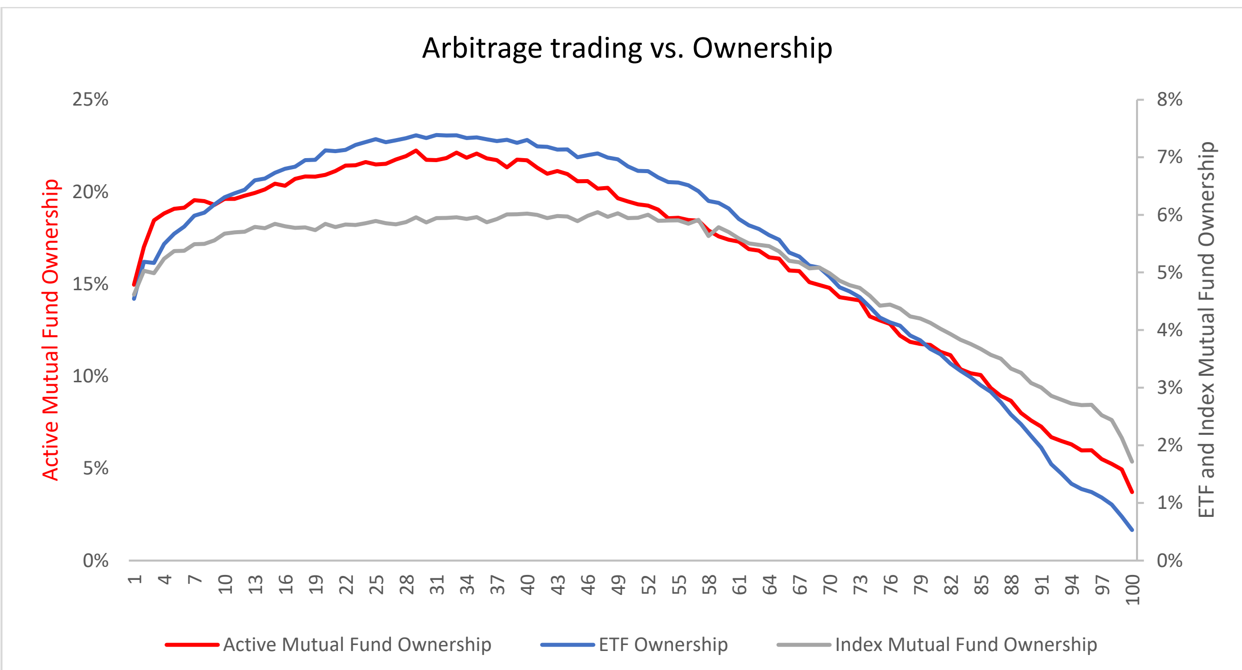


Figure II
Arbitrage trading vs. Ownership (2004:06 – 2017:09)

Figure II Panel A graphs the average ETF ownership as well as active and index mutual fund ownerships, for the full sample of stocks sorted into Arbitrage trading percentile ranks each month. Panel B graphs the average ETF ownership of stocks sorted into Arbitrage trading percentile ranks each month for subsamples of stocks categorized either by ETF ownership concentration or the number of ETFs who own the stock. In each month, we separate the full sample of stocks into one subsample whose ETF stock ownership concentration (HHI) is above the median and one subsample whose HHI is equal to or below the median. Similarly, we separate the full sample into one subsample in which the number of ETFs who own the stock is above the median and one subsample in which the number of ETFs who own the stock is equal to or below the median. From June 2004 to September 2017, in each month, stocks are ranked into 100 percentiles sorted by ETF stock arbitrage trading, and equal-weighted ETF and mutual fund ownerships are reported for each percentile. The same percentiles over the sample period are linked. Arbitrage trading on stock i in month t is computed $ln(|price - NAV|/vol_{ETF})$ where $(price - NAV)$ is the cross-product of the absolute monthly deviation of ETF share price from NAV and ETF stock ownership summed across all ETFs $j\epsilon N$ who own stock i in month t, and vol_{ETF} is the purchase and sale of stock by ETFs who own the stock summed across all ETFs in the month expressed in millions of dollars. Aggregate ETF ownership is the total number of shares owned by ETFs at month end as a percentage of total shares outstanding. For stock i in month t, HHI of ETF ownership is computed as the sum of squared ETF weights across all ETFs who own the stock, and ETF weights, as the number of shares held by the ETF as a percentage of total shares owned by all ETFs. In each month, dummy variable High HHI equals 1 if HHI of ETF ownership is above median, and 0 otherwise. Dummy variable Low HHI equals 1 if HHI of ETF ownership is below median, and 0 otherwise. High N ETF and low N ETF dummy variables are defined similarly by the number of ETFs holding the stock in the month.

Panel A. Full Sample



Panel B. Subsample by ETF ownership concentration or Number of ETFs

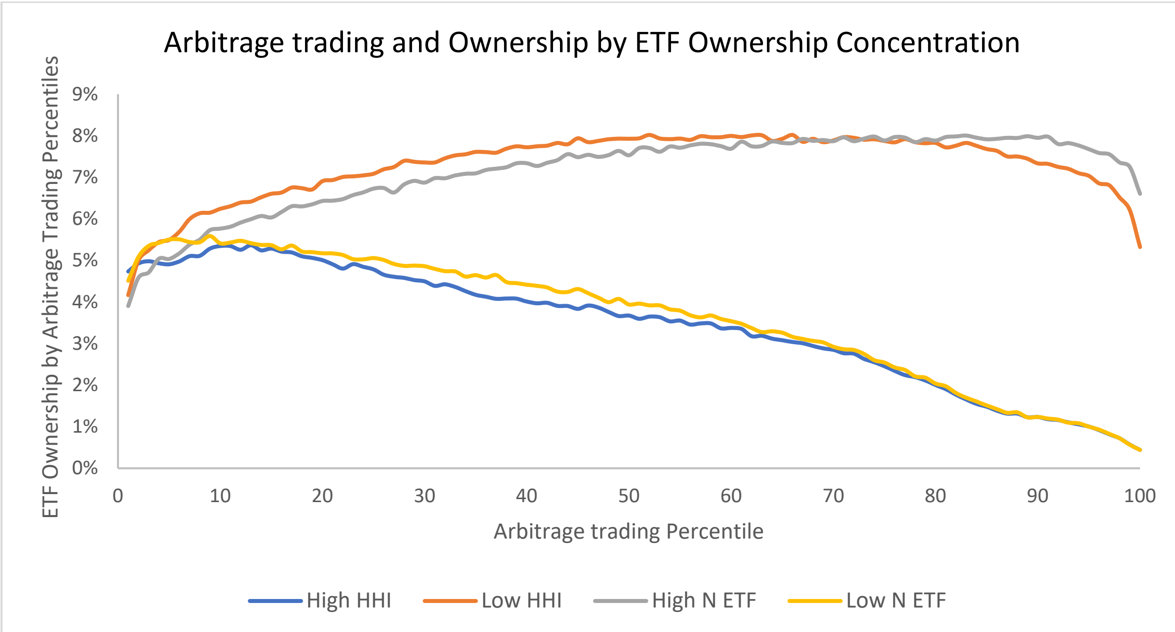
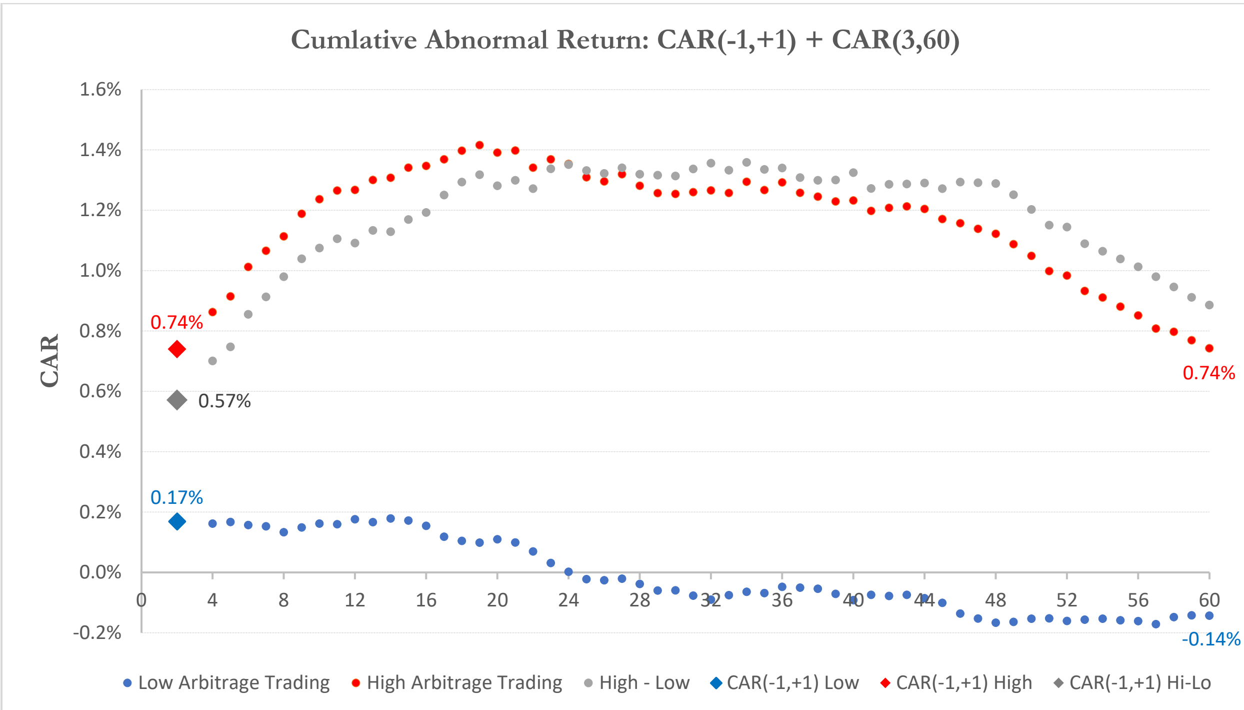


Figure III
Cumulative Abnormal Return

Figure graphs cumulative abnormal returns (CAR) over a three-day window around earnings announcement date $CAR(-1,+1)$, as well as from the third day to the earlier of sixty days or day prior to subsequent earnings announcement date $CAR(3{,}60)$. Cumulative abnormal returns are computed from daily returns in excess of daily returns on a benchmark portfolio to which the stock belongs. Stocks at June end of each year t are sorted into 2×3 benchmark portfolios by size (ME) and book-to-market equity (BE/ME). Median ME on NYSE stocks and the 30th and 70th percentiles of BE/ME on NYSE stocks, computed as book equity in the last fiscal year end in $t-1$ divided by ME in December of $t-1$, are used as breakpoints. Benchmark portfolio returns are the value-weighted daily returns across stocks in the portfolios.



Appendix Table I
Variable Definitions

ETF purchases is for each stock i held by ETF j at the end of month t, the number of shares owned by ETF j is denoted as $N_{i,j,t}$. If $N_{i,j,t} > N_{i,j,t-1}$, purchase of shares of stock i by ETF j in month t is $N_{i,j,t}$ - $N_{i,j,t-1}$, which is denoted as $Purchase_{i,j,t}$. Summing across all ETF j is the purchase of stock i by ETF in month t.

$$Share\ Purchases_{i,t} = \sum_{j} Purchase_{i,j,t}$$

ETF sales is for each stock i in the end of month t, the number of shares sold by ETF j is denoted as $Share\ Sales_{i,t}$, which is the change in number of shares held by ETF $N_{i,j,t}$ - $N_{i,j,t-1}$, minus the number of shares purchased by ETF $Share\ Purchases_{i,t}$, in month t. This is a negative number.

$$Share\ Sales_{i,t} = N_{i,j,t} - N_{i,j,t-1} - Share\ Purchases_{i,t}$$

ETF stock ownership is the percentage of total shares outstanding of stock i owned by all ETFs at the end of month t. The number of shares of stock i owned by ETF is summed across ETF j at the end of month t.

$$ETF\ Ownership_{i,t} = \frac{\sum_j Shares\ outstanding\ owned\ by\ ETF\ _{i,j,t}}{Total\ Share\ outstanding\ _{i,t}}$$

ETF stock arbitrage trading is defined as for stock i in month t, average daily ETF stock mispricing divided by dollar value traded by ETFs in the month measured in million dollars. We use its natural log in this study to reflect its log normal distribution. Dollar value traded by ETFs in the month is the product of stock price at the end of the month $Prc_{i,t}$ and number of shares purchased and sold summed over all ETFs holding the stock in the month $VOL^{ETF}_{i,t}$. Daily ETF stock mispricing is the weighted sum of ETF mispricing over all ETFs holding the stock, with ETF mispricing estimated as the absolute value of the difference between ETF close price and NAV, and weight being ETF stock ownership end of the month.

$$VOL^{ETF}_{i,t} = Share\ Purchases_{i,t} + \left|Share\ Sales_{i,t-1}\right|$$

$$Arbitrage\ Trading_{i,t} = \frac{ETF\ Stock\ Mispricing_{i,t}}{Prc_{i,t} * VOL^{ETF}_{i,t}/1{,}000{,}000}$$

Active Mutual fund stock ownership is the percentage of total shares outstanding of stock i owned by all active mutual funds at the end of quarter. The number of shares of stock i owned by active mutual funds is summed across all active mutual fund j holding stock i at the end of quarter.

$$Active\ Mutual\ Fund\ Ownership_{i,\mathrm{q}} = \frac{\sum_j Shares\ outstanding\ owned\ by\ Active\ Mutual\ Fund\ _{i,j,q}}{Total\ Share\ outstanding\ _{i,q}}$$

Index Mutual fund stock ownership is the percentage of total shares outstanding of stock i owned by all indexed mutual funds at the end of quarter. The number of shares of stock i owned by index mutual funds is summed across all index mutual fund j holding stock i at the end of quarter.

Herfindahl-Hirschman Index (HHI) of ETF stock ownership: For stock i in month t, HHI of ETF stock ownership is estimated as the sum of squared ETF weights over all ETFs holding the stock, with ETF weights estimated as the number of shares held by the ETF as a percentage of total shares held by all ETFs. We refer to it as HHI in the study for abbreviation.

Cumulative Abnormal Return (CAR): The earnings announcement cumulative abnormal return (CAR) is estimated as the three day window around the earnings announcement date [-1, 1], with returns adjusted by six size-book/market ratio portfolios formed following at the end of June each year. The size breakpoint for year t is the median NYSE market equity at the end of June of year t. BE/ME for June of year t is the book equity for the last fiscal year end in t-1 divided by ME for December of t-1. The BE/ME breakpoints are the 30th and 70th NYSE percentiles.

Delta Amihud Illiquidity is the change in the natural log of monthly Amihud illiquidity from the prior month, with monthly Amihud illiquidity estimated as daily Amihud illiquidity averaged over the month. Daily Amihud illiquidity is the absolute daily return divided by daily trading volume in million dollars following Amihud (2002).

$$ILLIQ_{i,d} = \frac{|r_{i,d}|}{dvol_{i,d}}$$

Volatility is standard deviation of daily stock returns over the month.

Stock spread: daily stock spread $S_{i,d}$ calculated following Corwin and Schultz (2012) with adjustments setting negative daily spread to zero, and then averaged across stock i quarter t. d is the number of days in month t. Following Corwin and Schultz (2012), we require at least 12 observations in a month to calculate average monthly stock spread.

$$S_{i,d} = \frac{2(e^{\alpha}-1)}{1+e^{\alpha}} \quad \alpha = \frac{\sqrt{2\beta}-\sqrt{\beta}}{3-2\sqrt{2}} - \sqrt{\frac{\gamma}{3-2\sqrt{2}}} \quad \gamma = [\,Ln\,(\frac{H^{O}_{d,d+1}}{L^{O}_{d,d+1}})\,]^2 \quad \beta = \sum_{j=0}^{1}\,[\,Ln\,(\frac{H^{O}_{d+j}}{L^{O}_{d+j}})\,]^2$$

$$S_{i,t} = \frac{\sum_d S_{i,d}}{d}$$

Variance Ratio for stock i in the month is calculated as $1 + 5 * \rho_{i,t}$, with $\rho_{i,t}$ estimated from an AR(1) process of stock daily returns $ret_{i,d}$ each month. Absolute variance ratio is the absolute value of stock monthly variance ratio minus one.

Market beta: For stock i, 4-factor market beta is the coefficient on the market factor estimated from a time-series regression of daily excess stock returns on the Carhart (1997) four factors in a month. 5-factor market beta is the coefficient on the market factor estimated from a time-series regression of daily excess stock returns on the Fama French (2015) five factors in a month.

Fama French 5-factor alpha: is estimated from time-series regressions of daily stock returns on Fama and French (2015) model each month and compounded over days in a month.

Carhart 4-factor alpha: is estimated from time-series regressions of daily stock returns on Fama and French (1992) market, SMB and HML factors and Carhart (1997) UMD factor each month and compounded over days in a month.

DGTW adjusted excess return: is estimated following Daniel, Grinblatt, Titman and Wermers (1997), as stock monthly return minus the average return in the month on the DGTW benchmark portfolio to which the stock belongs.

Market capitalization (in $millions) is closing price times total shares outstanding at the end of the month. Relative market capitalization is the market capitalization as a percentage of aggregate market value of equity at month end.

Book to market is book equity to shareholders' equity calculated following Daniel and Titman (2006).

Rolling 12 months' return is the cumulative monthly return of the past 12 months for stock i.

CRSP Turnover is the number of shares traded in the month reported by CRSP divided by number of share outstanding at the end of the month.

Inverse price is the inverse of closing price for stock i at the end of month.

Profitability is the total revenue minus cost of goods sold scaled by total assets, following Novy-Marx (2013).

Appendix Table II
ETF Sample

This table reports the number and stock characteristics of ETFs in our sample over the 160-month period 2004:06 to 2017:09. In Panel A, by ETF fund advisors; in Panel B, by average fund size; and in Panel C by the average number of stocks held. †Missing Information.

	PANEL A: TOP 10 ETF ADVISORS	Total	U.S. Equity	Sector Equity	Int'l Equity	of Total	Total
	2004:06-2017:09						
1.	Blackrock Funds Advisors (iShares)	141	58	67	16	13.5	13.5
2.	Invesco (PowerShares)	124	52	67	5	11.8	25.3
3.	State Street Global Advisors (SPDRs)	85	32	44	9	8.1	33.4
4.	Guggenheim Investments	75	43	26	6	7.2	40.6
5.	First Trust Advisors	71	31	36	4	6.8	47.3
6.	Vanguard Group	49	32	11	6	4.7	52.0
7.	Global X Funds	40	11	26	3	3.8	55.8
8.	VanEck	31	2	29		3.0	58.8
9.	WisdomTree Investments	24	18	1	5	2.3	61.1
10.	Russell Investments	22	22			2.1	63.2
11.	All Other	386	197	146	43	36.8	100.0
	Total	*1,048*	*498*	*453*	*97*	*100.0*	
	End 2017:09						
1.	Blackrock Funds Advisors (iShares)	123	54	59	10	16.2	16.2
2.	Invesco (PowerShares)	87	41	45	1	11.4	27.6
3.	State Street Global Advisors (SPDRs)	74	30	37	7	9.7	37.3
4.	Guggenheim Investments	69	31	36	2	9.1	46.4
5.	First Trust Advisors	48	31	11	6	6.3	52.7
6.	Vanguard Group	38	21	15	2	5.0	57.7
7.	Global X Funds	24	7	15	2	3.2	60.8
8.	VanEck	22	2	20		2.9	63.7
9.	WisdomTree Investments	19	16	3		2.5	66.2
10.	Fidelity Investments	18	7	11		2.4	68.6
11.	All Other	239	146	64	29	31.4	100.0
	Total	*761*	*386*	*316*	*59*	*100.0*	
	Start 2004:06						
1.	Blackrock Funds Advisors (iShares)	56	36	19	1	70.9	70.9
2.	Vanguard Group	17	10	7		21.5	92.4
3.	Invesco (PowerShares)	3	3			3.8	96.2
4.	Guggenheim Investments	1	1			1.3	97.5
5.	First Trust Advisors	1	1			1.3	98.7
6.	Fidelity Investments	1	1			1.3	100.0
	Total	*79*	*52*	*26*	*1*	*100.0*	

	PANEL B: AVE FUND SIZE ($ Millions)	Average	U.S. Equity	Sector Equity	Int'l Equity
	2004:06-2017:09				
1.	Blackrock Funds Advisors (iShares)	3,801	4,360	5,763	1,281
2.	State Street Global Advisors	5,951	8,102	9,509	242
3.	Vanguard Group	5,421	9,610	1,556	5,097
4.	Invesco (PowerShares)	869	1,270	1,064	274
5.	VanEck	1,111	452	1,770	
6.	First Trust Advisors	431	215	896	181
7.	Charles Schwab	2,645	3,729	3,580	627
8.	Guggenheim Investments	355	915	121	28
9.	Wisdom Tree	292	773	24	79
10.	DST Systems (ALPS)	1,682	293	3,071	
11.	All Other	209	229	249	150
	Average	*2,070*	*2,722*	*2,509*	*884*
	End 2017:09				
1.	Blackrock Funds Advisors (iShares)	8,160	21,054	964	2,462
2.	Vanguard Group	18,368	29,831	7,434	17,840
3.	State Street Global Advisors	9,029	10,187	16,552	347
4.	Invesco (PowerShares)	1,481	1,961	2,174	307
5.	Charles Schwab	6,710	11,877	3,708	4,546
6.	First Trust Advisors	747	423	1,572	247
7.	Guggenheim Investments	829	2,111	340	37
8.	VanEck	1,174	650	1,698	
9.	Wisdom Tree	805	1,534		76
10.	DST Systems (ALPS)	1,552	368	2,737	
11.	All Other	302	290	418	198
	Average	*4,469*	*7,299*	*3,760*	*2,895*
	Start 2004:06				
1.	State Street Global Advisors	2,876	7,835	724	68
2.	Blackrock Funds Advisors (iShares)	680	1,575	324	142
3.	Vanguard Group	218	413	23	
4.	Guggenheim Investments	372	372		
5.	Invesco (PowerShares)	97	97		
6.	Fidelity Investments	131	131		
7.	First Trust Advisors	†	†	†	†
	Average	*729*	*1,737*	*357*	*105*

PANEL C: NO. OF UNIQUE STOCKS HELD	Average	U.S. Equity	Sector Equity	Int'l Equity
2004:06-2017:09				
Vanguard Group	4,521	6,899	4,423	2,240
Blackrock Funds Advisors (iShares)	3,396	6,262	3,063	863
Invesco (PowerShares)	2,874	5,245	3,317	59
Guggenheim Investments	2,294	5,271	1,058	553
Fidelity Investments	3,350	3,864	2,835	
State Street Global Advisors (SPDRs)	2,543	4,757	2,188	684
WisdomTree Investments	1,603	4,025	30	754
First Trust Advisors	1,912	3,702	1,976	59
Charles Schwab	1,161	3,473	1	10
Northern Trust (Flexshares)	1,192	3,183	112	281
All Other	2,488	3,900	2,513	1,052
Average	*2,485*	*4,598*	*1,956*	*656*
End 2017:09				
Vanguard Group	2,390	3,427	2,144	1,600
Blackrock Funds Advisors (iShares)	1,784	3,391	1,413	548
Invesco (PowerShares)	1,304	2,685	1,217	11
State Street Global Advisors (SPDRs)	1,387	2,369	1,253	540
Charles Schwab	741	2,215	1	6
Guggenheim Investments	908	2,185	492	47
Fidelity Investments	1,589	1,046	2,131	
Deutsche Asset Management	970	1,937	2	
First Trust Advisors	955	1,809	1,042	15
Fidelity Investments	1,891	1,891		
All Other	1,569	2,439	1,374	895
Average	*1,408*	*2,309*	*1,107*	*458*
Start 2004:06				
Vanguard Group	2,846	3,825	1,867	
Blackrock Funds Advisors (iShares)	1,519	2,959	1,561	36
Fidelity Investments	1,491	1,491		
State Street Global Advisors (SPDRs)	623	1,352	488	29
Guggenheim Investments	483	483		
Invesco (PowerShares)	253	253		
First Trust Advisors	134	134		
Average	*1,050*	*1,500*	*1,305*	*33*

Appendix Table III
Regression Results on Control Variables

Table IV Contd.	Panel A:		$ln(\Delta Amihud\ Illiquidity)$				Panel B: Stock Volatility					
	1	2	3	4	5	6	7	8	9	10	11	12
$ln(RMCAP)$	0.027^{c}	0.028^{c}	0.029^{c}	0.030^{c}	0.028^{c}	0.029^{c}	-0.045^{c}	-0.037^{c}	-0.054^{c}	-0.042^{c}	-0.054^{c}	-0.043^{c}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Book/Market Ratio	-0.029^{c}	-0.044^{c}	-0.033^{c}	-0.049^{c}	-0.033^{c}	-0.049^{c}	0.022^{c}	0.011^{a}	0.026^{c}	0.010^{a}	0.026^{c}	0.010^{a}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.060)	(0.000)	(0.085)	(0.000)	(0.085)
Rolling 12-month return	-0.068^{c}	-0.101^{c}	-0.073^{c}	-0.108^{c}	-0.072^{c}	-0.108^{c}	0.010	-0.008	0.026^{c}	0.008	0.026^{c}	0.008
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.187)	(0.314)	(0.000)	(0.199)	(0.000)	(0.196)
CRSP Turnover	0.072^{c}	0.040^{c}	0.079^{c}	0.045^{c}	0.078^{c}	0.044^{c}	0.053^{c}	0.024^{c}	0.050^{c}	0.016^{c}	0.050^{c}	0.016^{c}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.009)	(0.000)	(0.010)
Inverse Price	0.046^{c}	0.078^{c}	0.047^{c}	0.079^{c}	0.048^{c}	0.081^{c}	0.160^{c}	0.119^{c}	0.182^{c}	0.129^{c}	0.182^{c}	0.129^{c}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	-0.004	-0.002	-0.005	0.000	-0.005	0.000	-0.008	-0.008	0.003	0.001	0.002	0.000
	(0.349)	(0.753)	(0.305)	(0.926)	(0.301)	(0.955)	(0.385)	(0.374)	(0.731)	(0.922)	(0.747)	(0.939)

Table V Contd.	Panel A: Corwin-Schultz Spread					
	1	2	3	4	5	6
$ln(RMCAP)$	-0.016^{b}	-0.012^{b}	-0.021^{c}	-0.016^{c}	-0.021^{c}	-0.016^{c}
	(0.011)	(0.033)	(0.002)	(0.006)	(0.002)	(0.007)
Book/Market Ratio	0.022^{c}	0.015^{c}	0.024^{c}	0.017^{c}	0.024^{c}	0.017^{c}
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Rolling 12-month return	0.019^{c}	0.007^{a}	0.028^{c}	0.015^{c}	0.028^{c}	0.014^{c}
	(0.000)	(0.079)	(0.000)	(0.001)	(0.000)	(0.002)
CRSP Turnover	0.076^{c}	0.061^{c}	0.093^{c}	0.075^{c}	0.093^{c}	0.075^{c}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inverse Price	0.164^{c}	0.127^{c}	0.198^{c}	0.153^{c}	0.197^{c}	0.153^{c}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	-0.003	-0.002	-0.007	-0.006	-0.008	-0.006
	(0.504)	(0.584)	(0.223)	(0.258)	(0.204)	(0.239)

Table V Contd.	Panel B: Variance Ratio						Panel B:		$\lvert Variance\,Ratio - 1 \rvert$			
	1	2	3	4	5	6	7	8	9	10	11	12
$ln(RMCAP)$	-0.024^{b}	-0.023^{b}	-0.023^{b}	-0.022^{b}	-0.022^{b}	-0.021^{b}	0.011^{a}	0.010^{a}	0.010^{a}	0.009^{a}	0.010^{a}	0.009^{a}
	(0.019)	(0.029)	(0.023)	(0.035)	(0.028)	(0.041)	(0.052)	(0.068)	(0.068)	(0.088)	(0.070)	(0.089)
Book/Market Ratio	-0.011^{a}	-0.010^{a}	-0.011^{a}	-0.010^{a}	-0.011^{b}	-0.010^{a}	0.005	0.004	0.004	0.004	0.004	0.004
	(0.050)	(0.064)	(0.052)	(0.065)	(0.049)	(0.061)	(0.132)	(0.188)	(0.155)	(0.216)	(0.150)	(0.211)

Rolling 12-month return	-0.013[c]	-0.013[c]	-0.014[c]	-0.013[c]	-0.014[c]	-0.014[c]	0.000	0.001	0.000	0.001	0.001	0.001
	(0.004)	(0.006)	(0.003)	(0.005)	(0.002)	(0.004)	(0.823)	(0.794)	(0.830)	(0.781)	(0.784)	(0.737)
CRSP Turnover	0.008	0.007	0.008	0.007	0.008	0.007	-0.013[c]	-0.013[c]	-0.013[c]	-0.013[c]	-0.013[c]	-0.013[c]
	(0.131)	(0.179)	(0.121)	(0.164)	(0.106)	(0.142)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inverse Price	-0.022[c]	-0.021[c]	-0.023[c]	-0.022[c]	-0.025[c]	-0.024[c]	0.013[c]	0.013[c]	0.013[c]	0.013[c]	0.013[c]	0.014[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	-0.010	-0.009	-0.012[a]	-0.012[a]	-0.012[a]	-0.012[a]	-0.003	-0.003	-0.002	-0.002	-0.002	-0.002
	(0.128)	(0.136)	(0.068)	(0.068)	(0.065)	(0.066)	(0.388)	(0.362)	(0.585)	(0.515)	(0.628)	(0.555)

Table VI Contd.	**Fama-French 5-Factor Model**						**Carhart 4-Factor Model**					
Market Return Beta	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
$ln(RMCAP)$	-0.007	-0.005	-0.010	-0.008	-0.011	-0.009	-0.021[b]	-0.020[b]	-0.024[c]	-0.023[c]	-0.024[c]	-0.024[c]
	(0.446)	(0.556)	(0.276)	(0.373)	(0.218)	(0.299)	(0.018)	(0.020)	(0.007)	(0.008)	(0.005)	(0.006)
Book/Market Ratio	-0.013[b]	-0.013[b]	-0.014[b]	-0.013[c]	-0.014[b]	-0.013[c]	0.000	-0.000	0.000	-0.000	0.000	-0.000
	(0.014)	(0.011)	(0.011)	(0.009)	(0.011)	(0.009)	(0.960)	(0.973)	(0.999)	(0.945)	(0.997)	(0.951)
Rolling 12-month return	0.008[a]	0.009[b]	0.008[a]	0.008[a]	0.008[a]	0.009[b]	0.013[b]	0.013[b]	0.013[b]	0.012[b]	0.013[b]	0.012[b]
	(0.066)	(0.045)	(0.074)	(0.052)	(0.063)	(0.046)	(0.030)	(0.036)	(0.035)	(0.041)	(0.032)	(0.039)
CRSP Turnover	0.008	0.008	0.007	0.007	0.006	0.007	0.021[c]	0.021[c]	0.020[c]	0.020[c]	0.019[c]	0.019[c]
	(0.241)	(0.178)	(0.321)	(0.244)	(0.365)	(0.281)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Inverse Price	0.018[b]	0.019[c]	0.020[c]	0.021[c]	0.019[c]	0.020[c]	0.026[c]	0.027[c]	0.028[c]	0.028[c]	0.028[c]	0.028[c]
	(0.012)	(0.005)	(0.006)	(0.003)	(0.007)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	-0.007	-0.005	-0.006	-0.005	-0.007	-0.005	0.001	0.002	0.002	0.003	0.002	0.002
	(0.352)	(0.453)	(0.433)	(0.536)	(0.364)	(0.457)	(0.850)	(0.766)	(0.738)	(0.668)	(0.812)	(0.741)

Table IX Contd.	**Fama-French 5-Factor Model**				**Carhart 4-Factor Model**				**DGTW**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
$ln(RMCAP)$	-0.916[c]	-0.870[c]	-0.827[c]	-0.826[c]	-0.844[c]	-0.797[c]	-0.766[c]	-0.754[c]	-0.844[c]	-0.816[c]	-0.810[c]	-0.806[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Book/Market Ratio	-0.046	0.019	0.020	0.004	0.033	0.073	0.059	0.059	-0.083	-0.040	-0.035	-0.050
	(0.632)	(0.795)	(0.753)	(0.949)	(0.701)	(0.292)	(0.328)	(0.292)	(0.397)	(0.561)	(0.574)	(0.375)
Rolling 12-month return	0.204[b]	0.176[c]	0.145[c]	0.139[c]	0.067	0.061	0.049	0.052	0.108	0.082	0.075	0.077
	(0.013)	(0.002)	(0.001)	(0.001)	(0.263)	(0.171)	(0.222)	(0.158)	(0.217)	(0.219)	(0.176)	(0.112)
CRSP Turnover	0.122	0.051	0.040	-0.003	0.044	0.004	0.000	-0.043	-0.190[a]	-0.214[c]	-0.227[c]	-0.234[c]
	(0.247)	(0.504)	(0.547)	(0.964)	(0.667)	(0.953)	(0.994)	(0.386)	(0.050)	(0.002)	(0.000)	(0.000)
Inverse Price	0.281[b]	0.297[c]	0.262[c]	0.218[b]	0.319[b]	0.332[c]	0.295[c]	0.257[c]	0.389[c]	0.382[c]	0.340[c]	0.305[c]
	(0.037)	(0.006)	(0.008)	(0.023)	(0.014)	(0.002)	(0.002)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	2.257[c]	1.805[c]	1.653[c]	1.586[c]	2.035[c]	1.670[c]	1.550[c]	1.493[c]	1.667[c]	1.426[c]	1.333[c]	1.284[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$ln(RMCAP)$	-0.887[c]	-0.833[c]	-0.793[c]	-0.783[c]	-0.817[c]	-0.779[c]	-0.779[c]	-0.743[c]	-0.843[c]	-0.831[c]	-0.832[c]	-0.826[c]

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Book/Market Ratio	-0.027	0.019	0.024	0.005	0.048	0.069	0.069	0.056	-0.089	-0.046	-0.036	-0.049
	(0.751)	(0.774)	(0.677)	(0.923)	(0.527)	(0.273)	(0.273)	(0.281)	(0.326)	(0.473)	(0.522)	(0.353)
Rolling 12-month return	0.203[c]	0.158[c]	0.128[c]	0.127[c]	0.075	0.045	0.045	0.038	0.091	0.051	0.045	0.049
	(0.006)	(0.002)	(0.002)	(0.001)	(0.144)	(0.281)	(0.281)	(0.268)	(0.261)	(0.405)	(0.383)	(0.281)
CRSP Turnover	0.078	0.023	0.023	-0.012	0.043	0.004	0.004	-0.033	-0.172[b]	-0.183[c]	-0.198[c]	-0.204[c]
	(0.370)	(0.712)	(0.671)	(0.819)	(0.590)	(0.938)	(0.938)	(0.464)	(0.044)	(0.003)	(0.000)	(0.000)
Inverse Price	0.310[c]	0.301[c]	0.268[c]	0.228[c]	0.327[c]	0.323[c]	0.323[c]	0.252[c]	0.332[c]	0.325[c]	0.289[c]	0.258[c]
	(0.005)	(0.002)	(0.003)	(0.008)	(0.003)	(0.001)	(0.001)	(0.003)	(0.002)	(0.000)	(0.001)	(0.001)
Profitability	1.791[c]	1.573[c]	1.471[c]	1.438[c]	1.654[c]	1.477[c]	1.477[c]	1.366[c]	1.434[c]	1.282[c]	1.223[c]	1.191[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Table XI Contd. Quarterly Earnings Announcements	**1st**				**2nd**		**3rd**		**4th**	
	$CAR(-1,1)$		$CAR(3,60)$		$CAR(3,60)$					
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
$ln(RMCAP)$	-0.606[c]	-0.598[c]	-2.477[c]	-2.489[c]	-2.274[c]	-2.279[c]	-2.332[c]	-2.322[c]	-1.940[c]	-1.933[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Book/Market Ratio	-0.098	-0.102[a]	-0.256	-0.269	-0.088	-0.098	0.528[c]	0.522[c]	0.599[c]	0.593[c]
	(0.109)	(0.097)	(0.151)	(0.130)	(0.643)	(0.608)	(0.007)	(0.008)	(0.001)	(0.001)
Rolling 12-month return	0.088[a]	0.083[a]	0.080	0.051	0.037	0.017	-0.018	-0.028	-0.120	-0.129
	(0.056)	(0.072)	(0.661)	(0.780)	(0.824)	(0.918)	(0.902)	(0.843)	(0.365)	(0.323)
CRSP Turnover	-0.179[c]	-0.177[c]	-0.103	-0.081	-0.138	-0.125	-0.375[b]	-0.368[b]	-0.113	-0.108
	(0.000)	(0.001)	(0.618)	(0.695)	(0.359)	(0.404)	(0.024)	(0.026)	(0.422)	(0.444)
Inverse Price	1.063[c]	1.046[c]	3.492[c]	3.423[c]	3.336[c]	3.286[c]	2.679[c]	2.655[c]	2.372[c]	2.351[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	-0.010	-0.010	0.419	0.410	0.232	0.227	0.431[a]	0.432[a]	0.268	0.268
	(0.931)	(0.926)	(0.114)	(0.122)	(0.335)	(0.347)	(0.062)	(0.062)	(0.244)	(0.244)

Appendix Table IV
Robustness Test

Table reports two-way stock and month fixed effects regressions of illiquidity, stock return volatility, spread, and variance ratio on arbitrage trading, ETF ownership, and residual arbitrage trading. For each firm, we estimate a time-series regression of absolute mispricing on the volume of purchases and sales by APs to compute absolute mispricing residuals. Variable definitions can be found in Table II and Appendix Table I. Errors are clustered by stock and month. [a], [b] and [c] denote 10%, 5% and 1% significant level, respectively. *p*-values are in parentheses. Coefficients on other control variables are reported in Appendix Table III.

	$\Delta ln(Amihud\ Illiq)$		Volatility		Spread		$Var\ Ratio$		$\|Var\ Ratio - 1\|$		5-Factor Return Beta	
	1	2	3	4	5	6	7	8	9	10	11	12
$Residual\ \|Mispricing\|$	0.001	0.001	0.012[c]	0.011[c]	0.015[c]	0.013[c]	-0.007	-0.007[a]	0.001	0.001	0.033[c]	0.031[c]
	(0.729)	(0.733)	(0.003)	(0.005)	(0.001)	(0.005)	(0.107)	(0.090)	(0.546)	(0.578)	(0.000)	(0.000)
$ETF\ AT \times High\_HHI$	-0.057[c]	-0.034[c]	-0.036[c]	-0.025[c]	-0.045[c]	-0.037[c]	-0.022[b]	-0.021[b]	0.018[c]	0.017[c]	-0.094[c]	-0.089[c]
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.014)	(0.024)	(0.000)	(0.000)	(0.000)	(0.000)
$ETF\ AT \times Low\_HHI$	-0.071[c]	-0.058[c]	-0.037[c]	-0.029[c]	-0.042[c]	-0.035[c]	-0.005	-0.002	0.016[c]	0.015[c]	-0.113[c]	-0.108[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.637)	(0.821)	(0.002)	(0.002)	(0.000)	(0.000)
$ETF\ Own \times High\_HHI$	0.042[c]	0.082[c]	0.047[c]	0.036[c]	0.018[b]	0.013[a]	-0.014	-0.011[a]	-0.009[b]	-0.009[b]	0.069[c]	0.066[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.036)	(0.072)	(0.104)	(0.087)	(0.044)	(0.039)	(0.000)	(0.000)
$ETF\ Own \times Low\_HHI$	0.023[c]	0.045[c]	0.039[c]	0.026[c]	0.009	0.006	0.005	0.006	-0.003	-0.003	0.017[a]	0.016[a]
	(0.003)	(0.000)	(0.000)	(0.000)	(0.216)	(0.336)	(0.554)	(0.479)	(0.537)	(0.505)	(0.067)	(0.084)
$Active\ Mutual\ Fund\ Own$	0.018[c]	0.028[c]	-0.004	0.000	-0.010[c]	-0.006[b]	0.021[c]	0.021[c]	-0.007[c]	-0.007[c]	0.010[b]	0.009[b]
	(0.000)	(0.000)	(0.360)	(0.905)	(0.002)	(0.023)	(0.000)	(0.000)	(0.005)	(0.006)	(0.016)	(0.020)
$Index\ Mutual\ Fund\ Own$	0.006	0.004	-0.014[c]	-0.007	-0.012[b]	-0.008[b]	-0.009	-0.009	-0.000	0.000	0.002	0.001
	(0.356)	(0.540)	(0.005)	(0.137)	(0.011)	(0.043)	(0.111)	(0.111)	(0.956)	(0.934)	(0.701)	(0.777)
$ln(RMCAP)$	0.028[c]	0.029[c]	-0.054[c]	-0.043[c]	-0.021[c]	-0.016[c]	-0.022[b]	-0.021[b]	0.010[a]	0.009[a]	-0.024[c]	-0.024[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.007)	(0.027)	(0.040)	(0.069)	(0.088)	(0.005)	(0.006)
Book/Market Ratio	-0.033[c]	-0.049[c]	0.026[c]	0.011[a]	0.024[c]	0.017[c]	-0.011[b]	-0.010*	0.004	0.004	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.082)	(0.000)	(0.001)	(0.049)	(0.061)	(0.148)	(0.209)	(0.989)	(0.958)
Rolling 12-month return	-0.072[c]	-0.108[c]	0.026[c]	0.008	0.028[c]	0.014[c]	-0.014[c]	-0.014[c]	0.001	0.001	0.013[b]	0.012[b]
	(0.000)	(0.000)	(0.000)	(0.197)	(0.000)	(0.002)	(0.002)	(0.004)	(0.783)	(0.736)	(0.032)	(0.039)
CRSP Turnover	0.078[c]	0.044[c]	0.050[c]	0.016[c]	0.093[c]	0.075[c]	0.008	0.007	-0.013[c]	-0.013[c]	0.020[c]	0.019[c]
	(0.000)	(0.000)	(0.000)	(0.010)	(0.000)	(0.000)	(0.107)	(0.146)	(0.000)	(0.000)	(0.002)	(0.002)
Inverse Price	0.048[c]	0.081[c]	0.182[c]	0.129[c]	0.197[c]	0.153[c]	-0.025[c]	-0.024[c]	0.013[c]	0.014[c]	0.028[c]	0.028[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	-0.005	0.000	0.002	0.000	-0.008	-0.006	-0.012[a]	-0.012[a]	-0.002	-0.002	0.002	0.002
	(0.299)	(0.958)	(0.751)	(0.943)	(0.200)	(0.235)	(0.066)	(0.067)	(0.624)	(0.552)	(0.821)	(0.748)
1 Mo Lag	-0.323[c]	-0.420[c]	0.232[c]	0.177[c]	0.312[c]	0.240[c]	0.015[c]	0.015[c]	-0.002	-0.002	0.031[c]	0.030[c]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.445)	(0.388)	(0.000)	(0.000)
2 Mo Lag		-0.252[c]		0.125[c]		0.133[c]		0.009[c]		-0.003		0.028[c]
		(0.000)		(0.000)		(0.000)		(0.001)		(0.260)		(0.000)

3 Mo Lag		-0.112^{c}		0.163^{c}		0.105^{c}		0.010^{c}		-0.004^{b}		0.022^{c}
		(0.000)		(0.000)		(0.000)		(0.000)		(0.045)		(0.000)
Stock Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Month Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster by Stock and Month	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
NOBS	404,154	398,029	407,504	401,332	407,484	401,276	407,504	401,332	407,504	401,332	407,432	401,213
R^2	0.209	0.252	0.594	0.617	0.651	0.666	0.121	0.121	0.070	0.071	0.100	0.102