ETF Dividend Cycles Predict Money Market Fund Flows and Treasury Yield Changes*

Pekka Honkanen† Yapei Zhang‡ Tong Zhou§

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Abstract

Exchange-traded funds (ETFs) collect approximately 7% of all U.S. corporate dividends, which they are required to redistribute to investors. How do the funds manage these dividend flows, and does such management have spillover effects on other financial markets? In this paper, we document a new stylized fact of the "ETF dividend cycle:" ETFs *gradually* invest in money market funds (MMFs) when they accumulate dividend receipts and *periodically* withdraw from MMFs when they distribute dividends. This cycle creates periodic liquidity shocks to MMFs and, consequently, to the Treasury markets as the affected MMFs liquidate some of their short-term Treasury holdings to satisfy ETFs' dividend-driven withdrawals. As a result, ETF dividend cycles can explain flows to MMFs and fluctuations in Treasury yields.

Keywords: exchange-traded funds, money market funds, dividends, Treasury markets, spillover effects

JEL Classification: G12, G23, G24

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†Assistant Professor of Finance. University of Georgia, Terry College of Business, 620 S. Lumpkin St., Athens, GA 30602, USA; e-mail: pekka.honkanen@uga.edu; tel: +1 (706) 459 1635.

‡Assistant Professor of Finance. School of Entrepreneurship and Management, ShanghaiTech University, 393 Huaxia Middle Road, Shanghai, China; e-mail: zhangyp3@shanghaitech.edu.cn.

§Assistant Professor of Finance. School of Entrepreneurship and Management, ShanghaiTech University, 393 Huaxia Middle Road, Shanghai, China; e-mail: zhoutong@shanghaitech.edu.cn.

1 Introduction

The assets under management of exchange-traded funds (ETFs) have grown by more than 26% in the past twenty years. By the end of 2021, there were a total of 1,843 ETFs in the United States, representing $7.7 trillion in assets under management (AUM).[1] In 2021, U.S. ETFs collected approximately 7% of all corporate dividends in the U.S. through their stock holdings. They are required to periodically redistribute the dividends that they have received to their own shareholders (i.e., the ETF investors). As a result, ETFs accumulate dividend receipts *gradually* but disburse them to investors *abruptly*, giving rise to a *dividend accumulation-disbursement cycle*. Depending on the magnitude of the "ETF dividend cycle," it can also generate liquidity shocks and price spillover impacts to other financial markets.

To the best of our knowledge, this paper is the first to document the stylized facts of "ETF dividend cycles." We study the asset pricing implications of ETFs adjusting their holdings of cash-like assets during the dividend accumulation-disbursement cycle in two aspects. First, using a database that allows us to examine the daily holdings of a subset of ETFs, we find that the accumulated dividends are placed in money market funds (MMFs) rather than the funds' underlying stocks. Using MMFs as a buffer for dividend receipts ensures high liquidity while still generating some return to the funds. When ETFs disburse dividends to their investors, they withdraw the cash from MMFs, forcing the latter to liquidate some of their holdings.

Second, the securities that MMFs sell to satisfy ETFs' dividend-driven withdrawals are generally short-term Treasuries. Specifically, using the universe of ETFs in the U.S., we find that for every 100 dollars of ETF dividend disbursement, MMFs reduce their holdings in one-, three-, and six-month Treasuries by approximately 53, 17, and 6 dollars, respectively. In contrast, the effect is negligible for Treasuries with longer maturities. These results are consistent with the intuition that MMFs sell their most liquid fixed-income securities when faced with large fund outflows (Shleifer and Vishny 2011; Choi et al. 2020).

We then examine the price impacts that "ETF dividend cycles" generate in the Treasury markets. On the one hand, we find that short-term Treasury yields, on average, increase on days when ETFs disburse dividends. These results remain highly robust when controlling for month-end effects as well as the total amount of corporate dividends. On the other hand, we find cross-sectional heterogeneity in the price impact on different Treasuries. Specifically, Treasuries sold by ETF-underlying MMFs decrease in price by more than their unaffected counterparts on ETF dividend payment dates. This evidence points to the fact that "ETF dividend cycles" lead to cyclical liquidations by MMFs, thereby causing periodic instability in the Treasury markets.

Our findings have potentially important implications. First, as ETFs reinvest their dividend

[1] Source: SEC N-CEN filings for 2021.

receipts in MMFs rather than index-underlying stocks, such dividend management practice leads to higher tracking errors. The longer time they hold in MMFs, the larger return difference they may yield from MMFs compared with their indices. Thus, a managerial implication to lower tracking errors is that ETFs should distribute dividends more frequently. Second, if MMFs adjust their Treasury holdings only on days with concentrated ETF dividend distributions, they might be worse off due to the larger buy-sell imbalance and higher price discount. This raises the question of whether MMFs can anticipate dividend-driven flows by ETFs (and other mutual funds) to adjust their holdings.

This article contributes to several strands of literature. First, our paper relates to previous studies examining mutual funds' dividend policies. Focusing on active dividend policies, Johnson et al. (2006) shows that mutual funds use minimum dividend yields to signal quality, and Dong (2015) examines the optimal dividend distribution schedules.[2] We supplement this literature by dissecting how ETFs manage their dividend receipts and disbursements.

Second, we contribute to the literature examining the determinants of money market fund flows. Prior research has examined the risk-taking behaviors and accounting policies of MMFs (Kacperczyk and Schnabl 2013; Witmer 2016), and information constraints and liquidity restrictions of investors (Schmidt et al. 2016; Li et al. 2021). We focus on the predictable flows of MMFs that are induced by the "ETF dividend cycles."

Third, our paper adds to the literature on the asset pricing implications of ETFs. Previous studies have examined the effects of ETF ownership on their underlying stocks from the perspectives of price discovery (Hasbrouck 2003; Richie et al. 2008; Glosten et al. 2021; Bhojraj et al. 2020), comovement and volatility (Sullivan and Xiong 2012; Broman 2016; Da and Shive 2018; Shum et al. 2016; Ben-David et al. 2018; Chinco and Fos 2021), and liquidity (Boehmer and Boehmer 2003; Dannhauser 2017; Israeli et al. 2017; Petajisto 2017). We examine the price spillover impact of "ETF dividend cycles" on MMFs and, consequently, the Treasury markets.

Finally, previous studies have examined fundamental factors that shift demand and supply for Treasuries and thereby cause yield fluctuations, such as economic conditions (Hendershott 1984), market structures (Kamara 1988), fiscal and monetary policy changes (Simon 1991; Rigobon and Sack 2004; Kuttner 2006; Han et al. 2007; Swanson 2011; Greenwood and Vayanos 2014; Vissing-Jorgensen 2021), regulatory requirements (He et al. 2022), and demands for safe or liquid assets (Kamara 1994; Nippani et al. 2001; Krishnamurthy 2002; Nippani and Smith 2010; Krishnamurthy and Vissing-Jorgensen 2012; Fleckenstein and Longstaff 2021). Lou et al. (2013) reveal that regular Treasury auctions could cause liquidity shocks and temporary price impacts on Treasuries. Supplementary to their research, we identify a new source of repeated and predictable liquidity shocks

[2]Other prior studies examine some funds' investment preference for dividend-paying stocks (Hameed and Xie 2019; Harris et al. 2015; Simutin 2014).

to the Treasury markets — MMF flows driven by ETF dividends. Unlike a Treasury auction, an ETF dividend event causes the underlying MMFs to reduce their demand for Treasuries without any change to the total number of outstanding Treasury bonds.

2 Data and Variable Construction

We collect dividend data for all U.S. listed stocks from the Center for Research in Security Prices (CRSP), identifying the amounts and the corresponding record and payment dates of each ordinary dividend at the security level. CRSP also contains the dividend payments of ETFs.

We collect quarterly ETF holdings for all U.S. ETFs from the CRSP Mutual Fund Holdings database. We then impute incoming dividends at the daily frequency using the holdings report dates that are closest to each dividend record date for the underlying stocks of the funds, and attribute the dividends to funds on the respective dividend payment dates. This lets us closely impute the incoming dividends based on the number of shares a fund holds, and attribute the cash flow to the actual dividend payment date.

We estimate the dividend payments by ETFs by using CRSP stock data, using the *divamt* variable to obtain per-share dividends, and multiplying this by the shares outstanding on the dividend record date (*rcrddt* in CRSP). We then accumulate these at the fund and day level based on the dividend payment date (*paydt* in CRSP) that corresponds to each dividend event. Similarly to the incoming dividends from the funds' stock holdings, this lets us attribute the dividend cash flows to the actual date the cash flows occur. Importantly, we use the CRSP stock data to obtain the dividend amounts as it contains the record and payment dates of the dividends. This lets us correctly attribute the dividends to the cash flow dates. While the CRSP mutual fund data would also let us obtain dividends, the dividend dates in this database correspond to the ex-dividend dates, and the database does not contain the actual payment dates.[3]

The CRSP mutual fund holdings data also contain ETFs' investments in MMFs. We use these to attribute the dividend flows (i.e., receipts by and payments from) of each ETF to their underlying MMFs, prorating the ETF level flow by the value of MMF holdings. We call this "MMF dividend flows." The quarterly mutual fund holdings data in CRSP are available starting in 2001, and our sample extends to the end of 2019.[4]

Finally, we obtain detailed MMF holdings at the monthly frequency from SEC Edgar using Form N-MFP. These data are available starting in 2010. The data identify the security-level holdings of all U.S. MMFs at each month-end. Importantly, the data also contain security type identifiers

[3]We thank the reviewer for bringing this to our attention and find it important to clarify to the reader.

[4]The data in 2020 and 2021 are heavily affected by the quantitative easing by the Federal Reserve starting in March 2020 as a response to the COVID-19 pandemic.

that enable us to directly group investments by category (e.g., government bonds, corporate bonds, repurchase agreements, etc.). Additionally, the data contain fund-level information, such as category identifiers (prime, government, tax-exempt, etc.), as well as weekly fund flows.

Table 1 shows the summary statistics for ETFs. As shown in Table 2, MMFs allocate on average 8% of their holdings to Treasury securities, with bonds with less than one month to maturity accounting for nearly three-quarters of the total at 5.5%. Combining Tables 1 and 2, we infer that the dividend-induced ETF flow accounts for about 0.45% of ETFs' net assets, 1% of their total Treasury holdings, and approximately 4.5% of their one-month Treasury holdings.

We obtain daily constant-maturity Treasury yield data from the Federal Reserve Economic Data (FRED).

[Tables 1 and 2 here.]

3 Stylized Facts of ETF Dividend Cycles

3.1 ETF Dividend Receipts and Disbursements

ETFs *receive* dividends from their underlying holdings and are required subsequently to *distribute* any dividend receipts to their investors. Figure 1 shows the ratio of dividends paid by all U.S. ETFs divided by the total corporate dividend payments by U.S. listed companies between 2001 and 2019. This ratio increases over our sample period and peaks at 7%.

[Figure 1 here.]

However, ETFs do not distribute dividends on the same schedule as their underlying stocks. Instead, ETFs disburse dividends on pre-scheduled dates, usually quarterly: illustrated in Figure 2, nearly 40% of all ETFs pay dividends four times per year.

[Figure 2 here.]

As ETFs receive corporate dividends at almost a daily frequency but disburse dividends at a much lower frequency, dividend receipts in ETFs accumulate between scheduled payout dates, creating a dividend accumulation-disbursement cycle. Figure 3 shows the weekly aggregate dividend receipt and payment flows to and from all U.S. ETFs. The weekly amount of corporate dividends received by ETFs is fairly stable and is generally less than $2 billion, whereas the dividends distributed by ETFs are less frequent and significantly larger in magnitude (up to $15 billion). This differentiation indicates gradual dividend accumulation and periodic release to investors. We observe a similar pattern in daily dividend accumulations and disbursements for BlackRock iShares ETFs (see Figure 4 for examples of four ETFs: DVY, DIVB, IVE, and IWB).

[Figures 3 and 4 here.]

3.2 Dividend Flows and Money Market Fund Holdings

We proceed to examine whether ETFs invest their dividend receipts in MMFs or reinvest them in stocks.[5] To do so, we focus on a sample consisting of BlackRock iShares ETFs, which enables us to observe the detailed daily holdings of the funds.[6] Using the daily holdings data, we can precisely estimate the daily dividend flows to and from each ETF, and we can closely identify any changes in the funds' MMF or equity holdings. We estimate the daily net dividend flows for each fund using the methodology described in Section 2 at the daily frequency. The sample contains approximately 1.2 million dividend receipt events and 67,000 dividend payment events for 3,618 ETF portfolios from 2010 to 2019. We then aggregate them at the fund-day level.

We first illustrate the relation between the changes in ETFs' MMFs or equity holdings and dividend inflows to and outflows from the funds in Figure 5. As shown, ETFs invest at least part of the dividend receipts in MMFs. However, when ETFs disburse dividends, most of these dividends are withdrawn from MMFs. Notably, there is no correlation between ETF dividend flows and their equity holdings.

[Figure 5 here.]

To confirm this finding, we estimate the following regression using the BlackRock iShares ETFs sample at the daily frequency:

$$\Delta\text{Holdings}_{f,t} = \beta\text{Netflow}_{f,t} + FE_w + FE_f + \varepsilon_{f,t}, \tag{1}$$

where $\Delta\text{Holdings}_{f,t}$ is the change in holdings of underlying MMFs or stocks by fund f on day t, and $\text{Netflow}_{f,t}$ is the daily net dividend flow (i.e., dividend receipts minus dividend payments) of fund f on day t. We control for ETF fixed effects and calendar week fixed effects.

The results presented in Table 3 support our observation in Figure 5. Specifically, the coefficient on net dividend flow is positive and statistically significant for MMF holdings, indicating that \$100 of dividend payments (receipts) lead to a decrease (increase) of \$68-71 in the total value of underlying MMFs.[7] In contrast, the coefficients are statistically indistinguishable from 0 for equity holdings. These results confirm that ETFs use MMFs, rather than equity holdings, as a buffer for dividend receipts and payments.

[Table 3 here.]

[5] ETFs hold very little cash (Chernenko and Sunderam 2016; Sherrill et al. 2017).

[6] We obtain the holdings data directly from the iShares website.

[7] The magnitude of the coefficient for MMF holdings is smaller than 1. We conjecture that this may be due to the timing issue: On the one hand, expecting the dividend flows, an ETF may adjust its holdings of MMFs in advance; on the other hand, ETFs may defer reinvesting or divesting their dividend flows in future months.

3.3 ETF Dividend Flows and MMF Holdings of Treasuries

As ETFs manage their dividend-cash balances to a large extent through MMF holdings, the asymmetric dividend flows to and from ETFs could be transmitted in a similar pattern to MMFs' flows to and from the Treasury markets. To explore how MMFs manage the ETF-dividend-driven flows, we estimate the following regression:

$$\Delta\text{THolding}_{\text{m},t} = \beta\text{ETFdiv}_{\text{m},t} + FE_t + FE_{\text{category}} + \gamma\text{Flow}_{\text{m,t}} + \varepsilon_{\text{m},t}, \tag{2}$$

where $\Delta\text{THolding}_{\text{m},t}$ is the change in Treasury holdings by MMF m in calendar month t. $\text{ETFdiv}_{\text{m},t}$ is the total net dividend flows (i.e., total dividend receipts minus total dividend payments) from all ETFs to MMF m in month t. We control for MMF flows that are unrelated to ETFs' dividend disbursements and receipts. We include fund-category fixed effects and calendar-month fixed effects in the regressions. The sample corresponds to 21,661 monthly observations for 576 MMFs from 2010 to 2019.

The results presented in Table 4 indicate that ETF dividends only affect MMF holdings in Treasuries with maturities of less than six months. For example, \$100 of dividend flows from ETFs leads to a \$53 (\$17, \$6) change in holdings of one-month (three-month, six-month) Treasuries by the affected MMFs. One plausible explanation for this result is that when MMFs are forced to liquidate large amounts of securities, they choose to liquidate the most liquid short-term Treasuries (Choi et al. 2020).

[Table 4 here.]

4 Spillover Price Impacts of ETF Dividend Cycles

4.1 Time-Series Variation in Treasury Yields

Section 3.3 shows that ETFs' dividend-induced flows to MMFs are primarily invested in and withdrawn from short-term Treasury bonds. In the following two sections, we study the price impact of ETF dividend-driven flows on the affected short-term Treasuries.

To quantify this price impact, we estimate the following regression:

$$\Delta y_{k,t} = \beta_k ln(d_{f,t} + 1) + Controls + \varepsilon_{k,t}, \tag{3}$$

where $\Delta y_{k,t}$ is the daily change in yield to maturity of Treasuries with maturity k, and $d_{f,t}$ is the daily aggregate dividend payments from all ETFs. The sample spans from 2001 to 2019.

We focus on ETF dividend disbursements in this and the following sections, as the magnitude

and price impacts of dividend outflows from ETFs are considerably larger than those of inflows. We control for seasonality in dividends or Treasury yields using calendar-month fixed effects. When ETFs disburse dividends, they withdraw money from MMFs, which induces selling pressure on short-term Treasuries and thereby increases short-term Treasury yields. Therefore, we expect a positive estimate of β_k.

As shown in Panel A of Table 5, the estimates of β_k for one-month, three-month, six-month, and one-year Treasuries are all positive and statistically significant at the 5% level. The economic magnitude of the effect is also significant: When an ETF distributes dividends of average size (i.e., 223 million), the yields to maturity of one-month, three-month, six-month, and one-year Treasuries increase by 0.58, 0.58, 0.42, and 0.38 basis points, respectively, corresponding to 0.20-0.44% of the sample mean yields.[8] However, the coefficients for Treasuries with longer maturities are neither statistically nor economically significant.

[Table 5 here.]

The total loss of value in Treasury markets due to ETF dividend price impacts can be approximated with a back-of-the-envelope calculation. For example, benchmarking to the one (three-) month average yield, the 0.58 (0.58) basis-point increase in yields resulting from one event of ETF dividends leads to a percentage decrease in Treasury prices of 0.05 (0.14) basis-point.[9] Given that the total market value of Treasuries maturing within three months by the end of 2021 is $409.3 billion, the increases in Treasury yields will cause a loss of $1.95 ($5.84) million in market value. As ETF dividend disbursements also lead to decreases in six-month and one-year Treasury prices, the loss in their market value can be estimated at $14.75-26.66 million. The total Treasury market value loss in an average ETF dividend event can thus be roughly estimated at $16-32 million. As Tables 1 shows that 205 out of 261 trading days in 2021 observe non-zero ETF dividends, the aggregate price impact is considerable.

We further examine the robustness of the time-series relation between ETF dividend payments and Treasury yields by ruling out potential confounding factors. The first factor that we examine is the month-end effect, as most of the ETF dividend payment dates are near month-ends. To rule out month-end effects, we control for an indicator variable for month-ends: If the effect is driven by month-end effects, the indicator variable will absorb most of the effect. Panel B of Table 5 presents

[8] For example, 0.58 is equal to the coefficient estimate in Table 5 Panel A Columne (1) (i.e., 0.030) multiplied by $ln(1 + 223 \times 10^6)$, where $223 million is the average amount of non-zero ETF dividends. The time-series averages of the yields to maturity of one-month, three-month, six-month, and one-year Treasuries are 1.30%, 1.67%, 1.78%, and 1.88%, respectively.

[9] For example, assuming that a Treasury bond that matures in one month pays zero coupons before maturity, a 0.58-basis-point increase in yield to maturity leads to a percentage decrease in its price of the magnitude of 0.000005 $[= 1/(1 + 1.30\% + 0.0058\%)^{(1/12)} \div 1/(1 + 1.30\%)^{(1/12)} - 1]$.

the results of estimating the following regression model:

$$\Delta y_{k,t} = \beta_k^1 ln(d_{f,t}+1) + \beta_k^2 End_{\mathbb{1}} + Controls + \varepsilon_{k,t}, \tag{4}$$

where $End_{\mathbb{1}}$ is equal to 1 for the five days before and after the end of the month.[10]

We find that our results change very little when we control for month-end effects. For example, the estimates of β_k for Treasuries with maturities shorter than one year remain significant and economically similar to those estimated in Panel A, while the estimates of β_k for Treasuries with maturities longer than one year remain statistically insignificant. These results suggest that the ETF dividend-driven price impacts are different from the month-end phenomena.

In Panel C of Table 5, we examine the possibility that the effects are due to corporate dividend payments, as it is possible that corporations keep the cash earmarked for dividends in MMFs and withdraw this to pay dividends. To rule out this possibility, we estimate the regression model (3) but include total corporate dividends as a control variable. We observe that the coefficients for β_k do not change qualitatively and remain statistically significant.

Another concern is that the regression model (3) imposes a linear effect, whereas dividends are concentrated in a subset of days each year.[11] To address this concern, we replace model (3) by the following dummy regression model (5),

$$\Delta y_{k,t} = \beta_k \mathbb{1}_{d_{f,t}>0} + Controls + \varepsilon_{k,t}, \tag{5}$$

where $\mathbb{1}_{d_{f,t}>0}$ takes value of one if day t observes positive ETF dividends payout. As the results in Table 6 show, Treasury yields are significantly higher during the days with ETF dividend payout events. On dividend payout days, short-term Treasury yields increase by about half a basis point. This number is quantitatively comparable to Lou et al. (2013), where they find a two basis points increase in Treasury yields on Treasury auction days, knowing that the average auction size is over $10 billion, while the average dividend payout is only 0.2 billion. Although the ETF-driven price impact is just one-quarter of the auction-driven price impact found in Lou et al. (2013), the former's economic importance is not negligible because ETF dividend payout events are more common (on average 113 days per year) than Treasury auctions (on average 46 times per year).[12]

[Table 6 here.]

[10] The results remain robust to using alternative definitions of month-end (e.g., the last ten days of the month).

[11] It is less of a concern for years after 2010 as two-thirds of the days during the year have ETF dividend payout events.

[12] Different from Treasury auctions, an ETF dividend distribution event causes no change to the total number of outstanding Treasury bonds.

4.2 Cross-Sectional Variation in Treasury Prices

In the previous section, we find *time-series* evidence that ETF dividends affect Treasury markets: Prices of Treasuries drop, on average, on ETF dividend dates. We proceed to test the *cross-sectional* implications. Specifically, we examine whether the prices of Treasuries that are more affected by dividend-paying ETFs fall more than Treasuries that are less affected.

To this end, we first define a Treasury bond as being "treated" if it is held by an MMF that experiences outflows due to ETFs distributing dividends. To define a group of "control" Treasuries, we match a treated Treasury with Treasuries that are not held by any MMF that is affected by ETF dividend-driven withdrawals, and that mature on the same date. We then construct a long-short strategy around ETF dividend dates: We (short-)sell treated Treasuries and buy controlled Treasuries one day before an ETF dividend date and unwind the portfolio at the end of this ETF dividend date. We expect a negative portfolio spread.

The results in Table 7 confirm the cross-sectional price impact of ETF dividends on Treasuries. For example, in Panel A, we find that the average annualized daily return of the treated Treasuries on ETF dividend dates is 1.34%, or 23.44% lower than the average annualized daily return of the control Treasuries on the same event dates (i.e., 1.76%). The effect is statistically significant at the 5% level. In Panels B and C, when we group ETF dividend dates into high or low based on the ETF dividend amount, we find that the long-short spread is larger in magnitude on high ETF dividend days. Moreover, the effect is no longer significant on low-dividend days. The annualized daily long-short spread on high (low) ETF dividend dates is 0.52% (0.25%).

Overall, Sections 4.1 and 4.2 confirm two patterns of price impacts of ETF dividends on the Treasury markets: In the time series, prices of Treasuries tend to drop on ETF dividend dates; in the cross-section, prices of Treasures that are held by ETF-underlying MMFs drop more on ETF dividend dates.

5 Conclusion

This article presents new stylized facts about the dividend management practices of U.S. ETFs. We first document that, in the "ETF dividend cycle," ETFs accumulate incoming corporate dividends in MMFs gradually but withdraw them abruptly in large amounts when they themselves have to pay dividends to investors. In other words, ETFs use MMFs, rather than the underlying equities, as a buffer for dividend receipts and payments. This pattern in ETF management of their dividend receipts and disbursements leads to large, sudden outflows from MMFs, forcing these funds to liquidate some of their underlying assets. We find that these liquidations are concentrated in short-term Treasury bonds.

We further document the asset pricing implications of the ETF dividend-driven bond sales. Specifically, in the aggregate time series, an ETF dividend distribution event of average size leads to increases in short-term Treasury yields by approximately 0.38-0.58 basis points. This finding is robust to controlling for month-end effects as well as corporate dividend payments. In the cross-section, Treasuries that are held by ETF-underlying MMFs, and thereby exposed to ETF dividend-induced selling pressure, decrease in price more than similar unaffected Treasuries.

Back-of-the-envelope calculations suggest that the loss of market value in short-term Treasuries is approximately $16-32 million on an average-size ETF dividend day. The total value fluctuation in the Treasury market could be considerable, as ETFs distribute dividends on 205 trading days in 2019, for example. The longer the interval between two ETF dividend payments is, the more corporate dividends the fund will accumulate, and the larger the later price impact on the Treasury markets. As such, given ETFs' discretion to set their dividend distribution schedules, one policy implication that could smooth money market fluctuations is mandating funds to disburse dividends at a higher frequency.

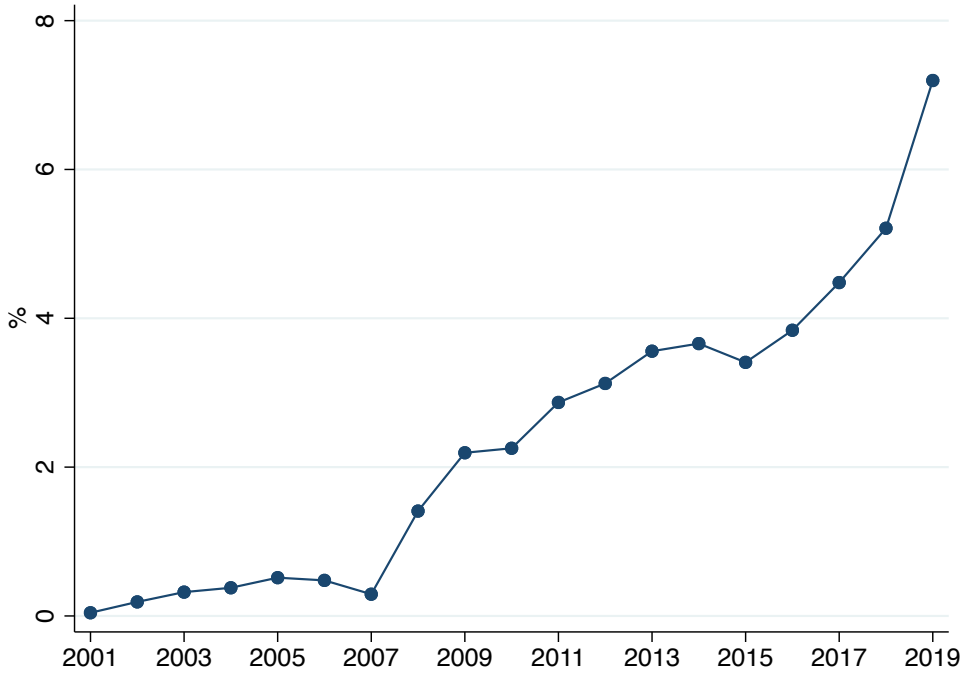

Figure 1: Share of corporate dividends distributed to ETFs

Description: This figure illustrates the ratio of total dividend payments across all ETFs over total corporate dividend payments from U.S. listed companies in each year from 2001 to 2019. Corporate and ETF dividends are from Compustat and CRSP.
Interpretation: The share of U.S. corporate dividends collected by ETFs has increased from almost zero to eight percent from 2001 to 2019.

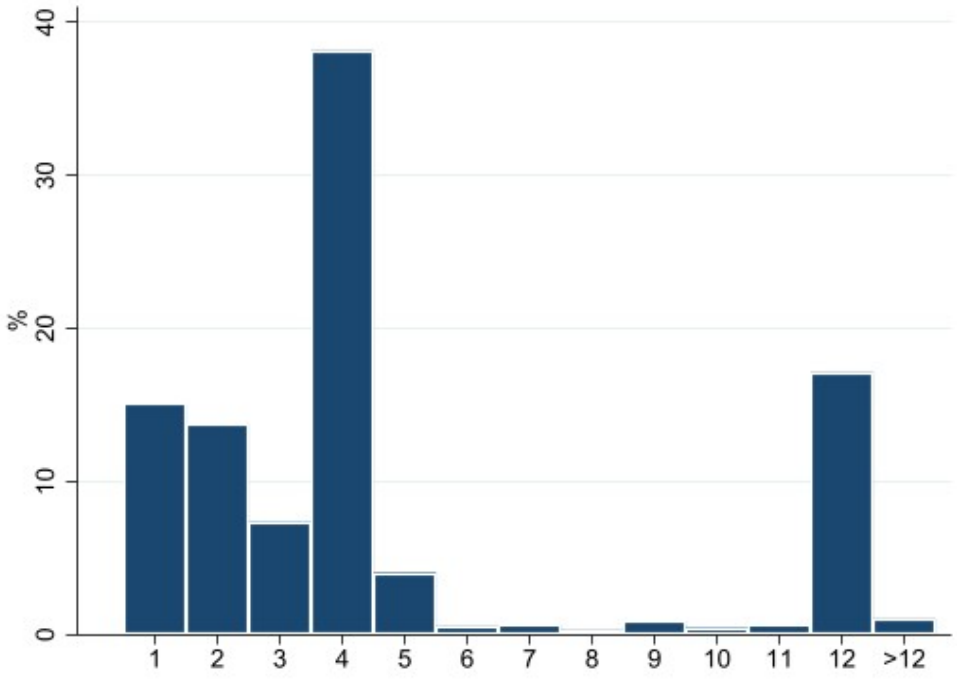

Figure 2: Distribution of ETF dividend disbursement frequencies

Description: This figure illustrates the distribution of the number of dividend distributions of ETFs in the sample in 2019. Data of ETF dividends is from CRSP.
Interpretation: The vast majority of ETFs distribute dividends four times per year, i.e. quarterly. After this, the most common frequencies are monthly (12 times per year), annual (once per year), and semi-annual (twice per year).

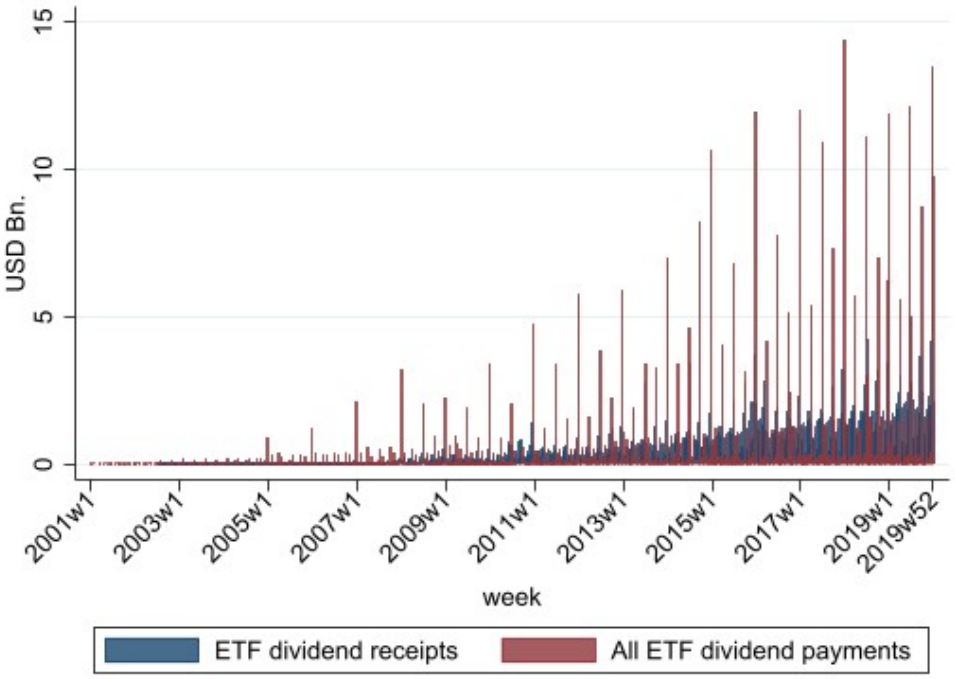

Figure 3: Aggregate ETF dividend receipts and payments

Description: This figure illustrates the weekly aggregate ETF dividend inflows and outflows from 2001 to 2019. Blue bars represent the corporate dividends received from their underlying stocks. Red bars represent the dividend disbursements to their investors. Sample: all ETFs covered in CRSP.
Interpretation: Dividend inflows to ETFs are much smoother than the dividend outflows.

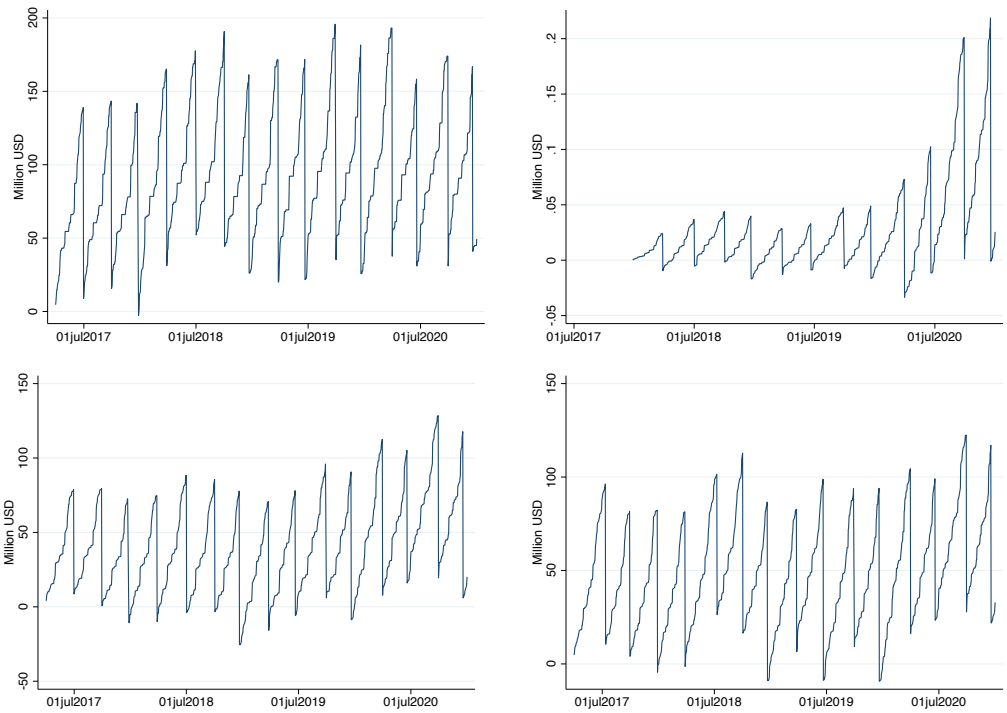

Figure 4: Individual cases of ETF dividend receipts and payments

Description: The figure shows imputed dividend accumulation and realized disbursements for four Blackrock iShares ETFs: DVY at the top left, DIVB at the right top, IVE at the bottom left, and IWB at the bottom right.
Interpretation: The four example ETFs accumulate and disburse dividends following predictable cycles. The dividends imputed from funds' daily holdings closely match with those paid out by the funds.

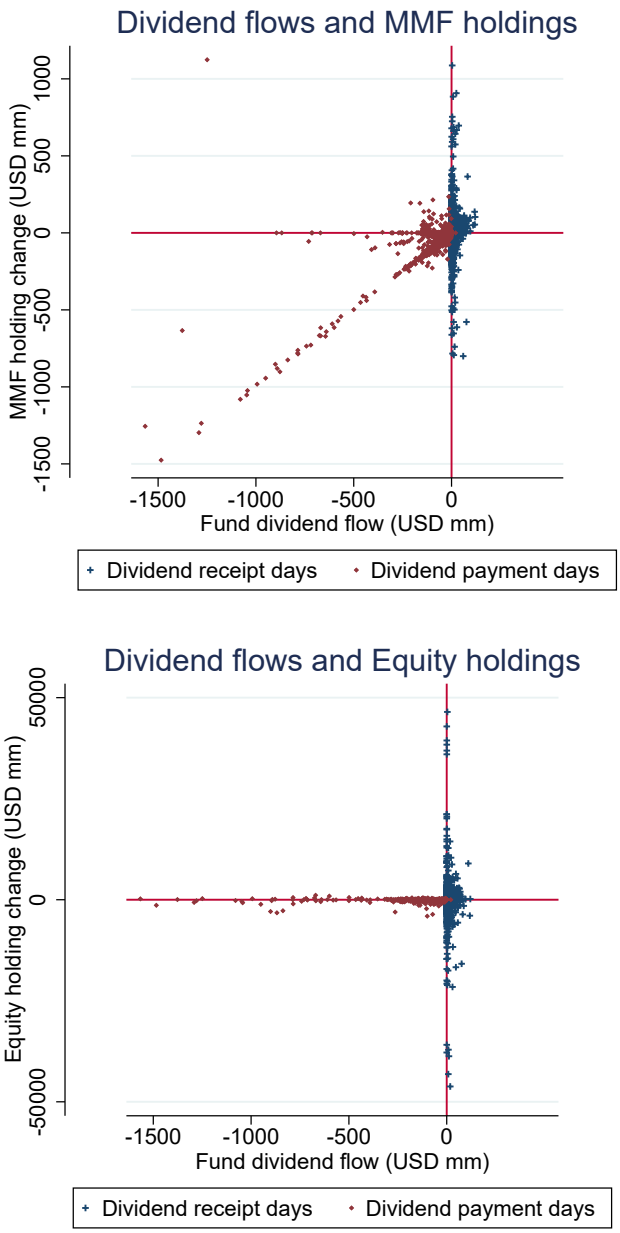

Figure 5: Dividend flows and changes in holdings of ETFs' underlying assets

Description: This figure plots daily ETF dividend flows (i.e., dividend receipts and disbursements) against daily changes in ETFs' holdings of money market funds (top panel) and equities (bottom panel). Blue dots represent dividend inflows, and red dots represent dividend outflows. Sample: BlackRock iShares ETFs.

Interpretation: ETFs' money market funds holdings closely match their dividend flows, with the effect being particularly strong for ETF dividend outflows. There is no relation between dividend flows and ETFs' equity holdings, indicating that the funds do not re-invest their dividend cash in equities.

Table 1: Descriptive statistics: ETF dividends

Description: This table reports the summary statistics of ETF dividends inflows and outflows in 2019 for days when dividends were nonzero. The number of trading days in 2019 is 261. Sample: All U.S. ETFs.

	mean	p10	p50	p90	sd
Avg daily ETF dividend payout (MM USD)	223.23	0.16	8.75	577.87	666.54
Avg daily dividend receipt from holdings (MM USD)	94.63	0.14	21.51	266.57	193.62
	number of days				
Non-zero div payout	205 / 261				
Non-zero div receipt	260 / 261				

Table 2: Descriptive statistics: MMFs

Description: This table reports monthly summary statistics for the money market funds (MMFs) in our sample. Total Treasury weight is the percentage weight of MMF assets allocated to Treasury securities. Weight in 1m (3m, 6m, 12m) Treasuries is the percentage weight of MMF assets allocated to Treasury securities with a maturity of one (three, six, twelve) month(s). Weight in repo is the percentage weight of fund assets allocated to repurchase agreements. Wk liquid assets weight is weight of assets that can be liquidated within one week. D liquid assets weight is weight of assets that can be liquidated within one day. TNA denotes total net assets in billions of U.S. dollars. ETF ordinary dividends (MM USD) denote the value total imputed dividends withdrawn from the fund by all ETFs paying dividends in the month in million U.S. dollars. ETF ordinary dividends (pct of TNA) denote the value of ETF ordinary dividends divided by fund TNA. ETF dividends/Tot Treasury hlds is the ratio of ETF ordinary dividends divided by the total holdings of Treasuries. ETF dividends/1m Treasury hlds is the ratio of ETF ordinary dividends divided by the holdings of one-month Treasuries. Number of dividend ETFs is the number of ETFs that hold an MMF and withdraw dividend money from it. The sample period for MMF holdings extends from 2010 to 2019. Sample: All U.S. Money Market Funds.

	mean	p10	p50	p90	sd
Total Treasury weight	7.99	0.00	0.00	25.81	17.34
Weight in 1m Treasuries	5.47	0.00	0.00	17.75	13.06
Weight in 3m Treasuries	1.78	0.00	0.00	5.79	4.64
Weight in 6m Treasuries	0.56	0.00	0.00	2.07	1.50
Weight in 12m Treasuries	0.04	0.00	0.00	0.00	0.19
Weight in repo	15.07	0.00	0.00	49.49	21.89
Wk liquid assets weight	24.14	0.00	0.00	95.08	37.38
D liquid assets weight	15.15	0.00	0.00	60.67	29.46
TNA (bn USD)	5.93	0.09	0.99	16.47	14.27
ETF ordinary dividends (MM USD)	42.17	0.06	1.66	83.34	150.23
ETF ordinary dividends (pct of TNA)	0.45	0.00	0.01	0.70	1.97
ETF dividends/Tot Treasury hlds	1.00	0.00	0.02	1.09	4.66
ETF dividends/1m Treasury hlds	4.50	0.00	0.02	1.13	49.48
Number of dividend ETFs	3.56	0.00	0.00	0.00	49.41

Table 3: ETF dividend reinvestment

Description: This table reports the regression results for Equation (1). The dependent variable in columns (1) and (2) is the daily change of dollar amount holdings in money market funds (MMFs). The dependent variable in columns (3) and (4) is the daily change of dollar amount holding in equities. The independent variable is the daily net dividend flow (i.e., dividend receipts minus dividend payments). We control for calendar-week and ETF fixed effects. Values in parentheses denote t-statistics. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively. Sample: BlackRock iShares ETFs.
Interpretation: One dollar of dividend flows leads to a 0.68-0.71 dollar change in ETFs' money market funds holdings, while there is no statistically significant relation between dividend flows and equity holdings.

	Dep Var = MMF Holdings Change		Dep Var = Equity Holdings Change	
	(1)	**(2)**	**(3)**	**(4)**
Dividend Flow	0.684***	0.710***	0.261	0.237
	(209.64)	(197.67)	(1.63)	(1.33)
Calendar-Week FE	No	Yes	No	Yes
Fund FE	No	Yes	No	Yes
R^2	0.315	0.328	0.000	0.002
Obs	95778	95775	80679	80675

Table 4: ETF dividend flows and MMF holdings of Treasuries

Description: This table reports the regression results for Equation (2). The dependent variables are monthly changes of ETF-underlying money market fund (MMF) holdings in Treasuries with different maturities (i.e., one-month, three-month, six-month, one-year, and long-term). Long-term denotes maturities longer than one year. The key independent variable is Monthly ETF Dividends, which measures the total dividend flows of ETFs holding the focal MMF (prorated at the ETFs level by the dollar value of holdings in different MMFs) during the same month. We control for MMF flows that are unrelated to ETF dividend disbursements and receipts. Calendar-month and fund-category fixed effects are included. Values in parentheses denote t-statistics. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively. Sample: All U.S. ETFs and MMFs.
Interpretation: Each dollar of net ETF dividend receipts leads to a 0.53 (0.17, 0.06) dollar change in 1-month (3-month, 6-month) Treasury holdings by affected money market funds. There is no effect for 1-year or long-term Treasuries.

	(1)	(2)	(3)	(4)	(5)
	1-month	3-month	6-month	1-year	Long-term
Monthly ETF Dividends	0.531**	0.173**	0.063**	0.002	0.001
	(3.04)	(2.86)	(2.98)	(0.68)	(1.2)
Other Flows	Yes	Yes	Yes	Yes	Yes
Calendar-Month FEs	Yes	Yes	Yes	Yes	Yes
Fund-Category FEs	Yes	Yes	Yes	Yes	Yes
R^2	0.103	0.073	0.042	0.014	0.008
Obs	60,863	60,863	60,863	60,863	60,863

Table 5: ETF dividend disbursements and the time series of Treasury rates

Description: This table reports the time-series regression results of Treasury rates on ETF dividend disbursements. Panel A reports the regression result of Equation (3). Panel B reports the regression result of Equation (4). Month-end is defined as the last 5 days at the end of the month and the first 5 days at the beginning of the next month. Panel C adds total corporate dividends as a control variable. Treasury rates are in basis points. ETF dividend disbursements and total corporate dividends are in USD million. Values in parentheses denote t-statistics. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively. Sample: All U.S. ETFs.
Interpretation: Higher ETF dividend payments cause increases in Treasury yields, as ETFs withdraw money from MMFs, which in turn sell some of their Treasury holdings.

Panel A: Baseline				
	(1)	(2)	(3)	(4)
	1-month	3-month	6-month	1-year
ln(ETF dividends + 1)	0.030**	0.030***	0.022***	0.020**
	(2.12)	(3.01)	(2.74)	(2.41)
R^2	0.043	0.058	0.069	0.062
Panel B: Controlling for Month-Ends				
	(1)	(2)	(3)	(4)
	1-month	3-month	6-month	1-year
ln(ETF dividends + 1)	0.027*	0.031***	0.024***	0.023***
	(1.93)	(3.06)	(3.00)	(2.84)
Month-end	0.281	-0.089	-0.268**	-0.433***
	(1.35)	(-0.62)	(-2.36)	(-3.69)
R^2	0.044	0.058	0.070	0.065
Panel C: Controlling for Corporate Dividends				
	(1)	(2)	(3)	(4)
	1-month	3-month	6-month	1-year
ln(ETF dividends + 1)	0.030**	0.028***	0.020***	0.020**
	(2.10)	(2.81)	(2.54)	(2.40)
Corporate dividends	0.002	0.066*	0.051*	0.001
	(0.03)	(1.73)	(1.69)	(0.02)
R^2	0.043	0.058	0.070	0.062
Year-month FE	Yes	Yes	Yes	Yes
Obs	4405	4787	4787	4787

Table 6: Positive ETF dividend payouts and the time series of Treasury rates

Description: This table reports the time-series regression results of Treasury rates on ETF positive dividend payout in Equation (5). Panel A reports the baseline regression results controlling for the calendar month fixed effect. Panel B reports the regression results controlling for month-ends, which is defined as the last 5 days at the end of the month and the first 5 days at the beginning of the next month. Panel C adds total corporate dividends as a control variable. Treasury rates are in basis points. The Independent variable is a dummy variable for ETF positive dividend payout that takes a value of one for days with ETF dividend payout events. Values in parentheses denote t-statistics. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively. Sample: All U.S. ETFs.
Interpretation: Treasury yields increase on ETF dividend payment days.

Panel A: Baseline				
	(1)	(2)	(3)	(4)
	1-month	3-month	6-month	1-year
Positive div payout	0.484**	0.507***	0.400***	0.381***
	(2.04)	(2.99)	(2.98)	(2.73)
R^2	0.043	0.058	0.069	0.062
Panel B: Controlling for Month-Ends				
	(1)	(2)	(3)	(4)
	1-month	3-month	6-month	1-year
Positive div payout	0.453*	0.515***	0.427***	0.425***
	(1.91)	(3.03)	(3.17)	(3.04)
Month-end	0.294	-0.074	-0.258**	-0.424***
	(1.43)	(-0.52)	(-2.29)	(-3.63)
R^2	0.044	0.058	0.070	0.065
Panel C: Controlling for Corporate Dividends				
	(1)	(2)	(3)	(4)
	1-month	3-month	6-month	1-year
Positive div payout	0.482**	0.481***	0.380***	0.380***
	(2.03)	(2.83)	(2.82)	(2.72)
Corporate dividends	0.004	0.068*	0.052*	0.001
	(0.08)	(1.79)	(1.72)	(0.04)
R^2	0.043	0.058	0.070	0.062
Year-month FE	Yes	Yes	Yes	Yes
Obs	4405	4787	4787	4787

Table 7: Performance of long-short strategies on ETF dividend dates

Description: We short-sell treated Treasuries and long controlled Treasuries one day prior to and unwind the portfolio on an ETF dividend date. A Treasury is defined as treated if it is the portfolio of an MMF that is held by any ETF that distributes dividends. A treated Treasury is matched with its controlled Treasuries if they mature on the same day. An ETF dividend date is categorized into high and low groups: If an ETF's dividend is larger or equal to the sample median, then it is in the high group; otherwise, it is in the low group. All numbers are annualized and in percentage points. Values in parentheses denote t-statistics. Values in brackets denote the economic significance of coefficient estimates, computed as the controlled-minus-treated spread divided by the return of controlled Treasuries. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively. Sample: All U.S. ETFs and MMFs.
Interpretation: Imputing dividends for ETFs to predict their dividend payments, and then creating a long-short trading strategy using Treasuries that are likely to be sold by MMFs held by dividend-paying ETFs yields a profitable trading strategy.

	Panel A	Panel B	Panel C
Treasury Return	All ETF Dividend Dates	High ETF Dividend Dates	Low ETF Dividend Dates
Treated Treasuries	1.3440	1.3746	1.2972
Controlled Treasuries	1.7556	1.8921	1.5474
Controlled minus Treated	0.4116**	0.5175**	0.2502
	(2.1658)	(2.0511)	(0.8712)
	[23.44%]	[27.35%]	[16.17%]

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