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THE UNINTENDED CONSEQUENCES OF THE GROWTH IN ETFS: INCREASED STOCK LENDING BY ETFS AND ITS EFFECTS ON THE MARKET

Authors: Grigorița Banaru
Iryna Khomyak

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Grigoriţa Banaru

and

Iryna Khomyak

Supervisor: Tālis J. Putniņš

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Abstract

This paper examines the unintended effects that exchange-traded funds (ETFs) have on the market through their involvement in stock lending. In competing to keep fees at the lowest possible levels, ETFs generate additional income by lending out the securities in their portfolios, which relaxes short selling constraints. We study how this expansion in stock lending affects company valuations (or overvaluations), the incorporation of bad news into prices, and the prevalence of downward price manipulation known as "bear raids". We use a sample of 14,969 US stocks over the period of 2000-2016 and a variety of empirical methods including fitted values analysis, first difference regressions, and mediation analysis with bootstrapping. We find that stock lending by ETFs helps to correct overvaluation, facilitates better incorporation of bad news into prices *upon* announcement, and increases the prevalence of bear raids. Thus, ETFs have both positive and negative unintended effects on markets through their involvement in stock lending. Given the recent very rapid growth in ETFs and passive investing, our findings bring important considerations to the existing literature about the effects of ETFs.

Key-words: exchange-traded funds (ETF), lendable supply, market efficiency, short-selling, overvaluation, bear raid

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1. Introduction

The economist Burton Malkiel (1973) claimed that "a blindfolded monkey throwing darts at a newspaper's financial pages could select a portfolio that would do just as well as one carefully selected by experts." The idea behind his statement is that even professional money managers cannot consistently beat the market given that typically asset prices follow a random walk. The author does not neglect the fact that the managers of active funds could outperform the market in general, but on an aggregate level, he argues, their final result would be the same as that of the market less the fees charged. With this argument, Malkiel was one of the first who recognised the merits of passive investment.

The last decade experienced a significant increase in the interest in passive management: more than a third of all the assets in the US are injected in passive funds compared to only a fifth a decade ago. In the first half of 2017, the flows from active into passive funds reached almost $500 billion (Bloomberg, 2017). The two main channels through which this type of investment is realised are exchange-traded funds (ETFs) and index mutual funds (IMFs). In this paper, we focus on the former, considering its relative young presence on the financial market.

An ETF is a marketable security that tracks indexes such as S&P 500, Dow Jones, Nasdaq etc. It is different from a mutual fund in the way that it can be traded like a common stock on a stock exchange and can be bought and sold during the day. ETFs have experienced an enormous growth since their appearance in 1993, the assets under the management of ETFs increasing from a total value of $416 billion in 2005 to $2.5 trillion as of September 2014 (the Economist, 2014), their growth in the last decade being more than 25% per year in contrast to mutual funds – 3% per year (Boroujerdi and Fogertey 2015).

With such a considerable growth, understanding the influence of ETFs on the financial market becomes of an undoubtful importance. As an investment vehicle, ETFs allow investors to passively manage their assets in a cost-efficient manner. The reduction in costs results from the fact that by pooling securities together, ETFs lower the transaction costs, increase liquidity, and improve informational efficiency (Bae, Wang, and Kang (2012); Glosten, Nallareddy, and Zou (2016)). There is a divergent opinion among researchers that ETFs have distorted the capital markets by increasing the volatility, co-movement, and systematic risk as well as affecting real managerial decisions (Israeli, Lee, and Sridharan (2017)).

It is known that ETFs often lend securities to short sellers so as to generate additional profit to reduce the fund fees (Blocher and Whaley, 2015). This is one of the two channels short sellers use to remove short selling constrains (Li and Zhu, 2017). As short selling can have diverse implications for the market, ranging from improving its efficiency to facilitating price manipulation, we expect ETFs lending to have several unintended effects on it. Specifically, we focus on three such effects, the first two being positive, and the third one - negative. We arrive at the following research questions:

RQ1: How does stock lending by ETFs help to correct overvaluations?

RQ2: How does stock lending by ETFs contribute to better incorporation of bad news into prices?

RQ3: How does stock lending by ETFs increase the frequency of bear raids?

To answer the proposed research questions, we perform a fitted values analysis through which we obtain the variation in the stock lending coming specifically from the ETFs and examine how this influences our variables of interest. We consider the short percent of a stock and its lendable quantity as proxies for the lendable supply of ETFs. Moreover, we employ first difference regressions and a mediation analysis with bootstrapping for our robustness checks.

In line with our expectations, we find that stock lending by ETFs help correct overvaluation and favours the frequency of bear raids. As for our second research question, we do not find any evidence that ETF stock lending does assist the incorporation of bad news into prices before the earnings announcement, however, it might do so in the periods *upon* the announcement. These results carry important implications for investors and regulators. Given the recent period of rigorous regulatory attention that attempts to limit the adverse effects of short selling (enhancing market panic, leading to excessive speculation and depressed prices) on the market, these results might be important for calibrating both the positive and negative effects ETFs might have on the market, and forming optimal regulatory decisions, especially in the context of a market crisis.

For investors, our results could assist them in understanding the side effects present on the market that might affect their securities ownership or future investment prospects. Specifically, our findings carry important implications in the context of avoiding the adverse effects of overvaluation and hoarding of bad news. We contribute to the existing literature by shading light on the side effects ETFs have on the market through the stock lending mechanism. To our best knowledge, there are no papers that scrutinise the effects of ETFs through the stock lending channel, our research aiming at filling this gap.

The rest of the paper is structured in the following manner: Section 2 presents a review of the empirical evidence, Section 3 describes the data sources, Section 4, 5 and 6 explain the methodology, elaborate on the results and their interpretation for the first, second and third research question respectively, and Section 6 forms the conclusion of the research.

2. Literature Review and Hypotheses

With the increasing growth in ETF stock lending activity, this topic attracts much attention from regulators, investors, and researchers. The following review of the literature builds upon two available literature topics. Specifically, we start with presenting the existing knowledge about the short selling effects on the market efficiency. Further, we develop on the influence of ETFs on market characteristics. We finish this section with identifying the gap in the proposed literature and positioning our research among the papers presented.

2.1. Short selling activity and its effects on the market efficiency

The existing literature regarding short selling and its effects on the market efficiency represents a debatable topic among researchers. In this subsection, we present both the documented positive and negative effects of short selling that form this divergence of opinion.

2.1.1. Short interest and its positive impact on the market efficiency

There is a vast literature that points out the positive sides of the short selling on the market efficiency. To start with, Miller (1977) argues that short selling constraints serve as an impediment to correcting mispricing, leading to overvaluation. This occurs since, in the presence of heterogeneous beliefs, and the restriction imposed to the bearish (pessimistic) traders in the form of short sale constraints, market prices reflect only the opinion of the bullish (optimistic) investors. Thus, short selling activity contributes to correcting mispricing and enhancing price discovery. In other words, in the absence of short selling constraints, short sellers target stocks that become overvalued, driving their prices down. In response to this theory, Jarrow (1980) argues that the direction of the price bias depends on the investors' expectations. The author suggests that, under heterogeneous beliefs, short selling constraints can bias the prices of risky assets both upwards and downwards, whereas under homogeneous perceptions of risk, the prices can be only biased upwards. Hence, following this argument, the implied assumption in the Miller's theory is that investors have homogeneous beliefs.

Unlike Miller, Diamond and Verracchia (1987) analyse the effects of the short selling constraints on the efficiency of the stock market within a rational expectation framework. Using such a model implies that investors account for the short selling constraints when forming their expectations, thus, the overvaluation generated by these constraints is already priced into securities. In other words, investors form their expectations rationally as the efficient market hypothesis predicts. For example, high costs of short selling limit the frequency of trading on private information. Consequently, the authors argue that such constraints lower the speed of private information being incorporated into prices, especially for bad news, reducing informational efficiency. Further, Diamond and Verrecchia suggest that an unanticipated increase in short activity represents a bearish signal. The negative relation between short interest and stock returns is also in line with the overpricing hypothesis. There is a vast empirical evidence that supports the bearish signal of short interest and the overpricing hypotheses (Senchack and Starks (1993); Asquith and Meulbroek (1995); Aitken, Frino, McCorry, and Swan (1998); Desai, Ramesh, Thiagarajan, and Balachandran (2002); Chen, et al. (2002), Jones and Lamont (2002), Ofek and Richardson (2002); Christophe et al. (2004)).

Using 474 seasoned equity offerings (SEOs) by NYSE and AMEX listed firms, Asquith and Meulbroek (1995) document a strong negative relationship between abnormally high levels of short interest around the offers (three times higher than the level registered during the three months preceding the announcement) and the expected proceeds from the issuance of the new shares, confirming that short interest does indeed communicate negative information. Analysing the transparent short selling of Australian stocks, Aitken et al. (1998) find evidence of a negative price impact of short selling of up to -0.20% with adverse information being absorbed within 15 minutes or 20 trades. Further, Desai et al. (2002) investigate the Nasdaq market from 1988 through 1994 and find that heavily shorted firms exhibit significant negative abnormal returns ranging from -0.76 to -1.13 % per month. These negative returns become more pronounced with an increased short interest, indicating that short selling serves as a bearish signal. The fact that unanticipated short selling activity is associated with a pessimistic market sentiment suggests that short sellers are informed traders and represent a valuable informational source on the financial markets.

Another negative consequence developed from the short selling constraints was suggested by Hong and Stein (2002). The authors point that these constraints might aggravate a market decline and, eventually, lead to a crash. Their finding is based on a heterogeneous agent model in which bearish investors, facing short selling restrictions, do not reveal their information. In such a case, the negative information gets accumulated, and is not expressed until the market starts to decline, which exerts a further downward pressure on it, and results in a crash.

Despite the fact that nowadays short selling is heavily regulated in an attempt to combat the severity of market panic or excessive speculation (e.g., uptick rule – SEC restricts short selling of a stock that has dropped more than 10% in one day (SEC, 2010), Honk Kong stock exchange decides which stocks can or cannot be shorted (Chang, Cheng, and Yu (2007)), researchers show that such regulations limit the efficiency on the market and lead to mispricing and overvaluation. Chang et al. (2007) find evidence that short selling constraints result in stock overvaluation, the effect being more pronounced for stocks for which there is a wider divergence of opinion. The authors also show that when trading is not prohibited, stock returns exhibit higher volatility and smaller positive skewness, this finding being consistent with the intuition behind Miller's theory. Bris, Goetzmann, and Zhu (2007) obtain similar results by analysing 47 countries, in 23 of which short selling was completely restricted at some point in time. The authors document higher cross-sectional variation of equity returns in markets where short selling is allowed, this being a sign of increased efficiency of price discovery. Also, significantly less negative skewness in stock returns is found in markets where short selling is restricted or not practiced. However, the imposition of short selling restrictions by regulators in an attempt to attenuate considerable declines does not have any impact.

2.1.2. Short selling and manipulation of prices

Even if most of the empirical evidence suggests that short selling improves market efficiency, there are some studies that show that short selling might be used for manipulative purposes. For instance, Henry and Koski (2010) use daily short selling data to analyse whether short selling around seasoned equity offerings (SEO) constitutes informed or manipulative trading. No evidence of informed trading is found. Moreover, abnormal pre-issue short selling around SEOs is significantly related to larger issue discounts. This speaks in favour of manipulative trading and is consistent with the predictions of Gerard and Nanda (1993). This result was found significant only for the non-shelf offerings and helps explain the increasing popularity of shelf registrations (a SEC provision that allows an issuer to sell portions of an issue over time without re-registering the security or receiving penalties), which serve as a way of avoiding manipulative trading costs. Moreover, the authors demonstrate that short selling regulation by Securities and Exchange Commission (SEC), specifically SEC Rule 105, limits some of the manipulative activity, however does not exclude it entirely. The recent short selling regulation by SEC tries to defend the integrity of the market by attempting to prevent the short sellers to profit from putting a downward pressure on the struggling stocks. This study extends on the existing literature by offering reverse evidence about manipulative trading. Given the fact that the study uses daily short-selling data compared to prior literature that uses monthly data, the authors trigger the validity of the prior studies. For example, previous evidence (e.g., Safieddine and Wilhelm, (1996); Kim and Shin, (2004); Singal and Xu, (2005)) that sustains lack of manipulative trading after Rule 10b-21 ("Naked" Short Selling Antifraud Rule) was imposed, might be simply caused by the lack of powerful tests. Using monthly short interest data, the authors also do not find any evidence of manipulation for their sample. Therefore, the use of daily data allows them to obtain more powerful results.

In their paper, Blocher, Engelberg, and Reed (2011) also try to demonstrate the manipulative motives of short sellers. The authors observe abnormally low returns on the last trading day of the year for stocks that exhibit high short interest. Moreover, this effect amplifies in the case of easily manipulative stocks and during the last hour of trading. In comparison with the previous literature (e.g., Securities and Exchange Commission (2006); Shilko, Van Ness, and Van Ness (2008)) that uses price and volume patterns to identify price manipulation, this paper employs ex-ante predictions about the way short sellers use price manipulation. In particular, the authors find evidence of price manipulation by hedge funds, which short sell to decrease end-of-the-year prices of the stocks they hold short positions in. The authors demonstrate that the convex relationship between performance and remuneration for hedge funds managers determines them to use short selling for temporary price declines.

Further, Misra, Lagi, and Bar-Yam (2011) study the price manipulation in the form of bear raids. Generally, a bear raid is defined as a concentrated short selling activity period with the aim of profiting from driving down the stock price. The target of such a manipulation is usually a firm that faces a challenging period, making it vulnerable and easy to exploit for the short sellers. Misra et al. provide empirical evidence of a bear raid before the financial crisis. The authors analyse the case of a large financial services company – Citigroup. Specifically, on November 1, 2007, the company experienced an unexpected increase in trading volume and decrease in price. The authors show that a large part of the increase in the trading volume is due to an unusual increase in borrowed shares which cannot be attributable to news events. Given the fact that after six days a similar number of shares was returned, the authors conclude that this is a direct sign of a bear raid given the magnitude and coincidence of opening and closing the short positions.

2.2. ETFs and the equity market

The topic of ETFs and its effects on the equity market does also embrace clashing views. This subsection elaborates on the two contradicting sides of the literature. We start with presenting the positive impact of ETFs on the market and continue with their 'dark' side documented in the literature.

2.2.1. The positive effects of ETFs on the market

To begin with, Bae et al. (2012) show that ETFs have a positive impact on the underlying stock's volatility, liquidity, and short interest, the increase in liquidity being primarily associated with a more pronounced short selling activity. Using a dynamic equilibrium model of ETFs for his analysis, Malamud (2015) draws a similar conclusion. Yu (2005), Richie and Madura (2007), and Winne et al. (2011) also document an improvement in the stocks' liquidity after the appearance of ETFs, this finding being consistent with the empirical evidence suggesting that index inclusion is associated with higher liquidity of the underlying stocks (Hegde and McDermott (2003)). The idea behind these studies is that the ETF arbitrage mechanism has a positive impact on intra-day price discovery of the component securities. This is especially pronounced when the underlying security faces a lower liquidity than the ETF. Therefore, ETFs can serve as an instrument for integrating firm-specific news into its underlying securities.

A more recent paper by Glosten et al. (2016) studies the effect of ETFs on the informational efficiency of the underlying securities. The authors find evidence that this effect is positive for stocks with weak informational environment and imperfectly competitive equity markets. This is explained by the previously mentioned idea that a more pronounced ETF activity is associated with incrementally more earnings news being captured in a firm's stock returns. Thus, the informational efficiency comes from ETFs serving as an enhancing mechanism of the link between fundamentals and stock prices. No such effect is found for stocks with strong informational environment and perfectly competitive equity markets.

Li and Zhu (2017) also examine the impact of the ETF activity on the market efficiency and suggest that there are two main channels through which ETFs could boost the efficiency on the market: 1) through allowing arbitrageurs to establish synthetic short positions in a stock; and 2) through the stock lending channel. Both channels have a relaxing effect on the short selling constraints. Respectively, ETF shorting activities lead to improved information about future returns of the underlying stocks. The researchers show that "stocks that are heavily shorted via their holding ETFs underperform those lightly shorted by 94 basis points per month." The paper also discusses the distinction between return predictability of ETF short activity and stock-level short activity, the former being concentrated in environments with drastic arbitrage constraints. Therefore, the enhancement in market efficiency results from ETFs facilitating trading of difficult to short stocks.

2.2.2. The dark side of ETFs

On the other side, there is a divergent literature that sustains the idea of ETFs distorting the capital markets. Hamm (2014) suggests that as uniformed investors tend to migrate from trading individual stocks to trading ETFs to avoid trading against informed investors, the market for individual stocks becomes more illiquid as the availability of ETFs increases. Following this idea and using a sample of ETF trading and holdings data from 2002 to 2008, the author finds evidence that there is a positive relationship between the percentage of a firm's shares held by ETFs and the adverse selection cost associated with trading the firm's stock.

Da and Shive (2016) and Ben-David, Franzoni, and Moussawi (2014) find evidence that ETF arbitrage facilitate return comovement. Using a sample of 549 US equity ETFs, Da and Shive demonstrate that an increase in ETFs holding of a stock leads to a significantly higher comovement between the stock returns and the returns of the index, leading to a reduction in the price efficiency of the individual stocks. The authors argue that such a pronounced comovement could result in higher trading costs for institutional investors who trade frequently, and these costs may even affect passive individual investors who trade through institutional investors.

Israeli et al. (2017) further document several negative sides of the ETF ownership. Specifically, the authors present four channels through which an ETF ownership can lead to negative consequences on the price efficiency of the underlying component securities. First, the authors argue that an ETF ownership is related to (1) higher trading costs that occur because of investors exiting the market of the underlying security in favour of ETFs, thus, decreasing the security's liquidity. The authors posit that the increased transaction costs result in a lower price efficiency of the component security. This occurs since the increase in the transaction costs accompanied by the reduced liquidity, deteriorates the investor's incentive to acquire and trade on firm-specific information. Over time, this results in a weaker information environment for a firm and a reduction in the speed of the security's price adjustment to firm-specific information. Second, consistent with the idea of price efficiency decline, the authors show that increased ETF ownership is linked to (2) a more pronounced stock return synchronicity (measures the extent to which firm-specific stock variation relates to market movements), and (3) a reduction in future earnings response coefficients (a linkage between current and future firm-specific earnings). The two variables are used as proxies for price efficiency. The results indicate that 1 percentage point increase in ETF ownership results in 4% increase in return synchronicity, and 14% decrease in the future earnings response coefficients. Finally, the increase in an ETF ownership is also associated with a decrease in the number of analysts covering the firm (4) (the third proxy used by the authors for informational efficiency/price informativeness), which is a result of a lower incentive for information acquisition discussed above.

One important aspect that should be emphasised to assess the novelty of our paper is the distinction between two main channels through which ETFs might affect the market efficiency, specifically, 1) the possibility of constructing a synthetic short position using an ETF holding; and 2) the stock lending channel. In the first case, a short seller desires to enter in a short position against a subset of stocks, however, he is not able to short them directly, thus, he bets against these stocks by shorting the ETF that contains them. In this scenario, short selling ETFs and stocks are partial substitutes. In the second case, however, the short seller does not borrow all the constituencies of an ETF but borrows the stock directly from the fund. This supply channel is a well-known way through which the ETF industry generates additional income to reduce its fees (Blocher and Whaley (2015); Massa, Zhang, and Zhang (2015)). For a more detailed explanation of the stock lending mechanism consult Appendix A. In this paper, we use the stock lending channel to analyse the side effects ETFs can have on the market.

All in all, the topic of ETFs and their side effects on the market remains a controversy in the literature. If we consider that lendable supply of ETFs, which facilitates short selling activity, leads to an increase in the market efficiency, we would expect that this supply serves as a mechanism for correcting overvaluations (Miller (1977)). Also, if we believe that short sellers are informed traders and short selling activity is associated with a bearish market sentiment (Diamond and Verracchia (1987), Aitken et al., (1998); Desai et al., (2002)), we would also expect that bad news are better incorporated into prices given the availability of the lendable supply by ETFs.

On the other hand, if we think about the negative sides of the short selling favouring price manipulation (Henry and Koski (2010); Blocher et al. (2011); Misra et al. (2011)), an increase in such manipulations should arise with an increase in the stock lending by ETFs. Given the empirical background presented, we focus on three ETFs' unintended consequences on the market reflected in the following hypotheses:

Hypothesis 1: An increase in ETF stock lending enhances market efficiency by correcting overvaluations.

Hypothesis 2: An increase in ETF stock lending leads to better incorporation of bad news into prices, further enhancing informational efficiency.

Hypothesis 3: An increase in ETF stock lending leads to an increase in the frequency of downward price manipulation known as "bear raids".

Our research develops on the existing empirical evidence in two different ways. First, we examine and quantify the role of ETFs in correcting overpricing and incorporating bad news into prices, specifically, through the stock lending channel. Second, given the fact that ETF ownership facilitates short selling, we investigate the effect of this factor on the manipulation strategies. Our attention is focused on bear raids and the change in their frequency caused by the increase in lendable supply of ETFs, which is, to our best knowledge, a totally untapped area in the literature.

3. Data description

Throughout the paper we utilise data from different sources to answer our research questions. Using the access provided to us by the University of Kentucky[1], we are able to access such databases as CRSP, Thomson Reuters Mutual Fund Holdings, Markit, I/B/E/S, and Compustat.

Firstly, we employ the Thomson Reuters Mutual Fund Holdings database to retrieve all the data on ETF and mutual fund holdings. Then, we download the data on Total Q, short interest, short percent, earnings announcement date, post-announcement returns, and volatility from the Peters and Taylor Total Q and Compustat databases. Afterwards, we use the CRSP database to get the SIC codes, the identification of ETFs, the number of shares outstanding, market capitalization, and share turnover. The next step is retrieving daily data on stock returns, opening and closing prices, bid-ask spreads, indicative fees for borrowing a stock, and lendable supply from the Markit database. Finally, we use I/B/E/S for accessing data on standard deviations of the analyst earnings forecasts.

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[1] One of the authors, Iryna Khomyak, was a full-time exchange student at University of Kentucky during the fall semester of the 2017/2018 academic year and was provided access to WRDS for academic purposes.

Table 1

Definitions of the variables

Variable	Definition	Regression notation
ETF holdings	the fraction of the company's stock that is held by exchange-traded funds at the end of a quarter (in %)	ETF_{it}
MF holdings	the fraction of the company's stock that is held by exchange-traded funds at the end of a quarter (in %)	MF_{it}
Lendable supply	the average of the daily lendable quantity of the company's stock divided by the total number of shares outstanding (in %)	$LendS_{it}$
Short percent	the short interest in a stock measured in the number of shorted shares divided by the total number of shares outstanding (in %)	ShP_{it}
Forecast divergence	the standard deviation of the analyst earnings forecast for a stock for the following quarter (in %)	$FDvrg_{it}$
Volatility	the standard deviation of the daily stock returns of a stock during a quarter (in %)	$Volatility_{it}$
Turnover	the ratio of the annualized trade volume of shares (4 quarter) of a stock divided by the total number of shares outstanding	$Turnover_{it}$
ln(MCap)	the natural logarithm of the company market capitalization measured in million USD at the end of a quarter	$\ln(MCap_{it})$
Total Q	calculated in the database using the following formula: $\frac{[MarketCap + (Long-term\ debt + Short-term\ debt) - Current\ assets]}{Property, plant, and\ equipment + Intangible\ assets}$	$TotalQ_{it}$
EAR	the absolute value of the cumulative stock return 3 days after an earnings announcement scaled by the standard deviation of daily returns in the quarter of the announcement (in %)	EAR_{it}
Negative news binary	a binary variable set equal to 1 if the earnings announcement has a negative post-announcement return during a 3-day interval and 0 otherwise	$Negative_{it}$
Bear	the number of bear raids minus the number of bull raids in a stock during a quarter (calculated using the methodology described further)	$Bear_{it}$
Costs	the average quarterly costs of short selling a stock, consisting of the sum of the the bid-ask spread divided by the stock opening price (in %) and the indicative fee for borrowing a stock (in %)	$Costs_{it}$

This table provides the definitions of the variables used throughout the paper and their regression notations.

Our sample includes the information about 14,969 US stocks (approximately the whole US equity market) over the period of 2000-2016. Since ETFs are required to report their holdings on a quarterly basis, the data is measured quarterly. Table 1 provides a description of the main variables used.

As suggested by similar studies, we exclude regulated utilities (SIC Codes 4900–4999), financial firms (6000–6999), and firms categorized as public service, international affairs, or non-operating establishments (9000+). Afterwards, we winsorize all the variables at the 5% and 95% levels to remove any potential problems with outliers. The summary statistics of the variables is reported in Table 2.

Table 2

Summary statistics of the variables

Variable	*N**	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
ETF holdings	169,567	3.574	3.012	0.204	10.260	0.829	2.540
MF holdings	194,487	18.207	12.716	0.362	41.139	0.202	1.835
Lendable supply	221,071	9.262	11.859	0.000	33.912	0.914	2.281
Short percent	218,066	3.987	4.657	0.023	16.859	1.493	4.337
Forecast divergence	134,194	3.236	3.577	0.000	14.000	1.796	5.492
Volatility	201,388	3.389	2.024	1.127	8.600	1.177	3.587
Turnover	288,506	2.720	5.499	0.000	109.944	8.967	113.138
ln(MCap)	288,236	5.537	2.043	1.956	9.276	0.041	2.135
Total Q	190,397	1.096	1.213	-0.161	4.608	1.597	4.929
EAR	200,504	2.562	2.184	0.141	7.887	1.018	3.115
Negative news binary	200,507	0.514	0.500	0.000	1.000	-0.054	1.003
Bear	226,270	27.777	7.197	11.000	38.000	-0.791	2.911
Costs	145,493	0.021	0.029	0.004	0.108	2.022	5.925

** stock-quarter observations*

This table provides the summary statistics of the variables used throughout the paper. Their definitions can be found in Table 1.

4. The impact of ETF stock lending on overvaluations

We devote this section to the analysis of the first research question. We start with determining the link between the ETF holdings and lendable supply as well as short percent, continue with explaining the methodology employed to address the research question, and finish with presenting the analysis of the results and their implications.

4.1. Methodological approach

4.1.1. The effect of ETF holdings on lendable supply and short percent

With the purpose of studying whether ETF stock ownership helps to correct overvaluations, increases the degree to which bad news are incorporated into prices, and diminishes the frequency of bear raid occurrence, we are considering two stock lending proxies – lendable supply of shares and short percent. Both variables serve as strong proxies for the studied channel of influence of ETFs on the market. By using the first proxy, we are able to establish the statistical link between ETF holdings and the lendable supply of shares in the market and, afterwards, examine how those shares are used by traders, whereas by using the second one, we manage to observe how ETF holdings influence the short interest in a stock directly. Hence, in order to increase the robustness of our results, we use both proxies in our regressions.

Before testing how ETF holdings are affecting overvaluations, bad news incorporation into prices, and the frequency of bear raids through the stock lending channel, we are first trying to establish the link between ETF holdings and lendable supply of shares as well as short percent developing the following panel regressions:

$$LendS_{it} = \beta_1 ETF_{it} + \beta_2 MF_{it} + \beta_3 \ln(MCap_{it}) + \beta_4 \ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it}, \quad (1)$$

$$ShP_{it} = \beta_1 ETF_{it} + \beta_2 MF_{it} + \beta_3 \ln(MCap_{it}) + \beta_4 \ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it}, \quad (2)$$

where $LendS_{it}$ is the lendable supply of stock i divided by its total number of shares in quarter t, ShP_{it} is the short interest in stock i divided by its total number of shares in quarter t, ETF_{it} is the percentage of the company i's market cap owned by exchange-traded funds in quarter t, MF_{it} is the percentage of the company i's market cap owned by mutual funds in quarter t, $\ln(MCap_{it})$ is the natural logarithm of the US dollar market cap of company i in quarter t, α_i and δ_t are stock and time fixed effects, and ε_{it} is the error term of the regression.

Since other active contributors to lendable supply, mutual funds, are also following an index, we are including mutual fund holdings into our regression to avoid bias due to potential correlation with ETF holdings. In addition, such authors as Banz (1981), Blume and Stambaugh (1983), Fama and French (1992, 1993), Keim (1983), and Roll (1983) have documented that the company's size is a factor affecting its market performance. Thus, we introduce this variable in our regression as well.

After running the regressions, we construct the fitted values $\widehat{LendS_{it}}$ and $\widehat{ShP_{it}}$. By constructing the respective fitted values, we are able to obtain the variation in the lendable supply coming specifically from ETFs and test whether the lendable supply of shares is the channel through which ETFs influence our dependent variables.

4.1.2. The effect of ETF stock lending on overvaluations

To answer our first research question, we first need to find a proper empirical proxy to measure overvaluation. The literature proposes such measures as book to market (B/M) ratio, Tobin's Q, Total Q, and value to price (V/P) ratio. Further we explain the reasoning behind our choice of the Total Q measure.

Such authors as Lee, Myers, and Swaminathan (1999), Chen and Jindra (2001), and Dong, Hirshleifer, and Teoh (2012)) argue that V/P allows for capturing the divergence of the stock price from its value better than variables such as B/M or Tobin's Q, by reflecting not only the past and current company's state, but also the analysts' forecasts for the following years. By separating the equity book value and future residual income, it allows for a differentiation based on future growth prospects: firms with higher return on equity will be able to generate more profit, thus, should be valued higher. Considering the time constraints of our research and the complexity of computing the V/P measure itself, we advocate for the Total

Q as a proxy for overvaluations for our further analysis.

Total Q is a new proxy available in the literature and was developed by Peters and Taylor (2016). The authors argue that this measure is an improved version of the Tobin's Q that includes intangible capital in the denominator, which consists of the sum of its organizational and knowledge capital. They demonstrate that this new variable is a superior proxy both for physical and intangible investment opportunities. The motivation for refining the classical Q measure lies in the fact that it was developed over 30 years ago, when a firm's value was mainly concentrated in its physical assets; however, the nowadays environment is mostly based on the service and technology industries, which derive a significant part of their value from intangible assets such as patents, software, human capital, networks, etc. Considering the advantages of this new proxy, we use it in our further tests. As for future research, other proxies for overvaluation could be used if they appear to be superior.

We base our further analysis on the two following steps: 1) establishing the link between ETFs and the dependent variables, and 2) testing whether stock lending proxies are one of the channels of influence by regressing our dependent variables on the fitted values $\widehat{LendS_{\iota t}}$ and $\widehat{ShP_{\iota t}}$ from regressions (1) and (2).

One of the hypotheses proposed by Miller (1977) is that under the condition of short selling constraints the divergence in the investor opinion causes stock overvaluations. Boehme, Danielsen, and Sorescu (2006) continue Miller's tests by looking at the interaction of the two factors, finding robust evidence that stocks subject to short-sale constraints and opinion dispersion simultaneously suffer from overvaluation. Drawing on the theory, we expect the effect of short selling constraints and ETFs to be different for different levels of the investors' divergence of opinion. As noticed by Glynn (2012), effect heterogeneity could not only bias, but also affect the statistical significance of the regression coefficients. As a potential solution, the author advises using interaction terms; hence, we add the moderated regression analysis (MRA), following the methodology described in Zedeck (1971). By regressing the dependent variable on the independent one (its possible moderator) and their interaction term, and observing the significance of the coefficients, it is possible to test whether a variable serves as a moderator and accounts for heterogeneity in effects if they are present. We also use a type of an earnings announcement – positive versus negative – as a moderator to identify the difference in how ETF holdings affect news incorporation.

Boehme et al. (2006) argue that the divergence in the analyst forecasts from the I/B/E/S database, which is an intuitive proxy to choose as it reflects the market sentiment, has a substantial limitation, since only large companies have predictions provided by two or more analysts. Not only would using this proxy limit the sample, but also bias the coefficients if the company's size is correlated with short-sale constraints or divergence in investor opinion. Trying to solve the issue, the authors suggest constructing a 'unitary portmanteau proxy' using the regression coefficients from regressing I/B/E/S data on two supplementary variables - idiosyncratic firm volatility ($SIGMA$) and trading volume divided by the total number of company shares ($TURNOVER$).

In Boehme et al. (2006), $SIGMA$ is constructed using the error term standard deviation from the market model by Brown and Warner (1985) for 100 days preceding the short selling constraint data. Due to the time constraints of our work, we use the standard deviation of the firm returns instead, which has served as an opinion divergence proxy in Berkman, Dimitrov, Jain, Koch, and Tice (2009). $TURNOVER$ is the stock trading volume scaled by the total number of shares measured over the same period of 100 days. They base the choice of the variable on the works of Shalen (1993) and Harris and Raviv (1993), which study the relationships between I/B/E/S forecast dispersion and return volatility, and Jones, Kaul, and Lipson (1994), which documents the link between trading volume, volatility and disagreement. Moreover, some other studies that have used these supplementary proxies include Gebhardt, Lee, and Swaminathan (2001), Danielsen and Sorescu (2001), and Diether, Malloy, and Scherbina (2002). After constructing the 'unitary portmanteau proxy' (Appendix B), we create a binary variable ($ODvrg_{it}$), which takes the value of 1 for companies with instrumented divergence of opinion higher than the market average in that quarter and 0 for those with lower.

Hence, to determine whether ETFs help to correct overvaluations, we develop the following panel regression:

$$TotalQ_{it} = \beta_1 ETF_{it} + \beta_2 ODvrg_{it} + \beta_3 (ETF_{it} ODvrg_{it}) + \beta_4 MF_{it} + \beta_5 \ln(MCap_{it}) + \beta_6 \ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it}, \quad (3)$$

where $TotalQ_{it}$ is the Total Q of stock i in quarter t, and $ODvrg_{it}$ is the opinion divergence proxy for stock i in quarter t, constructed using I/B/E/S forecasts, stock volatility and trading volume. All the other variables are defined as above.

Afterwards, we follow the same procedure with the fitted values of lendable supply and short percent from regressions (1) and (2) to test the channel of influence.

4.2. Analysis of results

Before analysing the effect of ETF holdings on the variables of interest, we try to establish the causal link between ETF stock ownership and lendable supply of shares as well as short interest.

After running the regressions (1) and (2), we get the following results: ETF holdings positively influence both lendable supply and short interest (Table 3). To be more exact, a percentage-point increase in ETF stock ownership (28% of its mean) leads to a 2-percentage-point increase in lendable supply (21.6% of its mean). A standard deviation increase in ETF holdings (3.01 percentage points), therefore, is expected to increase the lendable supply by 0.51 standard deviations (6.03 percentage points). Increasing ETF stock ownership by 1 percentage point (28% of its mean) is on average associated with an increase of 0.47 percentage points in the short percent in a stock (11.79% of its mean). Hence, increasing ETF holdings by one standard deviation (3.01 percentage points) leads to an increase of 0.30 standard deviations

Table 3

The influence of ETF holdings on lendable supply and short interest

	Dependent variables	
	$LendS_{it}$	ShP_{it}
$LendS_{it}$ / ShP_{it}	(1)	(2)
ETF_{it}	**2.0015** ***	**0.4661** ***
	(60.37)	*(21.29)*
MF_{it}	0.1430 ***	0.1213 ***
	(24.46)	*(25.55)*
$ln(MCap_{it})$	-0.8162 ***	3.1405 ***
	(-4.27)	*(19.34)*
$ln(MCap_{it})^2$	0.0953 ***	-0.2814 ***
	(5.88)	*(-19.76)*
F-statistics	669.73	92.2
Prob > F	0.000	0.000
N	150,969	138,331
Stock fixed effects	Yes	Yes
Time fixed effects	Yes	Yes

Stock and time fixed effects are not reported
t-statistics are reported in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

This table reports the estimates received from regressions (1) and (2):

$$LendS_{it} = \beta_1 ETF_{it} + \beta_2 MF_{it} + \beta_3 \ln(MCap_{it}) + \beta_4 \ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it},$$
$$ShP_{it} = \beta_1 ETF_{it} + \beta_2 MF_{it} + \beta_3 \ln(MCap_{it}) + \beta_4 \ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it},$$

where $LendS_{it}$ is the lendable supply of stock i divided by its total number of shares in quarter t, ShP_{it} is the short interest in stock i divided by its total number of shares in quarter t, ETF_{it} is the percentage of the company i's market cap owned by exchange-traded funds in quarter t, MF_{it} is the percentage of the company i's market cap owned by mutual funds in quarter t, $\ln(MCap_{it})$ is the natural logarithm of the US dollar market cap of company i in quarter t, α_i and δ_t are stock-fixed and time-fixed effects, and ε_{it} is the error term of the regression. For a more detailed description of the variables see Table 1. The coefficient significance levels are denoted by ***, **, and * representing 1%, 5%, and 10% respectively with t-statistics reported in the parentheses.

(1.40 percentage points) in the stock's short percent on average.

Controlling for stock holdings by mutual funds, company market capitalizations as well as stock and time fixed effects allows us to avoid obtaining biased coefficients. The results are statistically significant at 1% significance level.

Following Section 2, the next step is to measure the impact of ETF holdings on company overvaluations proxied by Total Q directly, and through the channel of influence (Table 4). From the regression (3) we observe that the coefficient before ETF stock ownership is negative, meaning that higher ETF holdings are associated with lower company Total Qs.

Table 4

The influence of ETF holdings on company's Total Q

	Independent variables ($\widetilde{ETF}_{it}$)		
	ETF_{it}	$\widehat{LendS}_{it}$	$\widehat{ShP}_{it}$
$TotalQ_{it}$	(1)	(2)	(3)
$\widetilde{ETF}_{it}$	**-0.0555 *****	**-0.0287 *****	**-0.1238 *****
	(-9.65)	*(-10.23)*	*(-10.24)*
$\widetilde{ETF}_{it}$ * $ODvrg_{it}$	**-0.0126 *****	**-0.0044 *****	**-0.0087 ****
	(-2.75)	*(-3.76)*	*(-2.01)*
$ODvrg_{it}$	0.1458 ***	0.1594 ***	0.1409 ***
	(7.66)	*(8.46)*	*(6.22)*
MF_{it}	-0.0033 ***	0.0010	0.0122 ***
	(-3.52)	*(0.87)*	*(6.32)*
$ln(MCap_{it})$	0.3466 ***	0.3234 ***	0.7528 ***
	(7.8)	*(7.24)*	*(13.32)*
$ln(MCap_{it})^2$	0.0270 ***	0.0298 ***	-0.0094 *
	(7.1)	*(7.76)*	*(-1.96)*
F-statistics	70.36	70.36	70.48
Prob > F	0.000	0.000	0.000
N	135,679	135,679	135,679
Stock fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes

Stock and time fixed effects are not reported
t-statistics are reported in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

This table reports the estimates received from regression (3):

$$TotalQ_{it} = \beta_1 E\tilde{T}F_{it} + \beta_2 ODvrg_{it} + \beta_3 (E\tilde{T}F_{it} ODvrg_{it}) + \beta_4 MF_{it} + \beta_5 \ln(MCap_{it}) + \beta_6 \ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it},$$

where $TotalQ_{it}$ is the Total Q of stock i in quarter t, $ODvrg_{it}$ is the opinion divergence proxy for stock i in quarter t, constructed using I/B/E/S forecasts, stock volatility and trading volume and represented by a binary variable equal to 1 if divergence of investor opinion is above average and 0 otherwise, MF_{it} is the percentage of the company i's market cap owned by mutual funds in quarter t, $\ln(MCap_{it})$ is the natural logarithm of the US dollar market cap of company i in quarter t, α_i and δ_t are stock-fixed and time-fixed effects, and ε_{it} is the error term of the regression. $E\tilde{T}F_{it}$ represents 3 independent variables defined as follows: ETF_{it} is the percentage of the company i's market cap owned by exchange-traded funds in quarter t, $\widehat{LendS}_{it}$ are the fitted values for stock i in quarter t received from regression (1), and $\widehat{ShP}_{it}$ are the fitted values for stock i in quarter t received from regression (2). For a more detailed description of the variables see Table 1. The coefficient significance levels are denoted by ***, **, and * representing 1%, 5%, and 10% respectively with *t*-statistics reported in the parentheses.

Furthermore, we can see that the divergence of opinion serves as a moderator of the effect of ETF holdings, increasing the negative effect. The direct effect of ETF holdings on a low divergence of opinion company can be assessed as following: if ETF stock ownership increases by 1 percentage point (28% of its mean), the company's Total Q decreases on average by 0.056 units (5.1% of its mean). From here follows that if ETF holdings are increased by 1 standard deviation (3.01 percentage points), firm's Total Q is expected to decrease by 0.14 standard deviations (0.169 units).

Examining the interaction term, we can conclude that if the volatility of a company is above the market average in the respective quarter, a percentage-point increase in ETF ownership (28% of its mean) decreases the company's Total Q by an additional 0.013 units (1.1% of its mean). For a standard-deviation increase in ETF holdings, a high divergence of opinion decreases company's Total Q by an additional 0.03 standard deviations (0.038 units). We find that mutual fund holdings have a similar effect to ETF holdings, while the company size and divergence of opinion is expected to increase the Total Q. All of the coefficients are statistically significant at 1% significance level.

Further on, we regress companies' Total Qs on the fitted values of lendable supply and short percent ($\widehat{LendS}_{it}$ and $\widehat{ShS}_{it}$) presented in Table 3.

The effect of ETF holdings through the lendable supply variable for a low divergence of opinion company can be described as the following: if ETF stock ownership is increased by a percentage point (28% of its mean), the firm's Total Q tends to decrease on average by 0.057 units (5.24% of its mean) through an increase in lendable supply.[2] Similarly, a standard-deviation increase in ETF holdings (3.01 percentage points) is expected to result in a decrease of 0.143 standard deviations in Total Q (0.173 units). High divergence of opinion amplifies the effect by decreasing Total Q by additional 0.009 units (0.8% of its mean) for a percentage point increase in ETF holdings. For a standard-deviation increase in ETF ownership, this effect constitutes 0.022 standards deviations in the Total Q (0.027 units).

The effect of ETF holdings through the short percent variable for a low divergence of opinion firm is the following: a percentage point increase in ETF stock ownership (28% of its mean) results in a decrease of 0.058 units of a firm's Total Q (5.26% of its mean) through an

[2] We multiply the coefficients from regressions (1) and (2) respectively by those from regression (3) to measure the effect of ETF holdings on Total Q through lendable supply and short percent. The effect was calculated using the following logic: a percentage-point increase in ETF holdings is expected to increase lendable supply by 2.0015 percentage points, while a percentage-point increase in lendable supply is associated with a decrease of 0.0287 in Total Q. Hence, the total effect of a percentage-point increase in ETF holdings on Total Q through lendable supply is 2.0015 $*$ (-0.0287) = -0.0574. The same method is used for further calculations involving the investigation of the stock lending channel.

increase in short percent. From here, a standard-deviation increase in ETF holdings decreases the Total Q by 0.143 standard deviations (0.174 units). For a high divergence of opinion company, the additional decrease in Total Q constitutes 0.004 units (0.3% of its mean) and 0.01 standard deviations (0.012 units) for a percentage-point and standard-deviation increase in ETF stock ownership respectively. The documented effects from mutual fund holdings and market capitalization are similar to those observed previously.

4.3. Discussion of results

In line with our expectations, we find that ETF stock lending facilitates the correction of overvaluations, which gives us a ground not to reject our first hypothesis. This is consistent with the Miller's (1977) theory that in the presence of heterogeneous beliefs, short selling activity contributes to correcting mispricing and enhancing price discovery. Therefore, this result is consistent with the empirical evidence discussed that short selling increases the market efficiency. Also, the fact that this effect is more pronounced for stocks with wider divergence of opinion is in agreement with the findings of Chang et al. (2007). In our case, the channel through which this effect occurs is the stock lending by ETFs channel, which helps to eliminate the short selling constraints, allowing the prices to account for the bearish sentiment, thus, correcting overvaluations.

This result brings important implications when we think about the adverse effects of overvaluation that could be avoided once the process of price discovery is enhanced. For instance, an overvaluation might harm a retail investor in case the firm he invested in does not meet the market expectations. Despite the fact that the gap between the retail and institutional investors has dissipated over time (i.e. the retail investor has obtained the possibility of using the services of brokerage firms, the ability to trade in more securities, and access investment and real-time data), we still cannot reject the superiority of the institutional investor over the retail investor in terms of their sophistication, resources, specialised knowledge as well as the ability to protect themselves. That is why, for a retail investor it is harder to face the potential negative consequences of holding overvalued stocks, meaning that the enhanced price discovery facilitated by ETF stock lending could benefit such type of investors.

Another adverse effect of overvaluations that might be avoided once improving the market efficiency comes in the form of agency costs. There are studies that document the fact that overvaluation exerts pressure on the management team and might incentivise earnings management (Jensen (2004); Chi and Gupta (2009); Badertscher (2011); Kadyrzhanova and

Rhodes-Kropf (2014)). The idea behind these studies is that when a firm is overvalued it obtains access to below cost of capital funds, which might lead to wasteful use of resources. Eventually, managers are supposed to justify the high valuation and perform in line with the market expectations. In an attempt to prove the good prospects of the company, they start to use earnings management to paint an overall healthy situation of the company's financial position.

Furthermore, an overvalued company could become a more attractive target for a hostile takeover, which would not benefit the shareholders of the acquiring firm once they realise that their expectations will not be met. Also, overvaluation might serve as an obstacle to investment if the investor perceives it as unjustified.

Overall, to avoid the adverse effects of overvaluation, it is important for the market to be efficient and correct such a mispricing. As described above, this might have negative implications for corporate managers, investors and shareholders. From the obtained results, we can say that stock lending by ETFs contributes to the mitigation of such issues by allowing to correct overvaluations.

5. The impact of ETF stock lending on news incorporation

In this section, we discuss the analysis performed for our second research question. We keep the same structure as in the previous section: first, we present the methodological approach to answer the question, and follow with the obtained results and their discussion.

5.1. Methodical approach

After the news are announced, the unexpected earnings directly influence the company's value through the change in expected future cash flows in the residual income and dividend discount models. The efficient market hypothesis developed in Fama, Fisher, Jensen, and Roll (1969) states that the market is considered to be efficient if it adjusts to information quickly and does not leave any opportunity for any abnormal returns in the future. As a result, the prices of securities reflect all the available information on the market at any given point in time (Fama (1965); Fama and Blume (1966); Fama, et al. (1967); Jensen (1968)). Therefore, having a bigger return upon announcement indicates that there was less information in the prices before the announcement, suggesting that the available information was not successfully impounded into prices before it was actually revealed. We want to test this proposition in the context of ETF stock lending process. Hence, we study the behaviour of the stock returns after earnings announcements to scrutinize the incorporation of news immediately following the announcement. Since choosing a longer post-announcement window poses risks of including additional information from other stock events, while shorter windows might not be enough to observe the full effect of an announcement, we choose to inspect the returns 3 days after an earnings announcement.[3] By scaling the absolute values of the post-announcement returns by historical volatility prior to the event, we are able to separate the additional information arriving to the market due to the earnings surprise. In addition, we are trying to observe the difference between positive and negative earnings surprises using those as moderators of the effect of ETF holdings.

This gives us the following panel regression:

$$EAR_{it} = \beta_1 ETF_{it} + \beta_2 Negative_{it} + \beta_3 (ETF_{it} Negative_{it}) + \beta_4 MF_{it} + \beta_5 \ln(MCap_{it}) + \beta_6 \ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it} \quad (4)$$

where EAR_{it} is the absolute value of the post-earnings announcement cumulative return of security i in quarter t scaled by the stock volatility prior to announcement, and $Negative_{it}$ is a binary variable taking the value of 1 if the earnings surprise is negative and 0 otherwise. All the other variables are defined as above.

Afterwards, the same regression is estimated using the fitted values from regressions (1) and (2), $\widehat{LendS_{it}}$ and $\widehat{ShP_{it}}$, instead of ETF holdings, to check the channel of influence. Doing this allows us to compare how efficiently bad news are incorporated in comparison to good news and what is the role of ETFs in the process.

As an additional check for the post-announcement window length, we do separate regressions for companies whose natural logarithm of market capitalization is above and below average. This allows us to control for the speed with which the information is arriving to the

[3] The typical choice of the post-announcement window length in the literature usually ranges between [-1; +1] and [-10; +10] days around an earnings announcement. Chordia and Shivakumar (2005) study the relationship between the inflation illusion and post-earnings-announcement drift, inspecting the cumulative stock returns in the 3 days around an earnings announcement; Zhou and Zhu (2012) examine the stock price dynamics around an earnings announcement in the same [-1; +1] window; Ayers, Li, and Yeung (2011) investigate the trading strategies of different investor types 3 days around an earnings announcement and how they affect the post-earnings-announcement drift; Kross and Schroeder (1984) study the relationship between the earnings announcement timing and stock returns 5 days around the announcement ([-2; +2] window); Mendenhall (1991) inspects the price response to Value Line forecast revisions 3 days after the revision publication date; Aharony and Swary (1980) use the abnormal stock return in the [-10;+10] window to test whether the changes in quarterly dividends convey any information in addition to quarterly earnings.

market, which depends on the stock's liquidity proxied by size. The empirical studies document an inverse relationship between the drift of the post-announcement abnormal returns and firm size (Bhushan (1944); Fama and French (2012)). While for some smaller thinly-traded stocks a 3-day window might not be enough for the new information to be fully incorporated into prices, inspecting stocks with larger market capitalization would serve as an additional test of our results.

5.2. Analysis of results

To answer our second research question, we first examine the effect of ETF holdings on the post-announcement returns of securities for both positive and negative earnings surprises, and, afterwards, narrow it down to assessing the same effect that occurs through the stock lending channel.

From Table 5 we observe that higher ETF holdings are associated with a higher absolute value of post-announcement returns, meaning that more information is incorporated into prices during the 3 days following an announcement. To be more exact, a percentage-point increase in ETF stock ownership (28% of its mean) is associated with an increase of 0.036 percentage points in EAR (1.4% of its mean). This means that if ETF holdings are increased by a standard deviation (3.01 percentage points), EAR is expected to increase by 0.05 standard deviations (0.108 percentage points). This result is statistically significant at 1% significance level. Since the interaction term for negative surprises is insignificant for ETFs directly, this effect is the same for positive and negative earnings surprises.

To assess how much is contributed to this effect through the stock lending channel, we analyze regressions (1) and (2) with the fitted values of lendable supply and short percent ($\widehat{LendS}_{it}$ and $\widehat{ShS}_{it}$).

For positive earnings surprises, the effect of ETF holdings through the lendable supply variable can be described as the following: if ETF stock ownership increases by 1 percentage point (28% of its mean), EAR in that quarter is expected to increase by 0.035 percentage points (1.37% of its mean) due to an increase in lendable supply. For a standard-deviation increase in ETF holdings (3.01 percentage points) this effect translates into an increase of 0.049 standard deviations in EAR (0.106 percentage points). The coefficient is statistically significant at 1% significance level. For negative earnings surprises, the effect of ETF holdings is more pronounced: a percentage-point increase in ETF stock ownership (28% of its mean) for negative surprises is expected to increase EAR by additional 0.004 percentage points (0.15%

Table 5
The influence of ETF holdings on post-earnings announcement returns

	Independent variables ($\widetilde{ETF}_{it}$)		
	ETF_{it}	$\widehat{LendS}_{it}$	$\widehat{ShP}_{it}$
EAR_{it}	(1)	(2)	(3)
$\widetilde{ETF}_{it}$	**0.0359** ***	**0.0176** ***	**0.0738** ***
	(5.9)	*(6.04)*	*(5.89)*
$\widetilde{ETF}_{it}$ * $Negative_{it}$	**0.0026**	**0.0019** **	**0.0116** ***
	(0.67)	*(1.98)*	*(2.73)*
$Negative_{it}$	-0.2362 ***	-0.2530 ***	-0.2792 ***
	(-13.18)	*(-14.67)*	*(-12.99)*
MF_{it}	0.0104 ***	0.0077 ***	0.0007
	(8.83)	*(5.76)*	*(0.35)*
$ln(MCap_{it})$	0.3623 ***	0.3758 ***	0.1080 *
	(8.6)	*(8.95)*	*(1.82)*
$ln(MCap_{it})^2$	-0.0269 ***	-0.0285 ***	-0.0042
	(-7.57)	*(-8.03)*	*(-0.83)*
F-statistics	54.01	52.89	54.25
Prob > F	0.000	0.000	0.000
N	147,408	147,408	147,408
Stock fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes

Stock and time fixed effects are not reported
t-statistics are reported in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

This table reports the estimates received from regression (5):

$$EAR_{\ it} = \beta_1 E\tilde{T}F_{it} + \beta_2 Negative_{it} + \beta_3 (E\tilde{T}F_{it} Negative_{it}) + \beta_4 MF_{it} + \beta_5 \ln(MCap_{it}) + \beta_6 \ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it},$$

where EAR_{it} is the absolute value of the post-earnings announcement cumulative return of security i in quarter *t* scaled by the stock volatility prior to announcement, and $Negative_{it}$ is a binary variable taking the value of 1 if the earnings surprise is negative and 0 otherwise for stock i in quarter *t*, MF_{it} is the percentage of the company i*'s* market cap owned by mutual funds in quarter *t*, $\ln(MCap_{it})$ is the natural logarithm of the US dollar market cap of company i in quarter *t*, α_i and δ_t are stock-fixed and time-fixed effects, and ε_{it} is the error term of the regression. $E\tilde{T}F_{it}$ represents 3 independent variables defined as follows: ETF_{it} is the percentage of the company i's market cap owned by exchange-traded funds in quarter *t*, $\widehat{LendS}_{it}$ are the fitted values for stock i in quarter *t* received from regression (1), and $\widehat{ShP}_{it}$ are the fitted values for stock i in quarter *t* received from regression (2). For a more detailed description of the variables see Table 1. The coefficient significance levels are denoted by ***, **, and * representing 1%, 5%, and 10% respectively with *t*-statistics reported in the parentheses.

of its mean). This means that if ETF holdings are increased by a standard deviation, EAR should on average increase by 0.005 standard deviations (0.011 percentage points) more for negative earnings surprises. The coefficient is statistically significant at 5% significance level.

Regression (4) that uses short percent gives us similar results: increasing ETF stock ownership by a percentage point (28% of its mean) is expected to result in an increase of 0.034 percentage points in EAR (1.3% of its mean) for positive earnings surprises due to an increase in short percent. Negative earnings surprises are associated with an additional increase of 0.005 percentage points in EAR (0.21% of its mean) per percentage-point increase in ETF holdings. For a standard-deviation increase in ETF holdings, these effects represent 0.047 standard deviations (0.104 percentage points) of EAR and an additional 0.007 standard deviations (0.016 percentage points) for positive and negative earnings surprises respectively. Both coefficients are statistically significant at 1% significance level. We also control for such factors as stock market capitalization, mutual fund holdings, and stock and time fixed effects in order to avoid a potential bias.

Running separate regressions for big and small companies (Appendix C), we notice that the effect of ETF holdings on EAR persists for both companies with low and high market capitalization. Since we expect a 3-day window to be enough for the information to be incorporated into the prices of large stocks, the regression output for the subsample of big stocks speaks in favour that our results are not biased by the choice of the window length. As for further research, we suggest running the tests using different post-announcement windows, which will serve as an additional robustness check.

5.3. Discussion of results

As for our second research question, we find that ETF stock lending leads to better incorporation of bad news into prices upon announcement, which is in contradiction with our expectations and with the literature on market efficiency (Fama (1965); Fama and Blume (1966); Fama, et al. (1967)). These empirical findings argue that having a bigger return upon announcement indicates that the available information on the market before the announcement was not successfully incorporated into prices before its revelation, this speaking in favour of a less efficient market. Hence, we reject our second hypothesis that ETF stock lending facilitates better incorporation of bad news into prices, further enhancing the market efficiency.

One potential explanation of such a result might be the post-earnings-announcement drift (PEAD) that is a well-scrutinised anomaly in finance and represents the tendency for the cumulative abnormal returns of a stock to drift for several weeks or even months after the earnings announcement (Ball and Brown (1968); Bernard and Thomas (1989); Bernard and Thomas (1990)). The direction of the drift is determined by the direction of the earnings surprise. This means that if a firm announces good news, its cumulative abnormal returns tend to drift upwards for at least 60 days following the quarterly earnings announcement. Analogously, if the announcement contains bad news, the cumulative abnormal returns will tend to drift downwards. Considering our results, we can presume that ETF stock lending does not facilitate the impounding of bad news into prices before the announcement, but it does lead to a more efficient price reaction following the announcement.

The literature on PEAD indicates that at least a part of the price response to new information is delayed, giving rise to the drift. There are two possibilities discussed why this delay might occur. One reason might be that market participants fail to comprehend the available earnings information: some traders might fail to formulate unbiased expectations about the future earnings at the moment when current earnings are announced, and a part of their response is delayed until the analysts' forecasts are investigated or future earnings are realised. Another possibility why the drift might persist is because of the involved transaction costs (short selling costs, bid-ask spread, commissions, opportunity costs – the costs of employing and monitoring of a certain strategy) that outweigh the gains from a prompt exploitation of the news for a sufficiently big number of market participants (Kormendi and Lipe (1987); Freeman and Tse (1989)). Therefore, if prices react more efficiently due to ETF stock lending, there are bigger earnings announcement abnormal returns, especially for bad news, and a smaller (or no) post-earnings drift. In other words, if we believe that our result is driven by this anomaly, ETF stock lending might be a channel through which this anomaly is alleviated or even eliminated given that ETF stock lending facilitates prices to react in a more efficient/quicker manner, especially for bad news.

Apart from this, the literature on earnings management shows the importance of avoiding bad news being incorporated into prices in a timely manner. In an earnings management scenario, managers deliberately withhold bad news from investors for meeting earnings targets, performing empire building, keeping their compensation contracts or avoiding negative effects on their reputation and career. The bad news hoarding theorem states that the accumulation of bad news eventually results in an abrupt decline in the stock prices. Jin and Mayers (2006) posit that when managers hide bad news for a long period of time, they accumulate in the company until the manager's incentive for hiding them dissipate or they reach a critical upper limit when all the undisclosed negative firm-specific information becomes public at once, leading to a large and sudden price drop. Furthermore, Bleck and Liu (2007) argue that withholding bad news prevents investors from recognising negative net present value (NPV) projects at their early stage and make the managers abandon them. Consequently, the negative NPV projects get piled and eventually substantialise, leading to stock price crashes.

Therefore, to avoid such drastic effects and their negative impact on investors and shareholders, it is of a crucial importance that bad news does not accumulate in a company for a long period of time, and the market has the ability of reflecting the investors' opinion that have a bearish view regarding the performance of such companies. This idea is also consistent with Hong and Stein (2002) that short selling constraints might aggravate a market decline and lead to a crash. Our findings show that ETF stock lending does not facilitate the incorporation of bad news into prices before earnings announcements. However, if ETF stock lending might contribute to better incorporation of bad news upon announcement and prevent or diminish the power of the drift, this could be beneficial for investors and shareholders in the context of avoiding the negative effects of hoarding bad news during the drift period. As a suggestion for further research, it would be interesting to analyse the PEAD in the context of ETF stock lending and examine if it is indeed the case that this anomaly is attenuated by ETFs.

6. The impact of ETF stock lending on the frequency of bear raids

This section is dedicated to answering the third research question. We will proceed in the same fashion as in the previous sections, mainly discussing the methodology which addresses the proposed research question and continuing with the presentation of results and their implications.

6.1. Methodological approach

In order to observe how the ETF holdings affect the frequency of bear raid events, we first need to construct a proxy for the event. We use an adaption of the approach implemented by Shkilko, Van Ness, and Van Ness (2012) for identifying price reversals.

The authors define a day of a 'price reversal' as a day during which the following two happen: (a) the stock price declines by 2 or more standard deviations of historical intraday cumulative returns, and (b) it then recovers by 90% to 110% of the original decline. For the procedure, Shkilko et al. (2012) employ the mean standard deviation of 5-minute cumulative returns over 20 trading days before the price reversal day. Using 2 standard deviations as the decline threshold allows the authors to separate price declines that could have easily happened by chance from the ones that have low probability of occurrence without the intervention of price manipulators. The recovery range is argued by authors to be necessary for filtering out the reversals caused by new information in the market. We slightly modify the proxy to match out the data frequency by setting the benchmark volatility to be the standard deviation of daily returns over a quarter and allowing for the price to come back during the next 5 days, as at lower data frequencies there are more external events affecting stock returns. Also, this low frequency is better aligned with the effects of ETF stock lending because intraday short selling that is covered by the end of the day does not necessarily need one to borrow the securities whereas holding a short position for a day or a few days does.

Building on the work of Brunnermeier and Pedersen (2005) and Carlin, Lobo, and Viswanathan et al. (2007) who document episodic liquidity crises, Shkilko et al. (2012) state that in the absence of some arbitrage opportunities and news, the only reason of such a quick price rebound could be the pressure put on the pre-rebound prices. Therefore, we use these 'predatory' episodes as a proxy for bear raids and try to determine the effect of the ETF stock holdings on their frequency.

Shkilko et al. (2012) also suggest eliminating the price reversals that took place during the 5-day bandwidth around an earnings or dividend announcement and 1-day bandwidth around corporate news. Another recommendation is to exclude such episodes as those found in Bechmann (2004), Mitchell, Pulvino, and Stafford (2004), and Henry and Koski (2010): the short selling around SEO announcements ([-5, +5]-day interval), merger announcements ([-1, +3]-month interval), and convertible calls ([-3, +1]-month interval). Even though these observations could create some bias, they are not excluded from our sample due to data limitations.

For our dependent variable, we then count the number of such 'bear raid' events in a stock during a quarter. Further on, in order to account for the overall stock volatility, we introduce another condition for a bear raid event: it has to be asymmetric, thus, not accompanied by similar spikes up. To implement this condition, we also construct a 'bull raid' event, which is exactly the opposite of a bear raid – a price increase by more than 2 standard deviations, which is wiped out afterwards. The number of such events is then subtracted from the number of bear raids. This variable is referred to as $Bear_{it}$ and shows the number of bear raids after eliminating the effect of the overall volatility in a stock.

Based on this, we estimate the following panel regression to test the effect of ETFs:

$$Bear_{it} = \beta_1 ETF_{it} + \beta_2 ODvrg_{it} + \beta_3 (ETF_{it} ODvrg_{it}) + \beta_4 MF_{it} + \beta_5 Costs_{it}$$
$$+ \beta_6 \ln(MCap_{it}) + \beta_7 \ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it} \quad (5)$$

where $Bear_{it}$ is the number of bear raids minus the number of bull raids in stock *i* in quarter *t*, and $Costs_{it}$ are costs of a short-sale, which include transaction costs and the costs of borrowing the stock. All the other variables are defined as above.

Since transaction and stock borrowing costs diminish the profit from a short-sale, we expect them to have an impact on the occurrence of a bear raid and to be correlated with other variables in the regression. For this reason, they are controlled in the model. Moreover, as noted in Misra et al. (2011), companies that are often subject to manipulative short selling activity are facing a challenging period, which gives us a ground to expect that opinion divergence could influence the probability of a bear raid. Hence, trying to avoid biased coefficients due to its possible correlation with the size, we include the factor in the regression.

To complete the procedure, the same relationship is tested using the fitted values of lendable supply and short percent from regressions (1) and (2).

6.2. Analysis of results

In this section we are trying to identify how ETF holdings affect the frequency of bear raids in the stock market. By regressing the difference of the number of bear raid events and bull raid events on ETF holdings (Table 6), we determine that a percentage-point increase in ETF stock ownership (28% of its mean) is on average expected to increase the bear raid variable by 0.23 units (0.8% of its mean) for a company with a low level of divergence of opinion. Hence, a standard-deviation increase in ETF holdings (3.01 percentage points) leads to an increase of 0.095 standard deviations in the bear raid variable (0.68 units). Moreover, the regression (5) also allows us to detect the divergence of opinion as a moderator on which the relation between ETF holdings and bear raid events depends on. Specifically, the effect of ETF holdings on the frequency of bear raids is by 0.162 units higher (0.58% of its mean) for a company with a high divergence of opinion compared to a one with low. This translates into an additional effect of 0.068 standard deviations in the bear raid variable (0.49 units) per each standard-deviation increase in ETF holdings.

Looking at the effect of ETF holdings via lendable supply, we can conclude that a percentage-point increase in ETF stock ownership (28% of its mean) is associated with an increase of 0.263 units in the frequency of bear raid events (0.95% of its mean) for low divergence of opinion companies and an additional 0.069 units (0.25% of its mean) for high divergence of opinion companies. These number translate into 0.11 (0.793 units) and 0.03 (0.207 units) standard deviations of the bear raid variable respectively for a standard-deviation increase in ETF holdings.

Analysing the effect of ETF holdings via short percent, we observe the following: if ETF stock ownership is increased by one percentage point (28% of its mean), the frequency of bear raids is expected to increase by 0.249 percentage points (0.9% of its mean) for companies with low divergence of investor opinion and an additional 0.09 percentage points (0.3% of its mean) for those with high divergence. For a standard-deviation increase in ETF holdings, the

Table 6
The influence of ETF holdings on bear raids

	Independent variables ($\widetilde{ETF}_{it}$)		
	ETF_{it}	$\widehat{LendS}_{it}$	$\widehat{ShP}_{it}$
$Bear_{it}$	(1)	(2)	(3)
$\widetilde{ETF}_{it}$	**0.2264** ***	**0.1316** ***	**0.5340** ***
	(16.46)	*(19.68)*	*(18.65)*
$\widetilde{ETF}_{it}$ * $ODvrg_{it}$	**0.1620** ***	**0.0344** ***	**0.1924** ***
	(12.40)	*(9.61)*	*(12.38)*
$ODvrg_{it}$	-0.8178 ***	-0.6906 ***	-1.0791 ***
	(-11.53)	*(-9.52)*	*(-12)*
MF_{it}	0.0460 ***	0.0244 ***	-0.0287 ***
	(17.3)	*(8.29)*	*(-6.17)*
$Costs_{it}$	-7.9913 ***	-8.1710 ***	-7.9753 ***
	(-6.71)	*(-6.82)*	*(-6.65)*
$ln(MCap_{it})$	-0.5040 ***	-0.2976 **	-2.6714 ***
	(-3.53)	*(-2.08)*	*(-15.25)*
$ln(MCap_{it})^2$	-0.0584 ***	-0.0786 ***	0.1329 ***
	(-5.10)	*(-6.82)*	*(9.42)*
F-statistics	281.59	278.73	274.13
Prob > F	0.000	0.000	0.000
N	121,612	121,612	121,612
Stock fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes

Stock and time fixed effects are not reported
t-statistics are reported in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

This table reports the estimates received from regression (6):

$$Bear_{it} = \beta_1 ETF_{it} + \beta_2 ODvrg_{it} + \beta_3(ETF_{it}ODvrg_{it}) + \beta_4 MF_{it} + \beta_5 Costs_{it} + \beta_6 \ln(MCap_{it}) + \beta_7 \ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it},$$

where $Bear_{it}$ is the number of bear raids minus the number of bull raids in a stock i in quarter *t*, $ODvrg_{it}$ is the opinion divergence proxy for stock i in quarter t, constructed using I/B/E/S forecasts, stock volatility and trading volume and represented by a binary variable equal to 1 if divergence of investor opinion is above average and 0 otherwise, MF_{it} is the percentage of the company i's market cap owned by mutual funds in quarter t, $Costs_{it}$ are costs of a short-sale, which include transaction costs and the costs of borrowing the stock for company i in quarter *t*, $\ln(MCap_{it})$ is the natural logarithm of the US dollar market cap of company i in quarter *t*, α_i and δ_t are stock-fixed and time-fixed effects, and ε_{it} is the error term of the regression. $E\tilde{T}F_{it}$ represents 3 independent variables defined as follows: ETF_{it} is the percentage of the company i's market cap owned by exchange-traded funds in quarter *t*, $\widehat{LendS}_{it}$ are the fitted values for stock i in quarter *t* received from regression (1), and $\widehat{ShP}_{it}$ are the fitted values for stock i in quarter *t* received from regression (2). For a more detailed description of the variables see Table 1. The coefficient significance levels are denoted by ***, **, and * representing 1%, 5%, and 10% respectively with *t*-statistics reported in the parentheses.

respective numbers are 0.104 (0.75 units) and 0.038 (0.27 units) standard deviations in the bear raid variable.

All of the coefficients are statistically significant at 1% significance level. Again, for the sake of avoiding econometrical issues we control for the effect of mutual funds holdings, company market capitalization, and stock and time fixed effects. Also, we observe that higher costs of entering a bear raid position are associated with a lower number of bear raid events on average (the sign of the coefficient before costs is negative).

6.3. Discussion of results

As ETF stock lending assists the diminution of short selling constraints, our initial expectation was that it also favours price manipulation, specifically, through increasing the frequency of bear raids. Our results are in consonance with the initial expectation of the effect, permitting us not to reject our third hypothesis. Put it differently, ETFs might assist activist short sellers in their manipulative purposes by allowing them to short stocks that are hard to be shorted otherwise. This result is consistent with the literature speaking in favour of short selling benefiting price manipulation (Henry and Koski (2010), Blocher et al. (2011); Misra et al. (2011)). Moreover, in line with our expectations, we found that this effect is more pronounced for companies with high divergence of opinion. This is in agreement with the idea that companies that are targets of price manipulation are usually facing a challenging period (Misra et al. (2011)).

Our results might be relevant from a regulatory point of view given the recent regulatory attention to short selling activities (e.g., uptick rule – SEC restricts short selling of a stock that has dropped more than 10% in one day (SEC, 2010)) that aims at fighting with the severity of market panic or excessive speculation. Specifically, it might be important in the context of emerging markets where legal enforcement is weak. Considering that price manipulation prevents price discovery, the negative effects of ETF stock lending should also be accounted for when planning an investment strategy.

Moreover, given the fact that ETFs do not have an uptick rule, investors might short sell stocks even during a market downturn. Ben Seager-Scott, chief investment strategist at the Tilney Group, states that "It (ETF stock lending) does add an extra level of complexity to otherwise plain vanilla trackers or ETFs and could add to the risks in periods of market shocks." (Mooney, 2018).

Among the other concerns expressed by investors (unrelated to bear raids) regarding the stock lending by ETF operators are the quality and risk of the collateral as well as the possibility of the counterparty going bankrupt. In the US, cash is usually received as collateral and there is an identified risk of getting no return or even generating losses from reinvesting this collateral. In Europe, however, securities are typically taken as collateral. Peter Sleep, a fund manager at Seven Investment Management, states that "In 2008 many US investors took cash and put that cash into what appeared to be low-risk bond funds and incurred quite large losses in the financial crisis whereas European investors sailed serenely on." (Mooney, 2018). Even so, ETF providers consider that they have strict enough policies into place to make the benefits of investing in ETFs outweigh the risks. All in all, ETF stock lending has both its advantages and drawbacks, and for an investor is of a crucial importance to calibrate them and make a proper due diligence before investing in these securities. From a regulatory point of view, it might also prove out to consider developing more rigorous regulations that would alleviate the negative impact these securities might have during a market crisis.

7. Robustness checks

Since ETFs track market indices, we do not expect overvaluations, post announcement returns, bear raids, and our stock lending proxies to affect the level of ETF holdings other than through company market capitalization, which we control for in our regressions. Therefore, it can be argued that ETF holdings are rather exogenous as an independent variable in our models.

However, apart from using both lendable supply and short percent in our regressions, we are implementing two other robustness checks – regressions in differences and mediation with bootstrapping. The motivation behind the former is the high residual autocorrelation, which is a common issue for regressions in levels. First differences are, therefore, used for the regressions involving companies' Total Qs and the number of bear raids, which is where the problem has been spotted. This allows us to be more confident that our regression coefficients are not biased.

As an additional robustness check, we try to establish the mediator framework described in Baron and Kenny (1986). The authors state that the following 3 conditions have to hold in order for a variable to be a pure mediator: (i) the independent variable should have a statistically significant influence on the mediator variable, (ii) the mediator should have a statistically significant influence on the dependent variable, and (iii) the relationship between the independent and dependent variable should become insignificant in the regression using both the mediator and the independent variable.

In most of the research the relationship in (iii) decreases in magnitude but remains statistically significant, which has caused some criticism. Zhao, Lynch & Chen (2010) claim that the mediation is still present and explain the case by stating that there could exist an omitted mediator of the independent variable. Trying to refine the model, the authors suggest following Preacher and Hayes' (2004) bootstrap procedure, which provides more reliable results as compared to the Sobel z-test[4] used in Baron and Kenny (1986), to determine whether the

[4] The significance test for the mediated effect of the independent (treatment) variable on the dependent variable used in Baron and Kenny (1986).

relationship in (i) and (ii) is significant.

Hence, we implement the mediation procedure in the following way. First, we test whether ETF holdings have any significant impact on our stock lending proxies (lendable supply and short percent). Further, we establish the statistical link between the short stock lending proxies and our dependent variables of interest. Afterwards, we simultaneously control for ETF ownership and short stock lending proxies in the same regression, testing whether the coefficient before the ETF variable remains of the same significance. Furthermore, we use the bootstrap procedure (1,000 runs) in every step of the analysis to increase the results reliability. Due to computer memory constraints, we draw 30 random subsamples from our data (each approximately one quarter of our sample) and report the median result of the mediation procedure. We perform a first difference analysis for all of the steps for the Total Q and the bear raid event to avoid the residual autocorrelation issue. The results for the first difference regressions and mediation procedures are reported in Appendix D and Appendix E respectively. All of them support our results presented above: the discussed effects of ETF stock lending on the Total Q, EAR, and the bear raid event variables have the same signs and remain statistically significant.

8. Conclusion

The research goal of this paper is to find if ETFs have any unintended side effects on the market, specifically, through the stock lending channel. ETFs often lend their securities so as to minimise the fund fees. This process assists the market participants in shorting the stocks that are otherwise difficult to short. As short selling has various implications, we believe that the process of ETF stock lending might have several unintended effects on the market. Studying the literature of short selling and ETFs, our research goal is to find how ETF stock lending impacts 1) overvaluations, 2) the incorporation of bad news into prices, and 3) the frequency of bear raids.

We perform a fitted values analysis where we obtain the variation in stock lending coming from the ETFs and scrutinise how this variation affects our variables of interest. As proxies for the lendable supply of ETFs we take the short percent and the lendable quantity of stocks. As for the robustness checks, we perform first difference regressions and a mediation analysis with bootstrapping.

Consistent with our expectations, we find that ETF stock lending helps to correct overvaluations and assists short sellers in their manipulative strategies such as bear raids. We also discover that ETF stock lending does not help bad news to be impounded into prices before the earnings announcement. However, it facilitates better incorporation of news upon the announcement, the effect being more pronounced for bad news.

These results carry important implications for investors and regulators. First, ETF stock lending helps to prevent the adverse effects of overvaluations and their negative implications such as agency costs, increased risk of holding overvalued stocks for retail investors, higher shareholders' risk of acquiring overvalued shares, and obstacles to investment in cases when the investor perceives it as unjustified.

Second, by facilitating better incorporation of bad news into prices *upon* announcement, ETF stock lending helps to avoid the hoarding of bad news, which might have negative implications for managers, shareholders and investors in the form of drastic price drops, unrecognised negative NPV projects, earnings management and a disgraced manager's reputational status. Moreover, given that ETF stock lending facilitates news to be more efficiently impounded into prices after the announcement, one potential proposition could be that ETFs help to attenuate the PEAD anomaly by making the price response more efficient. As for further research, it would be interesting to examine the effects of ETF stock lending in the context of the PEAD anomaly.

Finally, the fact that ETF stock lending facilitates the downward price manipulation in the form of bear raids cares important implications for policy makers. Considering the recent regulatory attention to short selling activities and their potential to have a devastating impact on the market health during downturns, it is of a great importance to consider and control all the channels, including the stock lending by ETFs channel, through which these negative implications might occur.

All in all, ETF stock lending has both its positive and negative implications and unintended effects on the market. We believe that with a proper investor's due diligence as well as a healthy regulatory environment in place, this relatively new financial security enhances the market efficiency and deserves to be acknowledged for the diversification of investment opportunities it provides.

9. References

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10. Appendices

10.1. Appendix A. The mechanism of ETF stock lending

The logic behind the ETF stock lending process is quite simple. An equity ETF generally holds thousands of shares of different stocks which can be lent out with the purpose of generating additional income and decrease the fund's fee. In a typical scenario, the aim of the borrower, usually a large financial firm, is to short sell the stock and profit if the stock falls in price, hedge against market movements or use this stock as a collateral in another transaction. In order for the stock to be lent out, the borrower is required to post a collateral to secure its loan and pay a fee to the ETF provider. The collateral usually represents either stocks or cash whose value should be at least 102% of the stocks loaned out, this being called overcollateralization. The collateral servers as a shock absorber in the case of the borrower's default and is marked to market daily. ETF providers usually reinvest any cash collateral into low risk money market securities to earn incremental returns on the cash received (non-cash collateral might be reinvested). If the stock is subject to any entitlements (e.g. dividends) while being lent out, the borrower returns them to the ETF. To close the process, the borrower must return the stock back to the ETF and receive its collateral back. Furthermore, the borrower rarely connects to the lender directly but usually does it through a lending agent who takes part of the fee for its services. For a visual representation of this process see Figure 1**.** There are also regulatory limits on securities lending – according to SEC, the total value of the securities lent out cannot exceed one-third of the fund's total market value.

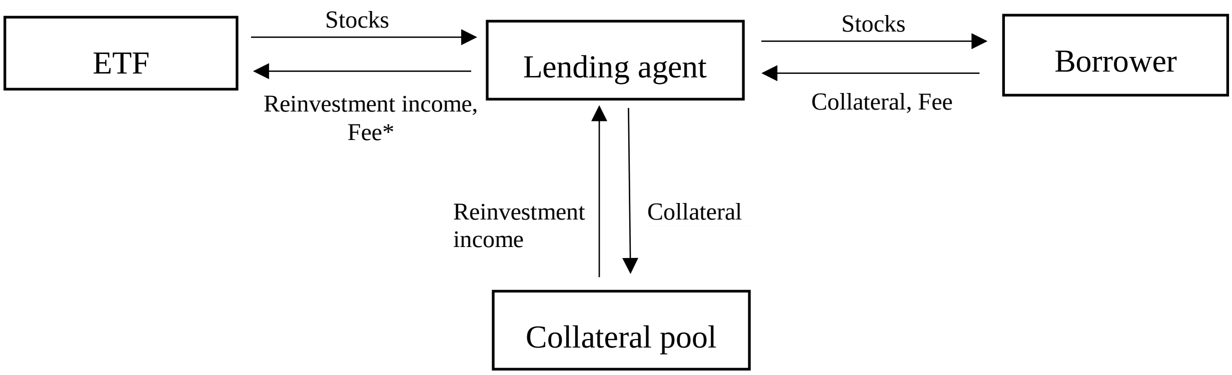

Figure1. A typical scenario of the ETF stock lending mechanism. Graph created by the authors.

10.2. Appendix B. Divergence of investor opinion 'unitary portmanteau proxy'

Table B.1

'Unitary portmanteau proxy' construction

This table reports the estimates received for the divergence of opinion 'unitary portmanteau proxy' construction based on the following regression:

$$FDvrg_{it} = \beta_1 Volatility_{it} + \beta_2 Turnover_{it} + \beta_3 \ln(MCap_{it}) + \beta_4 \ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it},$$

where $FDvrg_{it}$ is the standard deviation of the analyst forecasts for the following quarter for stock i at quarter t, $Volatility_{it}$ is the standard deviation of stock i's daily returns in quarter t, $Turnover_{it}$ is the annualized turnover of shares for stock i in quarter t, $\ln(MCap_{it})$ is the natural logarithm of the US dollar market cap of company i in quarter t, α_i and δ_t are stock-fixed and time-fixed effects, and ε_{it} is the error term of the regression. For a more detailed description of the variables see Table 1. The coefficient significance levels are denoted by ***, **, and * representing 1%, 5%, and 10% respectively with t-statistics reported in the parentheses.

$FDvrg_{it}$	(1)
$Volatility_{it}$	**0.1681** ***
	(12.35)
$Turnover_{it}$	0.1471 ***
	(9.45)
$ln(MCap_{it})$	-1.3427 ***
	(-10.13)
$ln(MCap_{it})^2$	0.1037 ***
	(9.35)
F-statistics	23.86
Prob > F	0.000
N	117,364
Stock fixed effects	Yes
Time fixed effects	Yes

Stock and time fixed effects are not reported
t-statistics are reported in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

10.3. Appendix C. Post-earnings-announcement returns regressions for big and small companies

Table C.1

Panel regression to establish how ETF holdings influence post-earnings announcement returns for big companies

This table reports the estimates received from regression (5) for the subsample of companies whose natural logarithm of market capitalization is above average:

$$EAR_{it} = \beta_1 E\tilde{T}F_{it} + \beta_2 Negative_{it} + \beta_3 (E\tilde{T}F_{it} Negative_{it}) + \beta_4 MF_{it} + \beta_5 \ln(MCap_{it})$$
$$+\beta_6 \ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it},$$

where EAR_{it} is the absolute value of the post-earnings announcement cumulative return of security i in quarter t scaled by the stock volatility prior to announcement, and $Negative_{it}$ is a binary variable taking the value of 1 if the earnings surprise is negative and 0 otherwise for stock i in quarter t, MF_{it} is the percentage of the company i's market cap owned by mutual funds in quarter t, $\ln(MCap_{it})$ is the natural logarithm of the US dollar market cap of company i in quarter t, α_i and δ_t are stock-fixed and time-fixed effects, and ε_{it} is the error term of the regression. $E\tilde{T}F_{it}$ represents 3 independent variables defined as follows: ETF_{it} is the percentage of the company i's market cap owned by exchange-traded funds in quarter t, $\widehat{LendS}_{it}$ are the fitted values for stock i in quarter t received from regression (1), and $\widehat{ShP}_{it}$ are the fitted values for stock i in quarter t received from regression (2). For a more detailed description of the variables see Table 1. The coefficient significance levels are denoted by ***, **, and * representing 1%, 5%, and 10% respectively with t-statistics reported in the parentheses.

	Independent variables ($\widetilde{ETF}_{it}$)		
	ETF_{it}	$\widehat{LendS}_{it}$	$\widehat{ShP}_{it}$
EAR_{it}	(1)	(2)	(3)
$\widetilde{ETF}_{it}$	**0.0155 ***	**0.0097 ****	**0.0349 ****
	(1.94)	*(2.49)*	*(2.09)*
$\widetilde{ETF}_{it}$ * $Negative_{it}$	**0.0179 *****	**0.0049 *****	**0.0335 *****
	(3.89)	*(4.14)*	*(5.93)*
$Negative_{it}$	-0.3944 ***	-0.3906 ***	-0.4864 ***
	(-15.79)	*(-16.62)*	*(-15.18)*
MF_{it}	0.0111 ***	0.0094 ***	0.0048 *
	(8.04)	*(5.88)*	*(1.81)*
$ln(MCap_{it})$	0.5293 ***	0.5367 ***	0.3855 ***
	(3.91)	*(3.97)*	*(2.6)*
$ln(MCap_{it})^2$	-0.0404 ***	-0.0414 ***	-0.0271 **
	(-4.32)	*(-4.44)*	*(-2.53)*
F-statistics	46.78	46.77	47.03
Prob > F	0.000	0.000	0.000
N	97,593	97,593	97,593
Stock fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes

Stock and time fixed effects are not reported
t-statistics are reported in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

Table C.2

Panel regression to establish how ETF holdings influence post-earnings announcement returns for small companies

This table reports the estimates received from regression (5) for the subsample of companies whose natural logarithm of market capitalization is below average:

$$EAR_{it} = \beta_1 \tilde{ETF}_{it} + \beta_2 Negative_{it} + \beta_3 (\tilde{ETF}_{it} Negative_{it}) + \beta_4 MF_{it} + \beta_5 \ln(MCap_{it})$$
$$+\beta_6 \ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it},$$

where EAR_{it} is the absolute value of the post-earnings announcement cumulative return of security i in quarter t scaled by the stock volatility prior to announcement, and $Negative_{it}$ is a binary variable taking the value of 1 if the earnings surprise is negative and 0 otherwise for stock i in quarter t, MF_{it} is the percentage of the company i*'s* market cap owned by mutual funds in quarter t, $\ln(MCap_{it})$ is the natural logarithm of the US dollar market cap of company i in quarter t, α_i and δ_t are stock-fixed and time-fixed effects, and ε_{it} is the error term of the regression. $\tilde{ETF}_{it}$ represents 3 independent variables defined as follows: ETF_{it} is the percentage of the company i's market cap owned by exchange-traded funds in quarter t, $\widehat{LendS}_{it}$ are the fitted values for stock i in quarter t received from regression (1), and $\widehat{ShP}_{it}$ are the fitted values for stock i in quarter t received from regression (2). For a more detailed description of the variables see Table 1. The coefficient significance levels are denoted by ***, **, and * representing 1%, 5%, and 10% respectively with *t*-statistics reported in the parentheses.

	Independent variables ($\widetilde{ETF}_{it}$)		
	ETF_{it}	$\widehat{LendS}_{it}$	$\widehat{ShP}_{it}$
EAR_{it}	(1)	(2)	(3)
$\widetilde{ETF}_{it}$	**0.0041**	**0.0084**	**0.0431** *
	(0.32)	*(1.4)*	*(1.69)*
$\widetilde{ETF}_{it}$ * $Negative_{it}$	**0.0459** ***	**0.0116** ***	**0.0393** ***
	(4.44)	*(5.11)*	*(4.82)*
$Negative_{it}$	-0.1432 ***	-0.1470 ***	-0.1705 ***
	(-5.18)	*(-5.59)*	*(-5.68)*
MF_{it}	0.0084 ***	0.0063 **	0.0003
	(3.34)	*(2.22)*	*(0.08)*
$ln(MCap_{it})$	0.2674 **	0.2801 **	0.0468
	(2.39)	*(2.5)*	*(0.35)*
$ln(MCap_{it})^2$	-0.0123	-0.0136	0.0077
	(-0.9)	*(-0.99)*	*(0.53)*
F-statistics	11.18	11.30	11.33
Prob > F	0.000	0.000	0.000
N	49,815	49,815	49,815
Stock fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes

Stock and time fixed effects are not reported
t-statistics are reported in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

10.4. Appendix D. Regressions in differences

Table D.1

First difference panel regression to establish how ETF holdings influence lendable supply and short interest

This table reports the estimates received from first difference regressions based on equations (1) and (2):

$$LendS_{it} = \beta_1 ETF_{it} + \beta_2 MF_{it} + \beta_3\, ln(MCap_{it}) + \beta_4\, ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it},$$

$$ShP_{it} = \beta_1 ETF_{it} + \beta_2 MF_{it} + \beta_3\, ln(MCap_{it}) + \beta_4\, ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it},$$

where $LendS_{it}$ is the lendable supply of stock i divided by its total number of shares in quarter t, ShP_{it} is the short interest in stock i divided by its total number of shares in quarter t, ETF_{it} is the percentage of the company i's market cap owned by exchange-traded funds in quarter t, MF_{it} is the percentage of the company i's market cap owned by mutual funds in quarter t, $ln(MCap_{it})$ is the natural logarithm of the US dollar market cap of company i in quarter t, α_i and δ_t are stock-fixed and time-fixed effects, and ε_{it} is the error term of the regression. For a more detailed description of the variables see Table 1. All of the variables are in first differences. The coefficient significance levels are denoted by ***, **, and * representing 1%, 5%, and 10% respectively with t-statistics reported in the parentheses.

	Dependent variables	
	$LendS_{it}$	ShP_{it}
$LendS_{it}$ / ShP_{it}	(1)	(2)
ETF_{it}	**0.4344** ***	**0.2669** ***
	(26.41)	*(18.97)*
MF_{it}	0.0900 ***	0.0922 ***
	(27.28)	*(31.69)*
$ln(MCap_{it})$	0.1523 **	1.5385 ***
	(2.04)	*(14.43)*
$ln(MCap_{it})^2$	-0.0344 ***	-0.1497 ***
	(-4.53)	*(-15.87)*
F-statistics	210.74	81.49
Prob > F	0.000	0.000
N	144,142	132,110
Stock fixed effects	Yes	Yes
Time fixed effects	Yes	Yes

Stock and time fixed effects are not reported
t-statistics are reported in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

Table D.2

First difference panel regression to establish how ETF holdings influence company's Total Q

This table reports the estimates received from regression (3):

$$TotalQ_{it} = \beta_1 E\tilde{T}F_{it} + \beta_2 L.ODvrg_{it} + \beta_3 (E\tilde{T}F_{it}\ L.ODvrg_{it}) + \beta_4 MF_{it} + \beta_5\ ln(MCap_{it}) + \beta_6\ ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it},$$

where $TotalQ_{it}$ is the Total Q of stock i in quarter t, $L.ODvrg_{it}$ is the lagged opinion divergence proxy for stock i in quarter t, constructed using I/B/E/S forecasts, stock volatility and trading volume and represented by a binary variable equal to 1 if divergence of investor opinion is high and 0 otherwise, MF_{it} is the percentage of the company i's market cap owned by mutual funds in quarter t, $\ln(\mathrm{MCap_{it}})$ is the natural logarithm of the US dollar market cap of company i in quarter t, α_i and δ_t are stock-fixed and time-fixed effects, and ε_{it} is the error term of the regression. $E\tilde{T}F_{it}$ represents 3 independent variables defined as follows: ETF_{it} is the percentage of the company i's market cap owned by exchange-traded funds in quarter *t*, $\widehat{LendS}_{it}$ are the fitted values for stock i in quarter *t* received from regression (1), and $\widehat{ShP}_{it}$ are the fitted values for stock i in quarter *t* received from regression (2). For a more detailed description of the variables see Table 1. All of the variables except $L.ODvrg_{it}$ are in first differences. The coefficient significance levels are denoted by ***, **, and * representing 1%, 5%, and 10% respectively with *t*-statistics reported in the parentheses.

	Independent variables ($\widetilde{ETF}_{it}$)		
	ETF_{it}	$\widehat{LendS}_{it}$	$\widehat{ShP}_{it}$
$TotalQ_{it}$	(1)	(2)	(3)
$\widetilde{ETF}_{it}$	**-0.0038** **	**-0.0135** ***	**-0.0132** **
	(-2.34)	*(-3.34)*	*(-2)*
$\widetilde{ETF}_{it}$ * $L.ODvrg_{it}$	**-0.0038**	**0.0043** **	**-0.0135** ***
	(-1.07)	*(2.17)*	*(-3.12)*
$L.ODvrg_{it}$	-0.0078 **	-0.0100 ***	-0.0072 **
	(-2.47)	*(-3.05)*	*(-2.38)*
MF_{it}	-0.0020 ***	-0.0009	-0.0003
	(-4.06)	*(-1.57)*	*(-0.35)*
$ln(MCap_{it})$	0.0229	0.0249	0.0576 **
	(1.14)	*(1.23)*	*(2.35)*
$ln(MCap_{it})^2$	0.0130 ***	0.0126 ***	0.0098 ***
	(6.19)	*(5.89)*	*(3.84)*
F-statistics	54.51	54.55	54.66
Prob > F	0.000	0.000	0.000
N	130,101	130,101	130,101
Stock fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes

Stock and time fixed effects are not reported
t-statistics are reported in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table D.3

First difference panel regression to establish how ETF holdings influence bear raids

This table reports the estimates received from regression (6):

$$Bear_{it} = \beta_1 ETF_{it} + \beta_2 L.ODvrg_{it} + \beta_3 (ETF_{it}\ L.ODvrg_{it}) + \beta_4 MF_{it} + \beta_5 Costs_{it} + \beta_6\ ln(MCap_{it}) + \beta_7\ ln(MCap_{it})^2 + \alpha_i + \delta_t + \varepsilon_{it},$$

where $Bear_{it}$ is the number of bear raids minus the number of bull raids in a stock i in quarter t, $L.ODvrg_{it}$ is the lagged opinion divergence proxy for stock i in quarter t, constructed using I/B/E/S forecasts, stock volatility and trading volume and represented by a binary variable equal to 1 if divergence of investor opinion is above average and 0 otherwise, MF_{it} is the percentage of the company i's market cap owned by mutual funds in quarter t, $Costs_{it}$ are costs of a short-sale, which include transaction costs and the costs of borrowing the stock for company i in quarter t, $ln(MCap_{it})$ is the natural logarithm of the US dollar market cap of company i in quarter t, α_i and δ_t are stock-fixed and time-fixed effects, and ε_{it} is the error term of the regression. $E\tilde{T}F_{it}$ represents 3 independent variables defined as follows: ETF_{it} is the percentage of the company i's market cap owned by exchange-traded funds in quarter t, $\widehat{LendS}_{it}$ are the fitted values for stock i in quarter t received from regression (1), and $\widehat{ShP}_{it}$ are the fitted values for stock i in quarter t received from regression (2). For a more detailed description of the variables see Table 1. All of the variables except $L.ODvrg_{it}$ are in first differences. The coefficient significance levels are denoted by ***, **, and * representing 1%, 5%, and 10% respectively with t-statistics reported in the parentheses.

	Independent variables ($\widetilde{ETF}_{it}$)		
	ETF_{it}	$\widehat{LendS}_{it}$	$\widehat{ShP}_{it}$
$Bear_{it}$	(1)	(2)	(3)
ETF_{it}	**0.1321** ***	**0.3848** ***	**0.6104** ***
	(3.77)	*(5.18)*	*(4.96)*
ETF_{it} * $L.ODvrg_{it}$	**0.1462** **	**0.1313** ***	**0.2264** ***
	(2.37)	*(4.88)*	*(3.66)*
$L.ODvrg_{it}$	0.1564 ***	0.1233 ***	0.1597 ***
	(3.88)	*(2.97)*	*(3.99)*
$Costs_{it}$	-20.6369 ***	-20.6298 ***	-20.5401 ***
	(-10.27)	*(-10.27)*	*(-10.23)*
MF_{it}	0.0448 ***	0.0050	-0.0206
	(6.64)	*(0.52)*	*(-1.54)*
$ln(MCap_{it})$	2.4054 ***	2.3481 ***	1.2123 ***
	(6.81)	*(6.64)*	*(2.99)*
$ln(MCap_{it})^2$	-0.8845 ***	-0.8701 ***	-0.7705 ***
	(-26.13)	*(-25.53)*	*(-19.47)*
F-statistics	314.02	312.72	312.35
Prob > F	0.000	0.000	0.000
N	116,346	116,346	116,346
Stock fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes

Stock and time fixed effects are not reported
t-statistics are reported in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

10.5. Appendix E. Mediation output

Table E.1

Mediation with bootstrapping

This table reports the results received from the mediation procedure using bootstrapping (1,000 runs), where ETF_{it} is the percentage of the company i's market cap owned by exchange-traded funds in quarter t, $LendS_{it}$ is the lendable supply of stock i divided by its total number of shares in quarter t, ShP_{it} is the short interest in stock i divided by its total number of shares in quarter t, $TotalQ_{it}$ is the Total Q of stock i in quarter t, EAR_{it} is the absolute value of the post-earnings announcement cumulative return of security i in quarter t scaled by the stock volatility prior to announcement, and $Bear_{it}$ is the number of bear raids minus the number of bull raids in a stock i in quarter t.

Treatment variable	ETF_{it}			
Dependent variable	$TotalQ_{it}$			
Mediator	Effect	Mean	95% Confidence interval	
$LendS_{it}$				
	*ACME**	-0.0017	-0.0027	-0.0007
	Direct Effect	-0.0021	-0.0098	0.0055
	Total Effect	-0.0038	-0.0115	0.0037
	% of Total Effect mediated	33.84%	-339.11%	393.46%

Treatment variable	ETF_{it}			
Dependent variable	$TotalQ_{it}$			
Mediator	Effect	Mean	95% Confidence interval	
ShP_{it}				
	*ACME**	**-0.0017**	**-0.0025**	**-0.0009**
	Direct Effect	-0.0050	-0.0110	0.0010
	Total Effect	-0.0066	-0.0127	-0.0005
	% of Total Effect mediated	24.67%	11.85%	130.62%

Treatment variable	ETF_{it}			
Dependent variable	EAR_{it}			
Mediator	Effect	Mean	95% Confidence interval	
$LendS_{it}$				
	*ACME**	**0.0388**	**0.0275**	**0.0506**
	Direct Effect	0.0464	0.0299	0.0628
	Total Effect	0.0852	0.0746	0.0963
	% of Total Effect mediated	45.65%	40.34%	52.11%

Treatment variable	ETF_{it}			
Dependent variable	EAR_{it}			
Mediator	Effect	Mean	95% Confidence interval	
ShP_{it}				
	*ACME**	0.0063	0.0041	0.0084
	Direct Effect	0.0605	0.0495	0.0715
	Total Effect	0.0668	0.0556	0.0778
	% of Total Effect mediated	9.34%	8.04%	11.24%

** Average causal mediation effect*

Treatment variable	***ETF*** $_{it}$			
Dependent variable	***Bear*** $_{it}$			
Mediator	Effect	Mean	95% Confidence interval	
LendS $_{it}$				
	ACME*	**0.0290**	**0.0170**	**0.0423**
	Direct Effect	0.0982	-0.0240	0.2240
	Total Effect	0.1272	0.0063	0.2513
	% of Total Effect mediated	22.20%	10.30%	125.76%

Treatment variable	***ETF*** $_{it}$			
Dependent variable	***Bear*** $_{it}$			
Mediator	Effect	Mean	95% Confidence interval	
ShP $_{it}$				
	ACME*	**0.0131**	**0.0059**	**0.0217**
	Direct Effect	0.1497	0.0359	0.2669
	Total Effect	0.1629	0.0499	0.2800
	% of Total Effect mediated	8.00%	4.64%	25.39%

** Average causal mediation effect*