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How prevalent are short squeezes? Evidence from the US and Europe☆

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ABSTRACT

We develop a novel measure to identify short squeezes triggered by sharp price increases. These "market squeezes" drive short sellers to close their positions early. To provide a comprehensive analysis of short squeeze dynamics, we also examine lender squeezes, identified through share recalls. We find that stock-day short-squeeze events are rare and short-lived. However, the quarterly proportion of unique stocks experiencing market squeezes is 9.9% (12.3%) in the US (EU), compared to 8.7% (5.4%), for lender squeezes. Our analysis shows that market and lender squeezes are driven by different determinants. We find that market squeezes impair price discovery, consistent with significant declines in short interest after these events. This contrasts with lender squeezes, after which short interest remains stable or increases, and price discovery remains unaffected.

1. Introduction

The January 2021 short-squeeze events involving among others GameStop, AMC, and Bed Bath & Beyond have attracted the attention of academics, investors, and regulators alike. Little is known, however, about the prevalence of short squeezes over time and across industries, their determinants, as well as their impact on the speed of price discovery. The contribution of this article is to develop a novel proxy for identifying short-squeeze events. We utilize this proxy to provide large-sample evidence about the time-series evolution, cross-industry dispersion, determinants, and the impact on price discovery of short squeezes across both the United States (US) and the European Union (EU).

There are several factors that represent risks to short sellers and that can contribute to the development of a short squeeze. First, prices can move adversely to the short seller's position, i.e., prices can increase resulting in a loss for the short seller. Theoretically, asset prices can increase to infinity, which implies that short-selling strategies have an unlimited loss potential. As a result, there is a risk of additional collateral requirements and related margin calls following such a price increase.[1] Second, the short seller can experience a recall of the shares by the lender. For example, if the price of the underlying security increases, lenders might decide to close their positions in order to realize the gains. To do so lenders have to recall the shares in order to sell them.[2] The materialization of any of these risks does not necessarily imply that a short squeeze is underway. Instead, a necessary

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[1] Collateral is usually set at 102%, meaning, when the borrower sells the securities short 100% of the proceeds have to be posted to the lender as collateral plus an additional 2%. In addition, there is a requirement of 50% margin with 30% maintenance margin, i.e., if the funds in the margin account decrease below 30%, the borrower receives a margin call and is required to deposit additional funds.

[2] There is a "re-rate" risk which is created by the possibility that each party to the securities lending transaction can request a change to the loan rate. While an increase in the borrowing rate makes short selling less profitable, it does not result in an immediate need to close a position.

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condition for a short squeeze is the existence of relatively high short interest before a potential short-squeeze event. If then one of these risks materializes (e.g., a sharp price increase or a lender recall, or both), short sellers would need to cover their short positions, the price of the asset rises as a result even further, forcing more short sellers to cover, and a short squeeze has occurred.

We incorporate this logic into our empirical analyses. As outlined above, a short squeeze occurs when the security price increases drastically and, as a result, short sellers have to cover their positions.[3] We call this type of short-squeeze event a "market squeeze" and propose a novel measure that allows to capture this type of event. This measure can be applied to all types of financial markets including equity, commodities, and bond markets. This measure is different from and complementary to the proxies of "lender squeezes" that identify instances when borrowed shares are recalled by the lender (Schultz, 2023). The development of the market squeeze measure was motivated by historical short-squeeze events described in the extant empirical literature on the topic, such as the January 2021 squeezes and the 2008 Volkswagen (VW) squeeze (see, e.g., Allen et al., 2023 and Allen et al., 2021).

Specifically, the measure is a dummy variable that equals one when the following conditions are met for stock i on day t for a given region (EU or US): (i) on the day before event day t the stock has relatively high quantity on loan, i.e., quantity on loan for stock i on day $t-1$ falls at or above the 90th percentile of quantity on loan of companies within the same industry and region; (ii) there is a pronounced positive return on day t, i.e., the daily stock return for stock i on day t is positive and falls at or above the 90th percentile of the distribution of daily returns of companies within the same industry and region; and (iii) there is a pronounced decrease on day t in quantity on loan, i.e., the daily decrease in quantity on loan for stock i on day t falls at or above the 90th percentile of the distribution of decreases of quantity on loan of companies within the same industry and region.[4] The October 27, 2008 VW squeeze event provides an example. On the previous trading day there were 37,919,970 shares on loan or 12.90% relative to shares outstanding. This places VW on that day above the 90th percentile of quantity on loan of companies in the same industry and region. The next trading day, October 27, the company experienced a pronounced positive return of 123%, which places VW on that day above the 90th percentile of daily returns of companies in the same industry and region. Concurrent with this price increase we observe a decrease in quantity on loan. Specifically, on October 27 quantity on loan fell to 35,174,930 or 11.96% relative to shares outstanding. This is an absolute decrease of about 0.94% in relative quantity on loan and places VW above the 90th percentile of the distribution of decreases of quantity on loan of companies within the same industry and region on that day. In other words, VW experienced a market squeeze because short sellers were likely forced to repurchase at least 2,745,040 shares due to rising prices and increasing margin calls.[5] Quantity on loan continued to decrease over the subsequent days and by the end of the trading week, October 31, 2008, it had dropped to 9.92% relative to shares outstanding.[6]

In our empirical analyses, we provide evidence for market squeezes and lender squeezes separately. First, we examine the occurrence of each of these two types of short-squeeze events on a stock-day level. For the US market, we find evidence of a market squeeze and a lender squeeze in 0.39% and 0.77% of the stock-day observations, respectively. For the EU market, we find evidence of a market squeeze and a lender squeeze in 0.56% and 0.16% of the stock-day observations, respectively. In other words, in about 99% of the stock-day observations we do not find evidence of a short squeeze. This evidence suggests that stock-day short-squeeze events of both types, market and lender squeeze, are rare across the US and the EU. We also find very little overlap between the market squeeze and the lender squeeze events for both geographic markets. This implies that our market squeeze proxy provides additional information and is complementary to the lender squeeze proxy developed by Schultz (2023).

Second, we examine the duration of short-squeeze events. We measure duration as the number of consecutive days with short-squeeze events for a particular stock. We find that short-squeeze events are short-lived. Specifically, more than 90% of the market and more than 70% of lender short-squeeze events across both the US and the EU do not last longer than one day. One interpretation of this finding is that financial markets are efficient in defusing many of the potentially severe short-squeeze events. The longest duration we observe for market and lender short-squeeze events is 8 and 33 days, respectively.

Third, we examine the time-series evolution and cross-industry dispersion of the number and proportion of unique stocks experiencing a short squeeze in a given quarter. For the US market, we find that the quarterly average of stocks that experience a market squeeze or a lender squeeze is 420 (9.9%) and 370 (8.7%), respectively. While the first six years of our sample period do not show a clear trend in the number of unique stocks experiencing short squeezes, there is a clear uptick over the period from 2015 through 2018 with a peak in 2016. When examining the evidence across different industries in the US, we find that short squeezes are more frequently experienced by companies in the energy (coal, mining, and oil stocks) as well as the financial and tobacco industries. For the EU market, we find that the quarterly average of unique firms that experience a market squeeze or a lender squeeze is 176 (12.3%) and 81 (5.4%), respectively. We do not find a clear trend in the number of unique stocks experiencing short squeezes over time. When examining the evidence across different industries, we find that short squeezes are more frequent in the tobacco, coal and mining, and textiles industries.

[3] According to the U.S. Securities and Exchange Commission (SEC), a short squeeze is created when there is "pressure on short sellers to cover their positions as a result of sharp price increases or difficulty in borrowing the security the sellers are short." See "Key Points About Regulation SHO," SEC, available at Link.

[4] We note that the three conditions are not independent but interrelated. These conditions are in line with historical short-squeeze events analyzed in the extant literature, which usually involve stocks with very high short interest before the squeeze event, a steep increase in the share price concurrent with a steep decrease in the quantity on loan. The interrelation between these conditions has been formally modeled by Brunnermeier and Pedersen (2005), who argue that under certain circumstances, large traders such as short sellers may experience financial difficulties (which can be as "benign" as having to meet a margin call due to an increase in the underlying asset price), which forces them to liquidate their short position. This pushes up the price of the underlying asset. Depending on how much the price of the underlying asset increases, other short sellers might become subject to financial distress as well, which leads to a "vicious" circle of closing of positions and increasing prices. In the framework of Brunnermeier and Pedersen (2005), the vicious circle is aggravated as the large traders' need to liquidate is known or observable by other, strategic traders (e.g., observing high quantity on loan in a stock), who in turn trade in the same direction to profit from the positive price movement. In other words, the strategic traders withdraw liquidity instead of providing it, thereby putting even more pressure on the short sellers.

[5] Our market squeeze proxy also successfully identifies the meme-stock short-squeeze events analyzed in Allen et al. (2023).

[6] We would expect to see a decrease in the quantity on loan even if a short seller defaults, i.e., a short seller is financially constrained and cannot meet margin/collateral requirements or a short seller cannot locate the underlying security to purchase it and return it to the lender. This is because it is customary that the lending intermediary, pursuant to its contractual obligation to the lender, will close the position by making the lender whole. See, e.g., "SECURITIES LENDING AUTHORIZATION AGREEMENT between BNP PARIBAS, NEW YORK BRANCH ('Agent') and Edgewood Growth Fund ('Customer')," Section 13, available at Link. See also, "Re: Basel III Proposals," Committee on Securities Lending, October 19, 2012, available at Link.

Fourth, we examine the determinants of short squeezes in a multivariate regression setting. We first provide a conceptual framework that motivates potential determinants of short squeezes and then empirically examine the relation between various relevant variables and the likelihood of a short squeeze occurring. Although many determinants are statistically significant, their economic significance is generally modest. We find that short interest, firm size, price dispersion, and turnover are the most economically significant determinants of market squeezes in both the US and EU samples. In contrast, indicative fee, lendable quantity, and utilization are the most economically significant determinants of lender squeezes in both the US and EU samples.

Finally, we investigate whether the short-squeeze events hindered the speed of price discovery of the underlying securities. If short-squeeze events represent an impediment to short sellers and, thus, prevent trading by investors with negative fundamental information we would expect that these events reduce the speed of price discovery. We find evidence consistent with a deterioration in the speed of price discovery after market squeeze events but not after lender squeeze events.

Overall, our analyses indicate that market squeezes and lender squeezes are fundamentally distinct, each shaped by different underlying factors. Moreover, market squeezes impede the speed of price discovery in affected stocks, whereas lender squeezes do not exhibit such an effect. This evidence is reinforced by the significant reduction in short interest observed after market squeezes, in contrast to stable or slightly increasing short interest following lender squeezes. Taken together, these findings highlight the distinctive characteristics of market and lender squeezes, demonstrating that only market squeezes have a lasting effect on short sellers and subsequently hinder the process of price discovery.

Providing international evidence about the prevalence of short-squeeze events is important for at least two reasons. First, while short squeezes did occur with some frequency historically (see, e.g., Allen et al., 2006) recent examples such as the January 2021 events have been relatively uncommon. The reason is that behavior intended to squeeze short sellers is illegal in most countries, which in turn helps to ensure capital market efficiency.[7] The latter relies to a large extent on the principle of arbitrage. If the price of an asset is too low relative to its discounted future cash flows then arbitrageurs will buy it and drive the price up; if the price is too high, they will short-sell it and drive the price down. Short sellers therefore play a crucial role in financial markets by facilitating price discovery, and empirical research in accounting and finance indicates that this function provides a range of social benefits to other market participants. For example, short sellers have been found to identify suspect financial reporting prior to public disclosures (Desai et al., 2006) and have been shown to detect accounting irregularities (Dechow and Sloan, 1997; Karpoff and Lou, 2010). Short sellers have also been shown to provide predictive information to investors in trading against analysts' recommendations (Drake et al., 2011) and more generally in stock market trading (Beneish et al., 2015), in bond market trading (Kecskés et al., 2013), as well as predictive information about large insider sales (Khan and Lu, 2013), auditor changes (Blau et al., 2013), risks considered by auditors (Cassell et al., 2011; Hope et al., 2017), and managers' voluntary disclosure choices (Li and Zhang, 2015). In doing so, short sellers have an important information intermediation role (Pownall and Simko, 2005) and contribute to price discovery and improved market efficiency (Drake et al., 2015; Jiang et al., 2022).

Among the most important limits to short-selling arbitrage is the possibility of a short squeeze. By limiting short sellers' ability to express their market view, squeezes can hinder price discovery and reduce the social benefits of short selling, including the detection of financial misrepresentation (Karpoff and Lou, 2010). Therefore, to understand the extent to which US and EU stock markets are impacted, it is important to document the time-series evolution, cross-industry dispersion, determinants, and the impact on price discovery of short squeezes.

Second, this evidence is important for regulatory reasons. Contrary to the EU and other countries, US short-selling regulation has historically not included any disclosure requirements for large short sellers' positions (Edwards et al., 2024). Following the 2008 Financial Crisis and under the Dodd-Frank Act, the SEC has been required to adopt rules providing for the public disclosure of short-sale information.[8] Following this requirement, in October 2023, the SEC has adopted new short-selling regulation that is intended to provide greater transparency through the requirement of short sellers to report lending and short-sale transactions to the SEC as well as through the publication of short-sale data. The new Rule 10c-1a and the new Rule 13f-2 are – to a certain extent – similar to the short-sale disclosure requirements that the EU implemented in 2012. One of the goals of the new US regulation is to allow the SEC to more quickly identify potential short-squeeze events. At the same time, one concern related to the regulation is that disclosing more short-sale information may also increase the risk of short squeezes.[9] The measure we propose can aid the SEC in tracking to what extent the new rules will have an impact on the frequency of short squeezes.[10]

Our novel proxy for identifying short-squeeze events expands the body of work in the field of short squeezes and market corners. In this field, one strand of literature focuses on commodities, derivatives, or bond markets (Kyle, 1984; Kumar and Seppi, 1992; Jarrow, 1992; Pirrong, 1993; Jegadeesh, 1993; Nyborg and Sundaresan, 1996; Cooper and Donaldson, 1998; Pirrong, 2001; Nyborg and Strebulaev, 2004; Merrick Jr. et al., 2005; Ben-Abdallah and Breton, 2016). Another strand examines squeezes and corners in equity markets (Kyle and Xiong, 2001; Brunnermeier and Pedersen, 2005; Allen et al., 2006; Kyle and Viswanathan, 2008; Lamont, 2012; D'Avolio, 2002; Riccò, 2019; Allen et al., 2021; Angel, 2021; Schultz, 2023; Stice Lawrence et al., 2025; Jarrow and Li, 2023; Allen et al., 2023). We contribute to these literature strands by developing a novel proxy of market short-squeeze events that allows us to present large-sample evidence on the topic. Specifically, we document the time-series evolution, cross-industry dispersion, and duration of short squeeze events both in the US and EU markets. Further, we present evidence on the determinants of short squeezes and document their impact on speed of price discovery.

The remainder of this article is organized as follows. In Section 2 we discuss our data sources and sample selection. In Section 3 we analyze the frequency of short squeezes, their impact on short interest, and the time-series evolution and cross-industry dispersion of these events. In Section 4 we explore the determinants of squeeze events, and in Section 5 we assess their impact on price discovery. In Section 6, we conclude.

2. Data

The data come from several sources. Daily data for the securities lending market are from IHS Markit. Data for daily market variables are from CRSP and Datastream, daily options information from OptionMetrics, daily retail trading volume from TAQ, and annual accounting variables from Compustat. Data on the number of analysts following a company are retrieved from I/B/E/S. We analyze the period starting

[7] For an extensive discussion on the broader topic of manipulation and fraud in financial markets see Alexander and Cumming (2022).

[8] SEC, Release No. 34-94313; File No. S7-08-22.

[9] In fact, on December 12, 2023, three hedge fund associations filed a petition against the SEC in an attempt to make the SEC abandon these rules. See National Association of Private Fund Managers et al. v. United States Securities and Exchange Commission, filed December 12, 2023, available at Link.

[10] For additional information on historical and current regulatory short-selling regimes in the EU and US, please see the Internet Appendix.

July 2006, which is when IHS Markit starts reporting their data, through March 2021. We restrict the sample to stocks listed on NYSE, NASDAQ, and AMEX for the US. We define the EU market as all market areas covered by IHS Markit EU and also part of the European Union (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Spain, and Sweden).

We drop missing observations and observations where the stock price is less than USD 1 or EUR 1. We remove observations with missing fees, utilization, stock prices, and returns.[11]

3. The number, proportion, and duration of short squeezes

In this section, we first summarize our market squeeze measure. We then, discuss the number and proportion of short-squeeze events over time and across industries, as well as their duration. For completeness and comparability, we also discuss the respective statistics for the lender squeeze measure proposed in Schultz (2023). Our market squeeze measure is an indicator for stock i on day t that equals one when three specific conditions are met. First, the quantity on loan for stock i on the day before the event day t must be at or above the 90th percentile compared to other companies within the same industry and region. Second, there must be a significant positive return on day t, with the daily return for stock i also falling at or above the 90th percentile among its industry peers and within its region. Lastly, there must be a notable decrease in the quantity on loan for stock i on day t, where the decrease is at or above the 90th percentile of decreases seen in its industry and within its region. Industries are categorized based on the two-digit standard industrial classification code (SIC2).

The market squeeze measure is intended to capture potentially severe short-squeeze events, i.e., short squeezes that have the potential to harm market quality and contribute to pronounced price bubbles. Examples of these types of short squeezes are the VW, GameStop, and AMC squeeze events, among others. Based on historical squeeze examples, which the academic literature has documented to have an adverse impact on markets (see, e.g., Allen et al., 2023, 2021), we have determined that the squeeze measure that captures the majority of the documented cases is relying on the 90th percentile cutoff for all three dimensions that we utilize to define a market squeeze. However, in our review, we have also identified more extreme squeeze events. For example, the AMC and GameStop squeezes fall above the 95th percentile when it comes to the cutoffs of the three dimensions. While those squeezes were unusual in that the stocks were also meme stocks, it is important to consider them in this framework because they have received significant attention from regulators and scholars. We therefore have considered the alternative 95th percentile cutoffs as robustness. We note that, while relaxing the cutoffs below the 90th percentile might increase the number of identified market squeezes it might also result in an increased number of false positives. For example, a short seller might recognize that the outlook of their trading strategy has changed and might decide to close their short position voluntarily. That is, if there is new, value-relevant information based on which short sellers decide to close their positions voluntarily and not external forces, such as a short squeeze, that force the short sellers to close the positions involuntarily, utilizing lower cutoffs will likely flag these as squeeze events although they are not.

Our market squeeze measure is distinct from and complimentary to the lender short squeeze measures proposed in Schultz (2023). Specifically, Schultz (2023) develops two proxies for the occurrence of lender short squeezes. The first proxy, which he calls "all lender squeeze," is a dummy variable that takes the value of one "when the shares available to lend are less than the shares on loan the previous day." The second proxy, which he calls "current lender squeeze," is a dummy variable that takes the value of one if "the total number of shares available to lend and the number of shares on loan fall by the same amount on the same day." For brevity, we combine these two proxies to construct one measure that captures lender squeezes — a dummy variable that takes the value of one if a company experiences either an all lender squeeze or a current lender squeeze on a given day, and zero otherwise. Of note is that the lender squeeze proxy does not capture short squeezes that occur when prices increase drastically and, as a result, short sellers have to involuntarily cover their positions due to risk controls. This is what the market squeeze measure is intended to capture.

We start our analysis by describing the evolution of short interest around market and lender squeeze events. Fig. 1 shows that prior to market squeezes, average short interest is markedly higher (14% in the US and 6% in the EU) compared to average short interest preceding lender squeezes (1.6% in the US and 1.5% in the EU). In the 20-day post-event period, short interest decreases substantially after market squeezes in both the US and EU, whereas it remains steady or even increases slightly after lender squeezes.[12]

Second, we examine the frequency of short-squeeze events on a stock-day level. Panels A and B in Table 1 show the proportion of sample stock days that have either market squeezes or lender squeezes and the proportion of stock days that have both types of squeezes for the US and the EU markets, respectively. The table further shows the proportion of stock days with no squeeze events of either type for both markets. In total, there are 13,990,317 stock-day observations for the US market and 4,804,123 stock-day observations for the EU market. On 55,600 stock-day observations, or 0.40% of the total event days, there is a market squeeze in the US market. On 26,956 stock-day observations, or 0.56% of the total event days, there is a market squeeze in the EU market. Further, on 108,554 stock-day observations, or 0.78% of the total event days, there is a lender squeeze in the US market. On 7,947 stock-day observations, or 0.17% of the total stock days, there is a lender squeeze in the EU market. There are 422 event days, or less than 0.01% of the total, that are classified as having both a market squeeze and a lender squeeze for the US market and there are 69 event days, or less than 0.01% of the total for the EU market. The lender short squeeze statistics are in line with Schultz (2023). The results imply that short-squeeze events are rare in both the US and the EU.

Third, we examine the duration of these events. The four panels in Fig. 2 show the duration of short squeezes for the US and the EU by type of short squeeze. More than 90% of the market and more than 70% of the lender short squeezes in the US do not last longer than one day. The longest duration we observe for market (lender) short squeezes is 8 (33) days in the US, however, this is true only for very few stocks. In the EU, we observe that more than 90% of the market and lender squeezes do not last longer than one day; the longest duration is 7 days

[11] IHS Markit records stock lending activity when it becomes known to the market; that is, as of the settlement date. In the US, the settlement date was the trade date plus three trading days up until September 5, 2017. Afterwards, the SEC shortened the settlement period to two trading days (Release No. 34-80295). In the EU the settlement date was the trade date plus three trading days up until October 5, 2014 (see, "Shortened Settlement Cycle Resource Center," Investment Company Institute, January 12, 2023, available at Link). The standard settlement cycle as of the end of our sample period is two trading days in both the US (SEC Release No. 34-80295) and the EU (Article 5 of the European Union regulation on Central Security Depositaries (CSD)). See, "HARMONISING SETTLEMENT CYCLES AT T+2," Societe Generale, August 8, 2022, available at Link. To match stock lending activity to the occurrence of an underlying short sale, we account for the trade settlement period by shifting stock loan transactions back by the corresponding number of days.

[12] Figure A1 in the Internet Appendix plots the level of short interest in the 20 days before and after market squeeze events based on the 95th percentile cutoffs for the US and EU. Similar to the corresponding Figure for the 90th percentile cutoffs (Fig. 1), this Figure shows that short interest is higher before a market squeeze and then drops in the 20 days following a market squeeze.

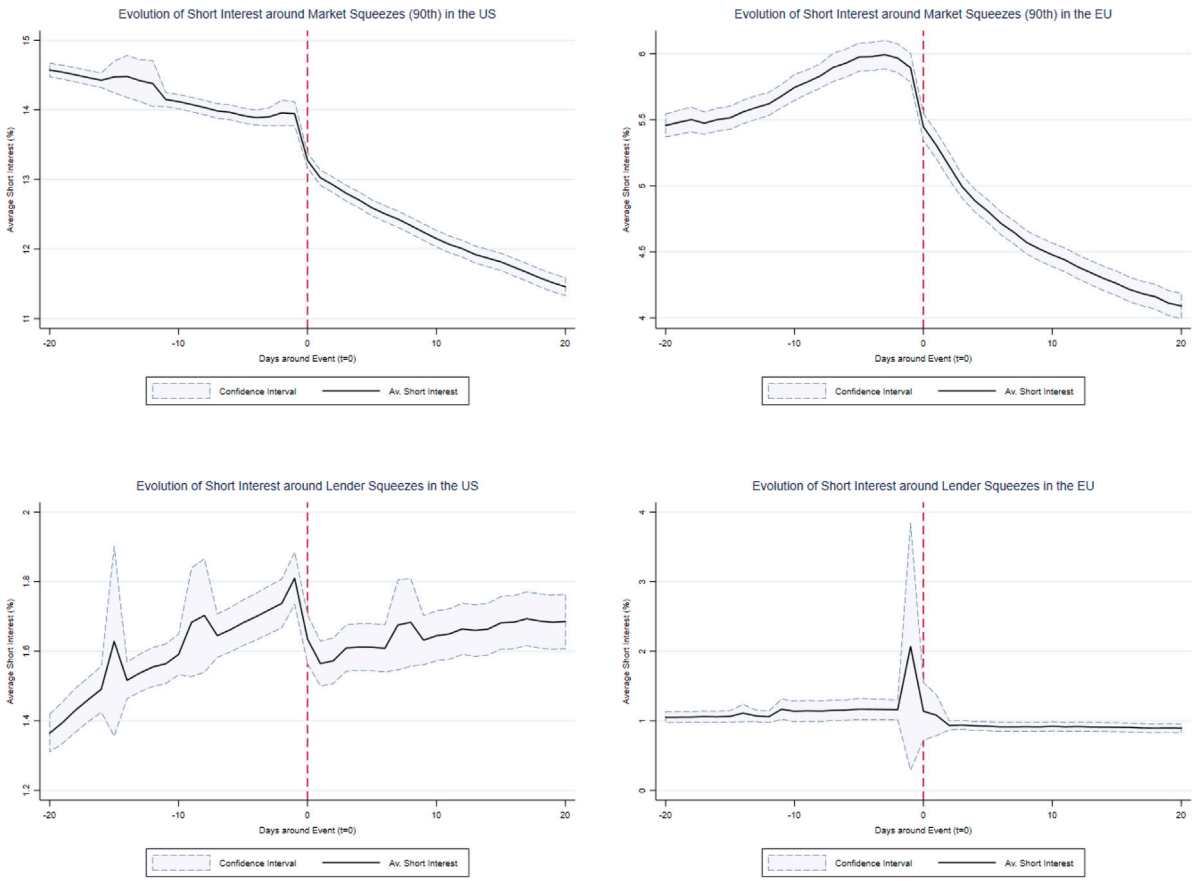


Fig. 1. Short interest around squeeze events. These figures depict the level of short interest (in percent) during the 20 days before and after market squeeze events in the US and the EU (upper row) and lender squeeze events in the US and the EU (bottom row). Definitions of market squeezes and lender squeezes are provided in Section 3. The shaded areas around the average short interest denote 95% confidence intervals. The sample period is July 01, 2006 through March 31, 2021. Data come from IHS Markit, CRSP, and Compustat.

for market squeezes and for lender squeezes. Similar to the US, these long squeeze durations are only true for a small number of stocks.

Finally, we examine the number and proportion of unique firms that experience a market squeeze and a lender squeeze event over time and across industries. Specifically, we examine the time-series evolution and cross-industry dispersion of the number and proportion of unique stocks experiencing short squeezes in any given quarter. In the first panel of Fig. 3, we show the average quarterly number of stocks and the relative proportion of stocks experiencing short squeezes in the US over the period of July 2006 through March 2021. A unique short-squeezed stock is defined as a stock-quarter observation that experiences either a market and/or a lender short squeeze. The quarterly average of stocks that experience at least one of these two types of short squeezes is 18.6%. The proportion of unique stocks experiencing short squeezes has increased steadily over the entire sample period from approximately 13% in 2006 to approximately 29% in 2018 with a slight reversal to approximately 20% in 2020. The largest increase happened over the years 2015 through 2018. Market commentators generally observed an elevated shorting activity during this time period "in the wake of market volatility."[13] An increase in market volatility and higher shorting demand can be one reason for the increase in the number of stocks experiencing short squeezes. We also provide a breakdown of the total quarterly number of stocks experiencing a short squeeze into the respective short-squeeze type. The quarterly average of firms that experience a market squeeze or a lender squeeze in the US is 420 (9.9%) and 370 (8.7%), respectively. While market squeezes maintained a constant level throughout our sample period, lender squeezes have become more common in recent years.

In the second panel of Fig. 3, we show the average quarterly number of stocks and the relative proportion of stocks experiencing short squeezes in the EU. In general, compared to the US we observe a lower number of unique firms experiencing short-squeeze events, however, the proportion is about the same (with an quarterly average of 17.7% of unique firms experiencing a short squeeze). We also do not find an upward trend in the number or proportion of short squeezes over time. Instead, the number of stocks experiencing market and lender squeezes, respectively, fluctuates relatively constantly between 165 (13.4%) and 361 (23%) throughout the sample period. Further, for the EU market, we find that the quarterly average of unique firms that experience a market squeeze or a lender squeeze is 176 (12.3%) and 81 (5.4%), respectively.[14]

In Fig. 4, we provide an industry breakdown of the average number and proportion of unique stocks experiencing a short squeeze per quarter for both the US and the EU. In the first panel, we present the results for the US. The highest proportion of short-squeezed stocks

[13] "Securities lending: Year in review," S&P Global Market Intelligence, December 21, 2016, available at Link.

[14] Figures A2 through A5 in the Internet Appendix provide a robustness set of empirical results for different versions of the market squeeze measure by varying the distributional cutoff requirements for quantity on loan on day $t-1$, the decrease in quantity on loan on day t, and the increase in the stock price on day t. In particular, as alternative cutoffs, we apply the 95th percentile and we also decrease each of the three dimensions to the 50th percentile one at a time. In general, the time-series patterns align with the patterns reported for the market squeeze measure based on the 90th percentile cutoffs.

Table 1
The number and proportion of stock-day observations with market squeezes and lender squeezes.

Panel A - US	No Market Squeeze	Market Squeeze	Total
No Lender Squeeze	13,826,585	55,178	13,881,763
	(98.83%)	(0.39%)	(99.22%)
Lender Squeeze	108,132	422	108,554
	(0.77%)	(0.00%)	(0.78%)
Total	13,934,717	55,600	13,990,317
	(99.60%)	(0.40%)	(100.00%)
Panel B - EU	**No Market Squeeze**	**Market Squeeze**	**Total**
No Lender Squeeze	4,769,289	26,887	4,796,176
	(99.27%)	(0.56%)	(99.83%)
Lender Squeeze	7878	69	7947
	(0.16%)	(0.00%)	(0.17%)
Total	4,777,167	26,956	4,804,123
	(99.44%)	(0.56%)	(100.00%)

This table presents the number and proportion of stock-day observations with market squeezes and lender squeezes in the US and the EU. Panel A presents information for the US market. Panel B presents information for the EU market. Definitions of market squeezes and lender squeezes are provided in Section 3. The data cover the period July 01, 2006 through March 31, 2021. The data frequency is daily. Data come from IHS Markit, CRSP, and Compustat.

per quarter in the US can be observed in the energy sector (coal, mining and oil stocks) as well as the financial and tobacco industries. It is worth noting that, in general, we observe relatively more market squeezes than lender squeezes across industries, with the exception of the healthcare, mines, and oil industries.

In the second panel of Fig. 4, we show the average quarterly number of stocks and the relative proportion of stocks experiencing short squeezes in the EU by industry. Similar to the US, the highest proportion of companies experiencing a short-squeeze event can be observed in the tobacco, coal and mines industries, followed by the textiles industry. Overall, the evidence for both geographic regions suggests that on average multiple stocks experience short-squeeze events every quarter, which mitigates concerns that these events are concentrated in a few stocks.

One reason for the difference in the number and proportion of short squeezes in the EU versus the US could be the relative lack of securities lending activity in Europe. Market commentators have found that European equities securities lending has lagged behind US securities lending generally.[15]

4. The determinants of short-squeeze events

Kyle (1984) and Brunnermeier and Pedersen (2005) present theoretical models that provide guidance for our empirical short-squeeze analysis. Below, we discuss a framework that builds on these two papers and guides our empirical tests and interpretations.

The framework of a short squeeze involves the following key players. First, suppose that there is a strategic investor (I) that is large enough to affect prices (Kyle, 1984 and Brunnermeier and Pedersen, 2005). Alternatively, a group of small traders with the same trading interest can form a coalition and influence prices similarly to I (Kyle and Xiong, 2001, Allen et al., 2023, and Jarrow and Li, 2023). Second, short sellers (S) are traders who have sold shares short, anticipating a decline in the stock's price. S operate under constraints such as limited collateral capacity and face the risk of share recalls from lenders and margin calls due to rising prices. Third, securities lenders (L) are entities (e.g., institutional investors) that lend shares to S; their lending and recall behavior affects the availability and cost of shares available for borrowing. Changes in their lending practices can exert pressure on S by altering the supply and cost of lendable shares.

Initially, S identify a stock they believe is overvalued – as a result a good short selling opportunity – and begin to short sell it. Therefore, over time, there is an accumulation of short interest in this stock. At the same time, I (or the coalition of small traders) believe that this stock is a good investment opportunity and begin purchasing it. Alternatively, strategic long investors might also buy the stock for predatory trading reasons, such as believing that they can initiate and profit from a short squeeze (Brunnermeier and Pedersen, 2005). Overvaluation indicators, such as substantial short interest with long security loan tenure[16] and low book-to-market ratios signal disagreement between long and short investors about the stock's value (Carlin et al., 2014, Rubin and Smith, 2009, and Atmaz et al., 2024). As disagreement between different investors increases, the stock price becomes more volatile, as measured by stock return volatility and price dispersion (Bargeron and Bonaime, 2020). If the price increases because of *I's* purchases or there is an exogenous rise in the stock's price, S come under pressure. With rising stock prices *L's* valuation of the security might fall relative to the marginal *I's* valuation. As a result, L will either increase the borrowing fee or recall the loan to S in order to sell the shares to a more optimistic I (D'Avolio, 2002 and Atmaz et al., 2024). If L sell the shares to I, i.e., close out their positions in the stock, this will decrease the number of lenders, which increases lender concentration in the market. A lower number of lenders in the securities lending market results in greater market power for the remaining lenders, which can drive up borrowing fees.[17] Further, when a few lenders hold large positions, they may be motivated to prevent the market value of their holdings from being driven down by short sellers and suddenly recall shares to drive the price up when they have to report their valuations.

A decrease in the shares available to borrow and an increase in borrowing fees will make it more challenging for S to hold their positions. Similarly, S might face margin calls following the rise in the stock price. Those S with limited capital may struggle to meet these margin calls. This combination of increased borrowing costs, increased margin calls, and increased recalls may compel S to buy back shares to cover their positions, further increasing demand for the stock. This

[15] "Securities lending: Year in review," S&P Global Market Intelligence, December 21, 2016, available at Link; "Securities Finance Quarterly Review," IHS Markit, Q1 2017, available at Link.

[16] Tenure measures the average number of days from the opening date to present for all outstanding securities loans. If the average tenure is high, it suggests that mispricing in the underlying security and a disagreement between investors has been persistent for a while.

[17] On the other hand, ceteris paribus, a decrease in the number of borrowers, i.e., higher borrower concentration, may result in greater market power for the remaining short sellers and could be associated with a decrease in borrowing fees, thus lowering shorting constraints. This is because – all else equal – fewer borrowers compete for the same number of lendable shares.

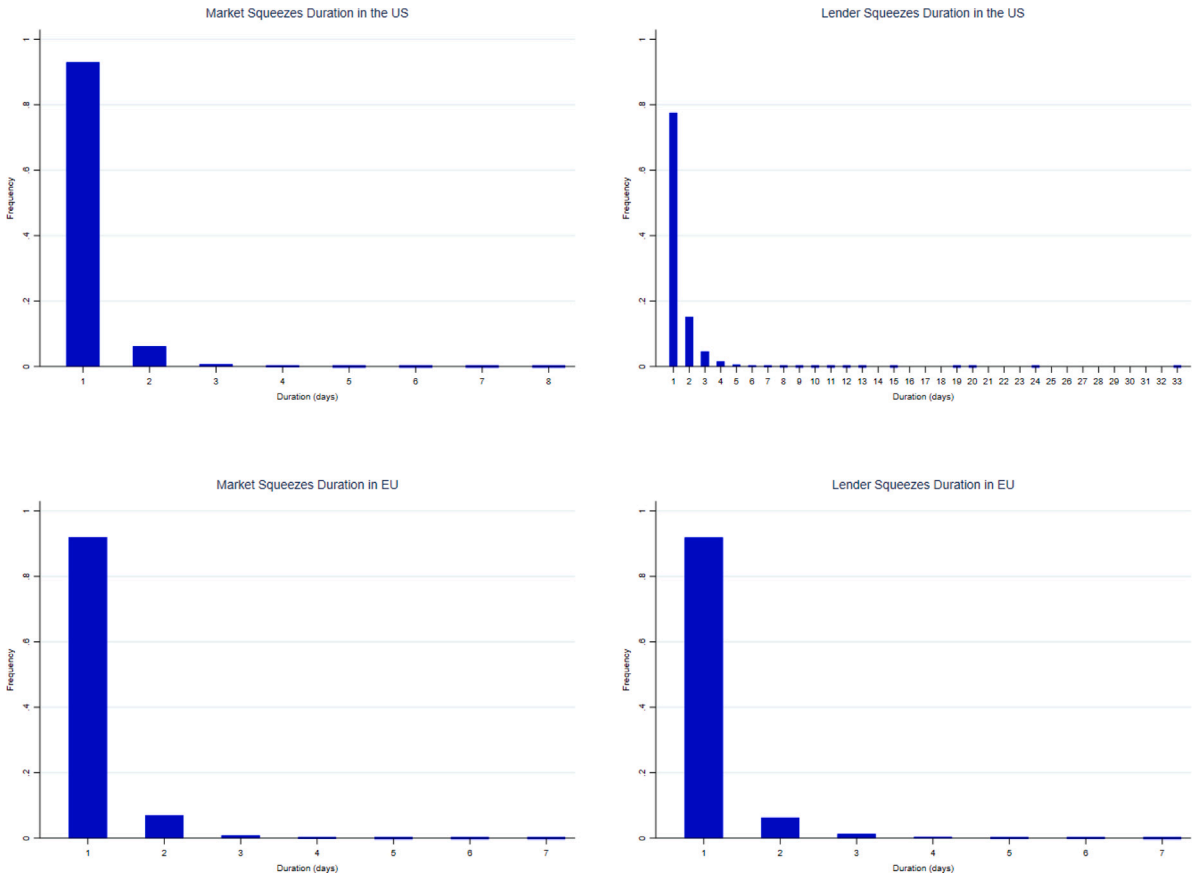


Fig. 2. The duration of short-squeeze events. These figures depict the duration (in number of days) of short-squeeze events in the US (upper row) and the EU (bottom row). The graphs on the left present the distribution of market squeeze duration, while the graphs on the right present the distribution of lender squeeze duration. Duration is defined as the number of consecutive stock-day short-squeeze events. Definitions of market squeezes and lender squeezes are provided in Section 3. The sample period is July 01, 2006 through March 31, 2021. Data come from IHS Markit, CRSP, and Compustat.

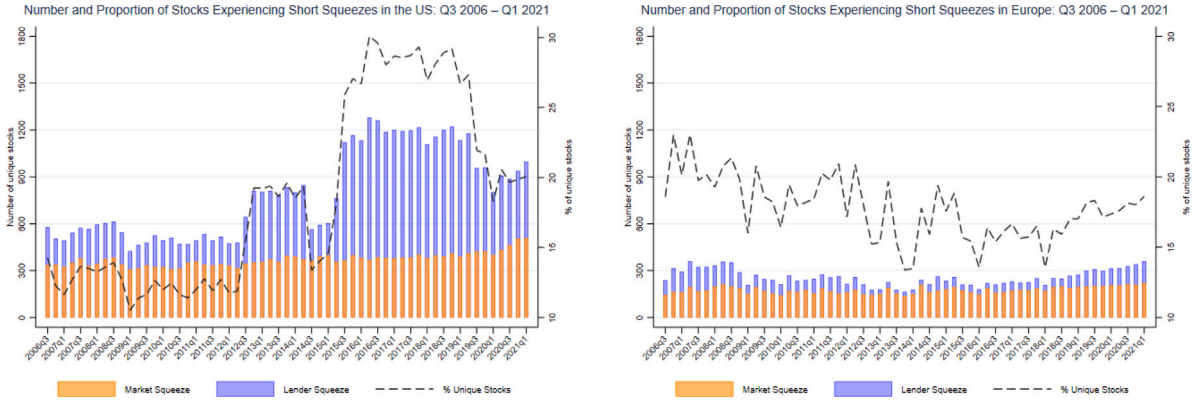


Fig. 3. The quarterly number and proportion of stocks experiencing a short squeeze in the US and the EU for the period Q3 2006 – Q1 2021. These figures show the breakdown of the number of unique short-squeezed stocks into market squeezes and lender squeezes in the US (left) and the EU (right). A unique short-squeezed stock is defined as one that experiences a market squeeze, a lender squeeze, or both, at least once in a given quarter (indicated by the dashed line). Definitions of market squeezes and lender squeezes are provided in Section 3. The sample period is July 01, 2006 through March 31, 2021. Data come from IHS Markit, Compustat, and CRSP.

demand pushes the stock price even higher, creating a positive feedback loop that amplifies the price increase. The more the price rises, the more S are forced to cover, which in turn fuels a further increase in the price. This is the short squeeze.

Building upon this conceptual framework of short squeezes, we summarize related hypotheses and integrate a set of variables that potentially influence the likelihood and dynamics of short squeezes. These variables encompass aspects of disagreement among investors about stocks' values, securities lending characteristics, and stock market activity.

First, as previewed in the framework above, variables that proxy for disagreement between investors about the fundamental value of a stock play a role in the likelihood of a short squeeze. Overvaluation of a stock as well as volatile movements in a stock's price are indicative of belief disagreement between long and short investors about a stock's value. As disagreement increases, short interest, borrowing fees, and lender

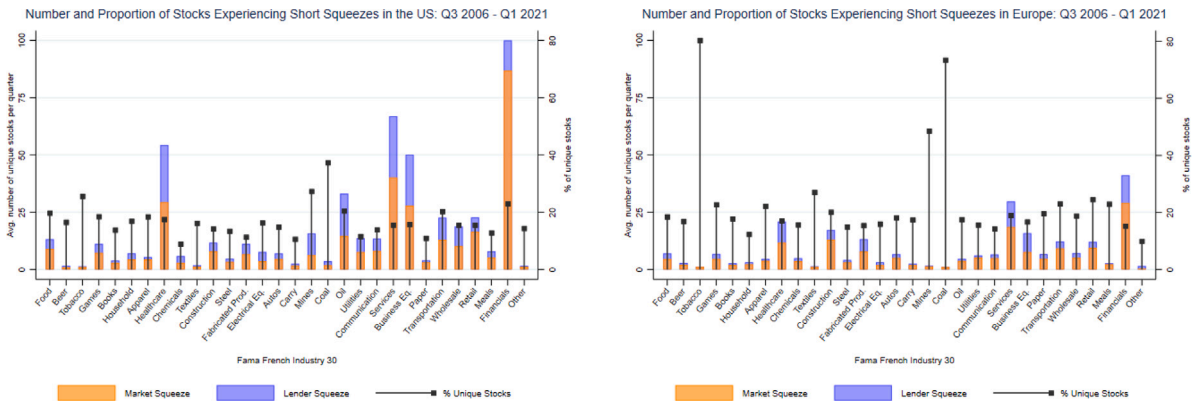


Fig. 4. The average quarterly number and proportion of stocks experiencing a short squeeze by industry in the US and the EU for the period Q3 2006 – Q1 2021. These figures show the breakdown of the quarterly average number of unique short-squeezed stocks into market squeezes and lender squeezes across industries in the US (left) and the EU (right), applying FF 30 industries. A unique short-squeezed stock is defined as one that experiences a market squeeze, a lender squeeze, or both, at least once in a given quarter. Definitions of market squeezes and lender squeezes are provided in Section 3. The sample period is July 01, 2006 through March 31, 2021. Data come from IHS Markit, CRSP, and Compustat.

recalls might increase, which, all else equal, increases the likelihood of a short squeeze. We, therefore, hypothesize that the probability of a market squeeze is positively associated with return volatility and price dispersion, and negatively associated with book-to-market.

Second, constraints on short sellers from the lending market are also a critical factor. As discussed above (see also D'Avolio, 2002 and Atmaz et al., 2024), an increase in borrowing fees, a decrease in lendable quantity, a decrease in borrower and/or an increase in lender concentration may increase the cost and difficulty of maintaining short positions. These costs and risks make short sellers more susceptible to price increases and more inclined to cover their positions when faced with rising prices, triggering a short squeeze. Further, the short squeeze dynamics might be exacerbated with increasing levels of loan utilization, which is the ratio of the number of shares borrowed to the total lendable quantity. High utilization indicates that most of the lendable shares are already borrowed, signaling crowded short positions. With limited additional shares to borrow, short sellers cannot easily expand or maintain positions, making them more susceptible to a short squeeze. We hypothesize that the probability of a short squeeze is increasing in increasing short interest, borrowing fees, utilization, average tenure, and lender concentration, and decreasing in lendable quantity and borrower concentration.

Third, equity market characteristics such as liquidity, analyst coverage, and past returns may also be relevant factors. Smaller and younger firms with lower (or no) dividend yield and lower stock market liquidity, evidenced by wider bid–ask spreads, and fewer analysts covering the stock are more prone to short squeezes. In such cases, strategic investors (or a group of small investors) that trade large quantities can have a pronounced impact on the stock price due to the lack of market depth combined with high informational asymmetries. Further, stocks with high informational asymmetries and low market depth are more likely to have high short interest. For example, Diether et al. (2009) find that on days with high levels of asymmetric information short interest increases. Higher short interest is associated with a higher likelihood of short squeezes. Further, shocks to investors' information sets, that induce high trading volume or high share turnover can increase the variability of borrowing costs, which can increase short-sale constraints (D'Avolio, 2002). Short sellers facing an increase in borrowing costs may cover their positions more quickly when the stock price rises to avoid further losses, amplifying the short squeeze. We, therefore, hypothesize that the probability of a short squeeze increases in increasing bid–ask spreads, turnover, and volume, and decreases in increasing analyst coverage, dividend yield, firm size, and firm age. Further, a high past-day return is usually indicative of a lower next-day return due to the short-term reversal effect in return predictability (Lou et al., 2019). All else equal, a lower return on a given day is associated with a lower likelihood of a short squeeze. Therefore, we expect that the likelihood of short squeezes decreases with an increase in past returns.

Finally, the short-squeeze events involving meme stocks in January 2021 showcase the impact of retail trading, options markets, and social media activity with respect to the probability of short squeezes (Pedersen, 2022, Jarrow and Li, 2023, Allen et al., 2023). The increase in retail investors buying shares can put upward pressure on stock prices, making it difficult for short sellers to maintain their positions and potentially leading to short squeezes. The availability of options may also amplify the likelihood of short squeezes; purchasing call options prompts options market makers to hedge by buying the underlying stock, adding to the buying pressure. Finally, high levels of social media activity and coordination among investors may increase the probability of a short squeeze (Allen et al., 2023). Therefore, we expect that the likelihood of a short squeeze increases with higher retail trading volume, the availability of options, and higher social media activity.

4.1. Model specification

In this section, we outline our methodology. The main variable of interest is a dummy variable for a short-squeeze event on a stock-day level. In particular, our main short-squeeze measure is a dummy variable that is one if a stock i on day t has experienced a market squeeze event. For completeness, we also examine lender squeeze events. We follow Diether et al. (2009), McKenzie and Henry (2012), and Schultz (2023) and apply a pooled OLS regression approach as follows:

$$Short\ squeeze_{i,j,t} = \sum_{f=1}^{m} \beta_{f,t} X_{i,j,t-1} + \alpha_j + \alpha_t + \epsilon_{i,j,t}, \quad (1)$$

where $Short\ squeeze_{i,j,t}$ is a dummy variable that is one if a stock i in industry j has experienced a short-squeeze event on day t (either a market squeeze or a lender squeeze), and zero otherwise. $X_{i,j,t-1}$ is a vector of m independent variables that, as previously discussed, are potentially associated with the likelihood of a short-squeeze event. The independent variables are lagged by one period. The model is estimated with industry (α_j) and time (α_t) dummies. To account for both cross-sectional and time-series serial correlation we report t-statistics that are based on standard errors clustered by firm and time (Petersen, 2009). Eq. (1) is estimated separately for the US and EU.

In this analysis, we aim to identify correlations by examining which firm and market characteristics are associated with the likelihood of a short squeeze, without making any causal claims. While we provide potential interpretations for the correlations we find, it should be understood that these interpretations are speculative and that our results

are predictive and not causal. We note that all specifications control for the level of short interest, ensuring that the interpretation of other potential determinants should be viewed as holding the level of short interest constant.

4.2. Analysis and results

In this section, we present and evaluate the results of the determinants analysis.

We start by discussing the summary statistics for the variables used in the analysis, which are presented in Tables 2 and 3. We note that the mean (median) short interest in the US during our sample period is 3.9% (1.7%). The corresponding mean (median) short interests for the EU is lower at 1.6% (0.5%). This evidence is consistent with the European equities securities lending market lagging behind US securities lending in terms of volume.[18] We also note that fees for securities lending transactions in the US are lower compared to the EU. In particular, the mean (median) indicative fee is 2.0% (0.4%) in the US compared to 3.3% (0.6%) in the EU. Further, the utilization is higher in the US compared to the EU with mean (median) utilization of 17.4% (8.6%) in the US compared to 14.6% (6.3%) in the EU. This evidence is also consistent with the European equities securities lending market lagging behind US equities securities lending and suggests that the US securities lending market is more competitive.

The results of the determinants analyses for the US and the EU markets are summarized in Tables 4 and 5. As previously mentioned, our market squeeze measure aims to identify potentially severe short-squeeze events. To ensure a robust analysis of the factors driving such events, we assess the results from regression models using as the dependent variable the market squeeze measure that is based on either the 90th percentile cutoff across all three dimensions or the more stringent 95th percentile cutoffs. To infer the relative economic significance of each determinant, we multiply its coefficient estimate by its standard deviation. This procedure allows for a relative comparison by indicating the percentage change in the likelihood of a short-squeeze event when an independent variable changes by one standard deviation. While most of the determinants we identified in our conceptual framework are significantly correlated with the likelihood of squeeze occurrence, their economic impact remains relatively modest. Notably, *Short interest*, *Size*, *Price Dispersion*, and *Turnover* are the most economically significant determinants of market squeezes in both the US and EU samples. We provide detailed interpretations of our findings below.

First, the empirical analyses confirm that disagreement among investors about the value of a stock plays a role in the likelihood of market squeezes. *Price Dispersion* and *Return Volatility* both show a positive and significant association with the likelihood of market squeezes in both the US and EU samples.[19] The interpretation is that stocks with more volatile movements in their stock prices, which is indicative of disagreement between long and short investors about the stock's value, are subject to a higher likelihood of market squeezes. We do not find a statistically significant association between the likelihood of market squeezes and the *Book-to-market* ratio in either the US or the EU samples. One possible explanation for this finding is that overvaluation alone does not drive the likelihood of market squeezes. Rather, it is the heightened disagreement among investors regarding a stock's value that increases the chances of such squeezes occurring. Looking separately at lender-squeeze events we find the opposite association, i.e., a negative and significant association for the likelihood of lender squeezes in the US sample for *Return Volatility* and no significance in the EU sample as well as across both samples for *Price Dispersion*. *Book-to-market* has a positive and statistically significant association with the likelihood of lender squeezes in the US sample, and no significance in the EU sample.

Second, the empirical analyses confirm that constraints on short sellers from the securities lending market play a role in determining the likelihood of market squeezes. For example, we find that the conjecture outlined in the conceptual framework is confirmed for *Short Interest*. *Short Interest* exhibits a positive and significant relation with the likelihood of market squeezes both in the US and in the EU sample. This finding is in line with market squeezes documented in the extant literature, that have taken place in companies with high short interest (e.g., Allen et al., 2021, 2023). One potential interpretation is that, all else equal, an increase in the demand for securities loans increases borrowing fees and could force short sellers to close out of their short positions potentially exacerbating a market squeeze event. Further, this result might indicate that an increase in short interest results in a reduction in the available quantity from which short sellers could borrow shares to re-establish their positions if needed. Also, it has been shown that firms can coordinate with shareholders to withdraw shares from the stock lending market, thus preventing short selling by causing loan recalls (Lamont, 2012). This – together with an increase in short interest – can have an effect on the likelihood of short squeezes. Looking separately at lender-squeeze events we find the opposite association, i.e., a negative and significant association for lender squeezes in both the US and the EU samples.

The results for the relation between *Borrowing Fees*, *Utilization*, *Lendable Quantity*, *Lender Concentration*, *Borrower Concentration*, and the probability of a market squeeze are less conclusive. For instance, for some of these variables, the results are confirmed in the US sample and not significant in the EU sample, or vice versa. For other variables, we find results opposite to the predictions from our conceptual framework across different subsamples. For example, *Lendable Quantity* exhibits a negative and significant relation with the likelihood of a market squeeze in the US sample; the coefficient estimate is not significant in the EU sample. One potential interpretation of the finding based on the US sample is that increasing lendable quantity indicates that it becomes less difficult and less costly to maintain a short position. Facing less tight and less costly borrowing conditions makes short sellers less susceptible to price increases and less inclined to cover their short positions when faced with rising prices, decreasing the probability of a market squeeze event. Looking separately at lender-squeeze events we find the opposite association, i.e., we find a positive and significant association for lender squeezes in both the US and the EU samples.

The results for *Borrower Concentration*, *Lender Concentration*, *Utilization*, and *Indicative Fees* are mixed across the US and EU samples. For example, *Borrower Concentration* exhibits a positive and significant relation with the likelihood of market squeezes in the US sample, and a negative and significant relation with the likelihood of market squeezes in the EU sample. The findings for the EU sample are in line with our conceptual framework. High *Borrower Concentration* may result in greater market power for the short sellers and could be associated with lower borrowing fees, ultimately lowering short sale constraints and the probability of a squeeze. This is because – all else equal – fewer borrowers compete for the same number of lendable shares. It will be more pronounced in cases when the number of borrowers is more concentrated compared to the number of lenders, likely resulting in lower borrowing fees and a lower probability of share recalls, ultimately lowering the likelihood of a squeeze event. The results for the US sample are, however, not in line with our conceptual framework. One potential explanation for this finding is that when there are fewer borrowers resulting in higher borrower concentration, it becomes easier to target and squeeze them, as the short interest is concentrated in fewer market players. This, in turn, might increase the likelihood of

[18] "Securities lending: Year in review," S&P Global Market Intelligence, December 21, 2016, available at Link.

[19] Results are generally confirmed when market squeezes are measured based on the 95th percentile distributional cutoffs. We lose significance for some of the determinants, which is likely due to the decrease in statistical power, i.e., the number of market squeeze events we identify decreases as we change the distributional cut-off requirements from the 90th percentile to the 95th percentile.

Table 2
Descriptive statistics — US sample.

Variable	No. Obs.	Mean	St. Dev.	$Q_{0.01}$	$Q_{0.25}$	$Q_{0.50}$	$Q_{0.75}$	$Q_{0.99}$
Average Tenure	10,283,199	3.97502	.96084	.95649	3.49417	4.09629	4.59111	5.89872
B/M	10,283,199	.60897	.59744	.02459	.26376	.47114	.77386	2.89836
Borrower Concentration	10,283,199	.31083	.20573	.09371	.16693	.24028	.38321	1
Dividend Yield	10,283,199	.01513	.03003	0	0	0	.02019	.14565
Firm Age	10,283,199	2.07738	.83778	0	1.60944	2.19722	2.70805	3.4012
Indicative Fee	10,283,199	.01967	.07771	.0025	.00375	.00375	.005	.3235
Lendable Quantity	10,283,199	.20806	.13228	.00096	.09284	.21655	.30549	.49629
Lender Concentration	10,283,199	.39361	.23283	.13089	.23069	.31274	.48083	1
Number Analyst	10,283,199	.25711	.56417	0	0	0	0	2.48491
Options	10,283,199	.74412	.43636	0	0	1	1	1
Price Dispersion	10,283,199	.03878	.03515	.00237	.01853	.02936	.04747	.17011
Quantity on Loan	10,283,199	3425.009	9472.683	.49	174.5	942.292	3391.188	34 379.86
Retail Volume	10,283,199	9.01579	2.73293	0	7.96693	9.34845	10.64963	14.00282
Return	10,283,199	.0007	.03553	−.08965	−.01242	0	.01277	.10053
Return Volatility	10,283,199	.02967	.01764	.00893	.01805	.02583	.03673	.08494
Short Interest	10,283,199	.03854	.0549	.00005	.00446	.01698	.04955	.25484
Size	10,283,199	20.58309	1.94184	16.49233	19.20426	20.52072	21.86907	25.32605
Spread	10,283,199	.00472	.01437	.00007	.00044	.00114	.00348	.05745
Turnover	10,283,199	.00961	.0388	.00025	.00303	.00599	.01075	.05788
Utilization	10,283,199	17.381	21.382	.063	2.511	8.597	23.802	92.376
Volume	10,283,199	12.3339	2.07665	6.56386	11.12399	12.51255	13.74466	16.58474

This table presents descriptive statistics for the variables used in the determinants analyses in Tables 4 and 5 for the US sample. Data come from Compustat, CRSP, Datastream, I/B/E/S, IHS Markit, OptionMetrics, and TAQ.

a market squeeze. Looking separately at lender-squeeze events we find a positive and significant association for lender squeezes in both the US and the EU samples.

The results for *Average Tenure* are opposite to the prediction from our conceptual framework. In particular, the association between *Average Tenure* and the likelihood of market squeezes in both the US and the EU samples is significantly negative. A potential explanation for these findings is that if tenure increases, it is likely that short sellers have sufficient capital to maintain their short positions in the presence of adverse market fluctuations or that these short sellers are highly convinced of their positions. Lower budget constraints and/or higher conviction allow them to maintain their short position even in the presence of extreme price increases. Looking separately at lender-squeeze events we find a negative and significant association for lender squeezes in both the US and the EU samples.

Third, equity market characteristics are confirmed to be associated with the likelihood of a market squeeze. For example, *Turnover* exhibits a positive and significant relation with the likelihood of market squeezes both in the US and in the EU sample. The interpretation is that shocks to investors' information sets, that induce high share turnover can increase the variability of borrowing costs, which can increase short-sale constraints. As a consequence, short sellers may cover their positions more quickly when the stock price rises to avoid further losses, amplifying the short squeeze. Looking separately at lender-squeeze events we find a positive and significant association for lender squeezes in both the US and the EU samples. Similarly, *Firm Size* is also in line with our conceptual framework, exhibiting a negative and significant relation with the likelihood of market squeezes both in the US and in the EU sample. One potential interpretation is that with smaller firms, strategic investors (or a group of small investors) that trade large quantities can have a pronounced impact on the stock price due to the lack of market depth and high informational asymmetries. Looking separately at lender-squeeze events we find an insignificant association in both the US and the EU samples.

The results for past *Return*, *Bid–Ask Spread*, *Trading Volume*, and *Firm Age* are mixed across the US and EU samples. For example, *Past Return* exhibits a negative and significant relation with the likelihood of market squeezes in the US sample. The coefficient is insignificant in the EU sample. One potential explanation is that high past-day return is usually indicative of lower next-day return due to the short-term reversal effect in return predictability. All else equal, a lower return on a given day is associated with a lower likelihood of a market squeeze. Looking separately at lender-squeeze events we find an insignificant association in both the US and the EU samples. As another example, *Spread* exhibits a positive and significant relation with the likelihood of market squeezes in the US sample. The coefficient is insignificant in the EU sample. One potential explanation is that days with larger bid–ask spreads can be indicative of high levels of asymmetric information. On these days, short interest is typically higher (Diether et al., 2009). As discussed above, higher short interest is associated with a higher probability of market squeezes. Looking separately at lender-squeeze events we find a positive and significant association in the US sample, and an insignificant association in the EU sample.

Finally, the empirical analyses show a positive and significant association between the likelihood of market squeezes and *Retail Volume* based on the US sample.[20] One potential interpretation is that an increase in retail investors trading puts upward pressure on stock prices, making it difficult for short sellers to maintain their positions and leading to market squeezes. The empirical results do not show a significant association between the likelihood of market squeezes and the availability of *Options*.[21] Looking separately at lender-squeeze events we find that the availability of options decreases the likelihood of lender squeezes, whereas retail trading volume shows a positive association with the likelihood of lender squeezes.[22]

Overall, our findings indicate that *Short Interest*, *Firm Size*, *Price Dispersion*, and *Turnover* are the most economically significant determinants of market squeezes in both the US and EU samples. In contrast, *Indicative Fee*, *Lendable Quantity*, and *Utilization* emerge as the primary drivers of lender squeezes across both regions. These results

[20] To proxy for retail trading activity, we utilize a measure of retail trading volume obtained from the Millisecond Intraday Indicators by WRDS dataset constructed with TAQ data. These data are available only for the US sample.

[21] To proxy for the availability of options, we construct an options indicator based on OptionMetrics data available to us only for the US.

[22] Table A1 in the Internet Appendix discusses results from including social media activity proxies in our analyses. Specifically, we include proxies for social media *Sentiment* and *Attention* based on StockTwits, Twitter, and Seeking Alpha posts and comments, as well as the abnormal Google search volume index (*Google ASVI*). For background and construction of these measures, we refer the reader to Cookson et al. (2024). Information on social media activity for a large cross-section of stocks is only available to us starting in 2012. We find a positive and statistically significant association between the likelihood of market squeezes and the *Google ASVI* and no significant relation with the proxies for sentiment and attention.

Table 3
Descriptive statistics — EU sample.

Variable	No. Obs.	Mean	St. Dev.	$Q_{0.01}$	$Q_{0.25}$	$Q_{0.50}$	$Q_{0.75}$	$Q_{0.99}$
Average Tenure	1,404,550	4.1858	.92694	1.72835	3.64208	4.22504	4.75805	6.45108
B/M	1,404,550	.79517	.75143	.04353	.36292	.62768	1.00149	3.50205
Borrower Concentration	1,404,550	.38727	.26549	.06942	.18852	.29605	.50426	1
Dividend Yield	1,404,550	.01605	.02387	0	0	0	.02767	.09283
Firm Age	1,404,550	1.61447	.83991	0	1.09861	1.79176	2.30259	3.13549
Indicative Fee	1,404,550	.03347	.06176	.00362	.005	.00625	.04	.26864
Lendable Quantity	1,404,550	.08287	.07512	.00022	.01958	.0621	.12837	.29085
Lender Concentration	1,404,550	.45837	.31137	.09512	.19796	.34543	.6786	1
Number Analyst	1,404,550	.14022	.45894	0	0	0	0	2.30259
Price Dispersion	1,404,550	.02884	.02414	.00073	.01509	.02291	.03539	.11511
Quantity on Loan	1,404,550	5194.054	22 115.99	.09	23.193	268.591	2356.879	89 301.56
Return	1,404,550	.00032	.0244	−.06428	−.01007	0	.01006	.07018
Return Volatility	1,404,550	.02186	.00976	.00855	.01538	.01972	.02588	.05486
Short Interest	1,404,550	.01575	.02804	.00001	.00101	.00547	.01832	.12899
Size	1,404,550	20.98956	1.88946	17.18977	19.5898	20.85277	22.30835	25.29131
Spread	1,404,550	.00868	.23424	.0001	.00154	.00443	.01025	.04884
Turnover	1,404,550	.00252	.00442	.00003	.00059	.0015	.0031	.01573
Utilization	1,404,550	14.63228	19.77534	.02642	1.92372	6.31557	18.51789	88.62354
Volume	1,404,550	11.02815	2.56125	4.85203	9.25884	11.11525	12.83366	16.60976

This table presents descriptive statistics for the variables used in the determinants analyses in Tables 4 and 5 for the EU sample. Data come from Compustat, CRSP, Datastream, I/B/E/S, and IHS Markit.

highlight the fundamental distinction between market squeezes and lender squeezes, demonstrating that each is driven by a distinct set of determinants.

5. Price discovery and short-squeeze events

Next, we examine the impact on price discovery. In particular, a short-squeeze event represents an impediment to short sellers and, thus, may restrain trading by investors with negative fundamental information. If that is the case we hypothesize that short-squeeze events should slow price discovery.

To test this hypothesis, we implement a test for potential deterioration of price discovery, which is motivated by Beber and Pagano (2013). Specifically, we perform an analysis on residuals from a market model, where we estimate a market model regression in which daily returns for each stock in our sample are regressed on daily returns of the S&P 500 (for the US) or the STOXX Europe 600 (for the EU). The choice of the daily frequency is in line with the frequency at which we measure the squeeze events. The regression analysis is performed on residuals under the assumption that a short-squeeze event should slow the discovery of firm-specific rather than market-wide information.

To test how price discovery changed over time, we differentiate between the following time periods: (1) *Pre-Event* window is defined as two weeks (10 trading days) before a short-squeeze event; (2) *Post-Event* window is defined as two weeks (10 trading days) after a short-squeeze event. Thus, the estimations are performed in a window of two weeks (10 trading days) around a short-squeeze event. As robustness, we also perform our estimations in four weeks (20 trading days) around a short-squeeze event. We estimate the following regression model separately for the EU and the US:

$$Y_{i,t} = \alpha + \beta Post\text{-}Event + \gamma Controls_{i,t} + \epsilon_{i,t}, \quad (2)$$

where $Y_{i,t}$ represents the first-order autocorrelation in the firm-specific component of returns (return residuals) computed during the pre- or post-event windows. If the firm-specific component of returns is assumed to be completely random in the sense of being statistically independent, the values of the autocorrelations should be zero, i.e., future residual return movements should be unpredictable. In other words, more generally, prices are assumed to follow a random walk. On the other hand, if the short-squeeze events slow price discovery the absolute magnitude of the autocorrelations should increase around a squeeze event and should be significantly higher in the period after the event compared to before. We therefore report the absolute values of the coefficients of interest regardless of their estimated signs because price discovery decreases as the autocorrelation measure deviates from zero (Saffi and Sigurdsson, 2011). The coefficient α measures the average level of the autocorrelations in the *Pre-Event* window, i.e., before a short-squeeze event. The coefficient β measures the change in the average level of the autocorrelations from the *Pre-Event* window to the *Post-Event* window. To control for differences in companies' size and market trading activity we additionally include size (market capitalization), trading volume, and price dispersion (Engelberg et al., 2012 and O'Hara and Ye, 2011). To be consistent with the measurement of the autocorrelation in the return residuals we use the average of each control variable for each security computed separately during the pre- and post-event windows (*Controls*).[23] We report t-statistics based on robust standard errors clustered by firm and time (Petersen, 2009).

Table 6 reports the estimation results. We report the results for two windows around a squeeze event, +/−10 days, and +/−20 days in the upper and lower panels, respectively. Columns (1) through (3) report the results for the US sample and columns (4) through (6) for the EU sample. We report results for market squeezes measured both based on the 90th and the 95th percentile cutoffs. The results indicate that there is a significant change in the average autocorrelation after a squeeze event compared to before. These differences are statistically significant for both the +/−10 day- and +/−20 day-windows for both the US and EU samples.[24] We interpret this evidence as a deterioration in the speed of price discovery after a market squeeze event. We note that the squeeze events in our samples do not have a perfect correlation with time because different stocks experience squeezes at different points in time, and some at multiple points in time.[25] Further the

[23] The results are robust to excluding the control variables. These are reported in Table A2 Panels A and B in the Internet Appendix.

[24] We also performed a test for significance of the difference between the *Pre-Event* and *Post-Event* coefficients and found that they are statistically significantly different for all estimations.

[25] Because short-squeeze events limit the activity of investors with bearish views, in robustness estimations, we test if the decrease in price discovery is more pronounced in overall declining markets (Beber and Pagano, 2013). Specifically, we perform the price discovery tests around squeeze events that occur when the overall market return is negative. Table A3 Panels A and B in the Internet Appendix report a larger change in the average absolute autocorrelation after a market squeeze event in the +/−10 days and +/−20 days event window compared to the price discovery results discussed in Section 5 for the market squeeze measure based on the 90th percentile cutoffs. The average autocorrelation does not change after a lender squeeze event.

Table 4
The determinants of market squeezes.

	US		EU	
	(1) Market Squeeze (90th)	(2) Market Squeeze (95th)	(3) Market Squeeze (90th)	(4) Market Squeeze (95th)
Investor Disagreement				
B/M	0.00003	0.00004	0.00039	0.00034
	(0.19)	(0.36)	(1.15)	(1.17)
Price Dispersion	0.01889***	0.00927***	0.04354***	0.02477***
	(9.82)	(6.55)	(5.95)	(4.27)
Return Volatility	0.03349***	0.00808	0.09017***	0.03796
	(4.48)	(1.51)	(3.04)	(1.51)
Securities Lending Characteristics				
Average Tenure	−0.00041***	−0.00013**	−0.00052***	−0.00024*
	(−5.71)	(−2.00)	(−3.41)	(−1.87)
Borrower Concentration	0.00108**	0.00054	−0.00205***	−0.00124**
	(2.12)	(1.11)	(−3.26)	(−2.10)
Indicative Fee	0.00247	0.00220	−0.00711***	−0.00318**
	(1.24)	(1.32)	(−2.75)	(−1.97)
Lender Concentration	0.00152**	0.00112*	−0.00269***	−0.00101*
	(2.34)	(1.80)	(−3.52)	(−1.90)
Lendable Quantity	−0.00673***	−0.00296***	0.00192	−0.00367
	(−5.27)	(−2.77)	(0.44)	(−1.47)
Short Interest	0.16354***	0.06004***	0.28499***	0.12209***
	(29.05)	(17.26)	(7.78)	(7.02)
Utilization	−0.00143	−0.00183**	0.00006**	0.00001
	(−1.43)	(−2.37)	(2.53)	(1.24)
Equity Market Characteristics				
Dividend Yield	−0.00295	−0.00548**	0.00475	−0.00024
	(−0.92)	(−2.07)	(0.59)	(−0.04)
Firm Age	−0.00039**	−0.00026	0.00064**	0.00035
	(−2.03)	(−1.51)	(1.99)	(1.32)
Number Analyst	0.00031	0.00020	−0.00062*	−0.00051**
	(1.10)	(0.75)	(−1.83)	(−1.99)
Options	−0.00031	0.00016		
	(−0.67)	(0.37)		
Return	−0.00406***	−0.00123	−0.00215	0.00272
	(−3.09)	(−1.52)	(−0.52)	(0.91)
Retail Volume	0.00007*	0.00004		
	(1.77)	(1.14)		
Size	−0.00055***	−0.00021**	−0.00030*	−0.00001
	(−5.48)	(−2.41)	(−1.72)	(−0.06)
Spread	0.00422*	−0.00216	−0.00003	−0.00001
	(1.66)	(−1.00)	(−0.99)	(−0.61)
Turnover	0.01179***	0.00638***	0.18187***	0.06693**
	(3.75)	(3.42)	(2.90)	(2.07)
Volume	0.00069***	0.00015**	−0.00022*	−0.00022**
	(8.17)	(2.31)	(−1.84)	(−2.21)
Observations	10,283,199	10,283,199	1,404,550	1,404,550
Adjusted R^2	0.020	0.008	0.019	0.014
Industry Dummies	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes

This table reports the results from the determinants regression estimation described in Eq. (1). The dependent variable is a market squeeze dummy computed for the US (columns (1)–(2)) and the EU (columns (3)–(4)) samples. We estimate this regression model for market squeezes measured at the 90th percentile cutoffs as well as the 95th percentile cutoffs. All independent variables are defined in Section 4. The sample period is from July 01, 2006 through March 31, 2021. The data frequency is daily. The *t*-statistics are reported in parentheses below the coefficient estimates and are based on robust standard errors clustered by firm and time (see Petersen, 2009). The symbols ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Data come from Compustat, CRSP, Datastream, I/B/E/S, IHS Markit, OptionMetrics, and TAQ.

results indicate that the average autocorrelation does not change after a lender squeeze event compared to before. This finding, combined with the evidence that short interest declines considerably following only a market squeeze event, while it remains stable or even slightly increases after a lender squeeze event (see Fig. 1), underscores the distinct nature of market and lender squeezes, indicating that only market squeezes exert a lasting impact on short sellers, and subsequently diminish the level of price discovery. Overall, these findings are consistent with a lower speed of price discovery after market squeeze events but not after lender squeeze events.

This evidence is consistent with market squeeze events slowing price discovery especially during overall market declines.

6. Conclusion

In this article, we construct a novel measure for identifying short-squeeze events triggered by sharp price increases. This type of short squeeze, which we call "market squeeze," is triggered if there is pressure on short sellers to cover their positions because of a sharp price increase resulting in increasing margin calls. This forces short sellers to close their positions early likely at a loss. The market squeeze measure is both distinct from and complementary to existing lender squeeze measures, which aim to identify short squeezes based on the recall of borrowed shares by lenders.

We document the time-series evolution, cross-industry dispersion, determinants, and impact on the speed of price discovery of market squeezes in the US and the EU. For completeness and comparability, we also discuss the respective statistics for the lender squeeze measure proposed in Schultz (2023). We find that stock-day short-squeeze

Table 5
The determinants of lender squeezes.

	US	EU
	(1)	(2)
	Lender Squeeze	Lender Squeeze
Investor Disagreement		
B/M	0.00142***	−0.00002
	(3.41)	(−0.16)
Price Dispersion	−0.00199	0.00002
	(−0.77)	(0.01)
Return Volatility	−0.04194***	−0.00712
	(−2.92)	(−0.63)
Securities Lending Characteristics		
Average Tenure	−0.00184***	−0.00020***
	(−12.28)	(−3.31)
Borrower Concentration	0.00160***	0.00075**
	(2.70)	(2.00)
Indicative Fee	0.06554***	0.00795***
	(12.77)	(3.56)
Lender Concentration	0.02060***	0.00036
	(16.12)	(1.02)
Lendable Quantity	0.03924***	0.00399***
	(11.92)	(2.97)
Short Interest	−0.17297***	−0.04231***
	(−17.32)	(−4.62)
Utilization	0.06682***	0.00011***
	(18.86)	(7.99)
Equity Market Characteristics		
Dividend Yield	0.03897***	−0.00300*
	(4.71)	(−1.69)
Firm Age	0.00024	−0.00031***
	(1.24)	(−2.71)
Number Analyst	0.00026*	0.00005
	(1.68)	(0.56)
Options	−0.00266***	
	(−5.23)	
Return	0.00218	0.00075
	(1.46)	(0.38)
Retail Volume	0.00045***	
	(8.04)	
Size	−0.00016	−0.00008
	(−1.19)	(−1.36)
Spread	0.07710***	−0.00001
	(7.02)	(−0.91)
Turnover	0.02363***	0.04685*
	(6.34)	(1.88)
Volume	−0.00068***	−0.00009**
	(−5.62)	(−2.41)
Observations	10,283,199	1,404,550
Adjusted R^2	0.051	0.006
Industry Dummies	Yes	Yes
Time Dummies	Yes	Yes

This table reports the results from the determinants regression estimation described in Eq. (1). The dependent variable is a lender squeeze dummy computed for the US (column (1)) and the EU (column (2)) samples. We estimate this regression model for lender squeezes (Schultz, 2023). All independent variables are defined in Section 4. The sample period is from July 01, 2006 through March 31, 2021. The data frequency is daily. The *t*-statistics are reported in parentheses below the coefficient estimates and are based on robust standard errors clustered by firm and time (see Petersen, 2009). The symbols ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Data come from Compustat, CRSP, Datastream, I/B/E/S, IHS Markit, OptionMetrics, and TAQ.

events are rare and short-lived. However, the quarterly average of unique firms that experience a market squeeze event in the US and in the EU is 9.9% and 12.3%, respectively. For lender squeezes, we find that the quarterly average is 8.7% and 5.4%, respectively. This evidence implies that a non-trivial proportion of firms experience a short squeeze in a given quarter. The cross-industry analysis reveals that in the US squeezes are more frequent in the energy (coal, mining, and oil stocks) as well as the financial and tobacco industries, whereas in the EU squeezes are more frequent in the tobacco, coal, mining, and textiles industries.

When examining the determinants of short squeezes we find that short interest, firm size, price dispersion, and turnover are the most economically significant determinants of market squeezes in both the US and EU samples. In contrast, indicative fees, lendable quantity, and utilization are the most economically significant determinants of lender squeezes in both the US and EU samples. Thus, our analyses reveal that market squeezes and lender squeezes are fundamentally distinct, each driven by different determinants. Notably, within our sample, only market squeeze events impede the speed of price discovery in the affected stocks, while lender squeezes have no such effect. This evidence is supported by the observed significant decline in short interest following market squeezes, whereas short interest remains stable or slightly increases after lender squeezes. Overall these findings underscore the distinct nature of market and lender squeezes, indicating that only market squeezes exert a lasting effect on short sellers, subsequently deteriorating price discovery.

Table 6
Price discovery and short squeezes.

	US			EU		
+/-10 days	(1) Market Squeeze (90th)	(2) Market Squeeze (95th)	(3) Lender Squeeze	(4) Market Squeeze (90th)	(5) Market Squeeze (95th)	(6) Lender Squeeze
Post-Event	0.007***	0.008***	0.001	0.010***	0.012***	0.002
	(3.771)	(2.786)	(0.241)	(3.488)	(3.236)	(0.387)
Pre-Event	0.256***	0.297***	0.586***	0.143***	0.124***	0.330***
	(6.279)	(3.810)	(22.416)	(4.685)	(3.031)	(5.982)
Controls	YES	YES	YES	YES	YES	YES
Observations	108,925	36,821	203,715	43,791	21,082	11,697
Adjusted R^2	0.002	0.004	0.022	0.003	0.003	0.017
+/-20 days	(1)	(2)	(3)	(4)	(5)	(6)
	Market Squeeze (90th)	Market Squeeze (95th)	Lender Squeeze	Market Squeeze (90th)	Market Squeeze (95th)	Lender Squeeze
Post-Event	0.008***	0.007***	0.001	0.010***	0.014***	0.005
	(5.323)	(3.022)	(0.566)	(4.145)	(4.083)	(0.947)
Pre-Event	0.199***	0.229***	0.611***	0.093***	0.045	0.256***
	(4.786)	(2.741)	(20.609)	(2.858)	(1.066)	(4.870)
Controls	YES	YES	YES	YES	YES	YES
Observations	108,925	36,821	203,715	43,805	21,092	11,697
Adjusted R^2	0.003	0.006	0.042	0.005	0.006	0.030

This table reports the results from the price discovery regression estimation described in Eq. (2). The dependent variable is the first-order autocorrelation in the firm-specific component of returns (return residuals) computed for the US (columns (1)–(3)) and the EU (columns (4)–(6)) samples before and after short-squeeze events. We estimate this regression model for market squeezes (measured at the 90th and 95th percentile cutoffs) as well as lender squeezes (Schultz, 2023). The first-order autocorrelation of residuals are estimated from a market model regression of daily returns (see Section 5 for details). The upper panel presents information for the regression model estimated for 10 days before and after the squeeze event, i.e., for the period *Pre-Event* we use observations from $t-10$ through $t-1$ and for the period *Post-Event* we use observations from $t+1$ through $t+10$, where t represents the day of the short-squeeze event. The lower panel presents information for the regression model estimated for 20 days before and after the squeeze event, i.e., for the period *Pre-Event* we use observations from $t-20$ through $t-1$ and for the period *Post-Event* we use observations from $t+1$ through $t+20$. Controls include (i) natural log market cap, (ii) daily price dispersion, and (iii) daily volume, all measured as the average over the pre-and post-event windows. The t-statistics are reported in parentheses below the coefficient estimates and are based on robust standard errors clustered by firm and time (see Petersen, 2009). The symbols ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Definitions of market squeeze and lender squeeze are provided in Section 3. The data cover the period July 01, 2006 through March 31, 2021. Data come from Compustat, CRSP, Datastream, and IHS Markit.

CRediT authorship contribution statement

Franklin Allen: Writing – review & editing, Supervision, Resources, Funding acquisition. **Marlene Haas:** Writing – review & editing, Project administration, Investigation, Conceptualization. **Matteo Pirovano:** Writing – review & editing, Software, Methodology, Formal analysis, Data curation. **Angel Tengulov:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Appendix A. Variable definitions:

This table defines the variables used in the analyses. Xpressfeed mnemonics are in parentheses where applicable.

Variable name	Description
Average Tenure	The average number of days from opening date to present for all outstanding loan transactions for a given security.
B/M	The ratio of the book value of common equity to the market value of common equity ($\frac{CEQ_t}{PRCC_F_t \times CSHO_t}$).
Borrower Concentration	A measure between 0 and 1. A very small number indicates a large number of borrowers and 1 indicates a single borrower.
Dividend Yield	Common dividends per share divided by price per share ($\frac{DVC_t}{CSHO_t \times PRCC_F_t}$).
Firm Age	The natural log of years since IPO or years of information on Compustat if IPO year is missing.
Indicative Fee	Borrowing cost, in fee terms, for a hedge fund on a given day.
Lendable Quantity	The active lendable quantity of shares available to lend, adjusted to remove lendable quantity which is not being actively made available for lending, scaled by shares outstanding.
Lender Concentration	A measure between 0 and 1. A very small number indicates a large number of lenders and 1 indicates a single lender.
Number Analysts	Natural logarithm of the number of analysts issuing a forecast for long-term growth in earnings per share.
Options	An indicator that equals one if the firm has exchange-traded options, and zero otherwise based on OptionMetrics IvyDB US data.
Price Dispersion	Relative price dispersion measured as: $\frac{(High_{i,t}-Low_{i,t})}{m_{i,t}}$, where: $m_{i,t} = \frac{(High_{i,t}+Low_{i,t})}{2}$.
Quantity on Loan	The total quantity of outstanding securities loans.
Retail Volume	A measure of retail trading volume based on TAQ data sourced from the Millisecond Intraday Indicators by WRDS file.

Return	The daily simple return.
Return Volatility	The volatility of returns for the past trading year (day $t-1$ through day $t-252$).
Short Interest	The ratio of total quantity of outstanding securities loans and company's shares outstanding.
Size	Natural logarithm of market capitalization ($ln(PRCC_F_t \times CSHO_t)$).
Spread	The relative spread measured as: $\frac{(Ask_{i,t}-Bid_{i,t})}{m_{i,t}}$, where: $m_{i,t} = \frac{(Ask_{i,t}+Bid_{i,t})}{2}$.
Turnover	The average of daily volume from day $t-1$ through day $t-5$ divided by shares outstanding.
Utilization	The proportion of shares available to lend that are on loan in percent.
Volume	Natural logarithm of total daily volume in number of shares.

Appendix B. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jbankfin.2025.107436.

Data availability

The authors do not have permission to share data.

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