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Short-selling restrictions and financial stability in Europe:
Evidence from the Covid-19 crisis

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ABSTRACT
In March 2020, six European countries imposed temporary short-selling bans to prevent further stock price declines, to reduce volatility, and to ensure financial stability during the Covid-19 pandemic, whereas other countries abstained from implementing these restrictions. We examine the effects of these regulatory interventions on stock returns and market quality for major European countries with and without bans. Our results reveal that restricting short selling did not stabilize stock prices but adversely affected market liquidity, as reflected in wider bid-ask spreads and lower turnover. In addition, smaller stock markets and smaller firms suffered more from the deterioration in market quality. Using logit regressions, we investigate the determinants for the probability that a country would impose short-selling restrictions. The results suggest that countries with weaker economies, lower fiscal capacity, less financial development, and stricter lockdown measures were more likely to adopt a ban. Overall, short-selling bans during the Covid-19 crisis negatively affected market quality and consequently regulators in general should abstain from implementing such restrictions in the future.

1. Introduction

The essential functions of organized securities markets are to provide a fair and orderly market environment, in which prices instantaneously and fully reflect all information, and where trading occurs immediately at minimal costs and risks (Schmidt, 1977). These informational (external) and operational (internal) efficiencies result in an optimal allocation of resources with funds employed at its best usage (Tinic and West, 1979, pp. 91-98). This paradigm needs to hold not only during normal times but also during extreme market distress, such as the recent Covid-19 crisis. It is therefore important to investigate and determine whether regulators should impose trading restrictions during crisis periods to guarantee the fair and orderly functioning of securities markets. Interestingly, six European countries implemented short-selling bans immediately at the outbreak of the pandemic, presumably to prevent further stock price declines, higher volatility, investor misbehavior and most importantly to ensure financial stability, while the other European countries abstained from imposing restrictions. This is in contrast to the regulatory activities during the global financial crisis (2007–2009), where most countries introduced short-selling bans at different times, in particular to protect banks and the stability of the financial system. For similar reasons, some Eurozone countries imposed a temporary ban on short selling of financial stocks during the European sovereign debt crisis (2011–2012). The academic evidence of short-selling bans from these previous crises indicates

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negative market quality effects (Beber and Pagano, 2013; Pagano, 2020). Interestingly, the U.S. abstained from imposing such restrictions during the Covid-19 crisis, whereas some European countries continued their interventionist policies (Bessler and Vendrasco, 2021).

Therefore, the important research and policy questions arising from the Covid-19 pandemic are whether restricting short selling negatively affected market quality, or whether allowing the initiation of new net short positions resulted either in a higher market quality or in financial market instability. These complex issues require a comprehensive analysis of the factors that negatively influence fair and orderly markets, especially during crisis periods. More specifically, an important issue is whether preventing trading based on negative information and expectations hinders the price discovery process and market efficiency, resulting in negative market quality effects. In this study, we first investigate how short-selling restrictions affected stock prices and in particular market quality measures in 12 European countries between 2 January and 30 June 2020. We employ cross-sectional regressions and fixed-effects panel regressions to provide empirical evidence for the effects of the short-selling ban. To address potential endogeneity concerns of the ban, we also use propensity score matching and instrumental variables (IV) regressions. In the second part of the paper, we investigate under which conditions countries feel compelled to impose these restrictions. In addition, we analyze potential concerns about short-selling activities, market manipulation, and financial stability resulting from allowing short selling during the Covid-19 crisis. Overall, this study provides further evidence on the question whether regulators should intervene and restrict short selling during crisis periods.

Our findings suggest that restricting short selling had a negative impact on stock returns and market quality in the six European countries that imposed a ban. More specifically, the regulatory intervention did not reduce price volatility or boosted stock prices, although these effects are difficult to distinguish from the monetary and fiscal policy measures announced contemporaneously in support of the economy. With respect to liquidity, the short-selling bans widened bid-ask spreads and decreased turnover. Especially smaller markets and stocks of smaller firms, as measured by market capitalization at the end of 2019, suffered from the negative liquidity effects. Robustness tests support our findings in a matched sample setting as well as when we instrument the ban decision with the country’s default risk and financial stress level. Focusing on the determinants of the short-selling ban, we document that countries with weaker economic conditions, lower fiscal capacity, a less developed financial system and more stringent lockdown measures were more likely to impose the ban. During the crash period, we do not find evidence for an excessive increase in short positions in countries that later imposed short-selling restrictions. Our main conclusions are that regulators should allow short-selling activities even in crisis periods, as long as exchanges and regulators can prevent illegal insider trading and other market manipulations and there is no risk to financial stability. Then markets usually benefit from the positive functions of short sellers as their activities result in an increase in information efficiency, higher liquidity, and higher market quality. It is also important to note that other mechanisms such as circuit breakers can achieve similar objectives (see Internet Appendix, Part II).

We organize the rest of our paper as follows. Section 2 contains the literature review and hypotheses development on short selling and market quality. Section 3 describes the data and sample. In Section 4, we analyze the effects on equity market quality in countries with and without short-selling restrictions. Section 5 investigates the determinants of the introduction of a short-selling ban in a country. In Section 6, we discuss the role of short-selling activities, market manipulation, and financial stability concerns. Section 7 concludes. We provide additional analyses, evidence, and discussion in the Internet Appendix.

2. Literature review and hypotheses

In this section, we examine the short selling effects on securities markets (2.1) and distinguish between the informational and real effects of short selling (2.1.1) and the impact of short selling during market distress (2.1.2). Subsequently, we discuss the effects of short-selling restrictions on market quality and develop our hypotheses (2.2).

2.1. Effects of short selling on securities markets

2.1.1. Short sellers as information intermediaries and the effects on corporate decisions

Previous research provides considerable evidence with respect to the effects of short selling. Jiang et al. (2022) and Reed (2013) offer excellent reviews of the theoretical and empirical short-selling literature. Short sellers usually target overvalued stocks with high market-to-book ratios and with more institutional investors (Dechow et al., 2001; Christophe et al., 2004), and often have the ability to correctly predict negative stock returns (Boehmer et al., 2008; Diether et al., 2009). By collecting and processing publicly available information (Engelberg et al., 2012), and most importantly, private information (Karpoff and Lou, 2010), they detect miss-valued stocks (Jones and Lamont, 2002). Consequently, short selling contributes to the price discovery process by quickly incorporating negative information into stock prices. This increases the information efficiency and orderly functioning of securities markets (Bris et al., 2007; Chen and Rhee, 2010; Boehmer and Wu, 2013). Hence, short sellers as information intermediaries gather and possess superior information relative to other market participants (Chen et al., 2016).

Various studies also indicate that short-selling activities have real effects on corporate policies such as financing, investment, and payout decisions. More specifically, as short selling usually leads to declining stock prices, this results in lower equity issuances and investments (Grullon et al., 2015), in higher external financing costs (Meng et al., 2020), in disciplining management with respect to

1 The Financial Times reported that market abuse and insider trading has increased since the start of Covid-19 due to working from home, resulting in less direct oversight from peers and control over communications, which are in place at the office (FT, 2021).
M&As activities (Chang et al., 2019), and in higher cash dividends (Chen et al., 2019). Short sellers’ actions also enhance the information environment by uncovering financial misconduct (Karppon and Lou, 2010), reducing earnings management (Fang et al., 2016; Massa et al., 2015b), and improving the financial reporting quality (Li and Zhang, 2015). Overall, short sellers perform a positive and essential information function in securities markets.

2.1.2. Short selling in periods of market distress

The empirical evidence clearly indicates that short selling is beneficial during non-crisis or “normal” times. However, excessive short selling may have destabilizing effects in securities markets during periods with substantial stock prices declines. Geraci et al. (2018) report that short selling accelerates negative return trends and increases volatility, with stronger effects observed for smaller stocks. This may prompt regulators to impose short-selling restrictions, aiming to reduce the probability and severity of a stock market panic in exceptional times of market distress. Consequently, short selling could be a concern to regulators at the beginning and during a crisis, although most empirical evidence suggests the opposite, as discussed in the next section.

2.2. Hypotheses development

Previous research finds negative effects from short-selling bans on market quality during the global financial crisis in 2007/2008 and the European sovereign debt crisis in 2011/2012. For example, restricting short selling may result in an overvaluation of banned stocks as prices only reflect optimistic views (Miller, 1977). Consistent with these theoretical predictions, empirical studies suggest that any form of short-selling restrictions lead to an overvaluation of banned stocks (Beber and Pagano, 2013; Boehme et al., 2006; Bohmer et al., 2013; Chang et al., 2007; Bris et al., 2007; Frino et al., 2011), and generate negative returns after the ban is abandoned (Autore et al., 2011). The usual motivation of financial market regulators to restrict short selling is to stabilize stock prices and reduce volatility. However, there are also monetary and fiscal policy options that may be helpful to achieve the same goal. On March 12, 2020, the European Central Bank announced a comprehensive package of measures (ECB, 2020a), including the €750 billion Pandemic Purchase Program (PEPP). This occurred exactly on 18 March 2020 (ECB, 2020b), the day when many regulators implemented the short-selling ban. Immediately afterwards, stock prices started to recover. These important confounding events may cloud the direct effect of the ban on stock performance. Therefore, it is empirically challenging to differentiate between the effects of the short-selling ban and other measures implemented to support the economy and stock prices. Nevertheless, we hypothesize a reversal and increase in stock prices, which we express in our first hypothesis:

**Hypothesis 1.** When regulators impose short-selling restrictions, banned stocks experience positive or less negative abnormal returns than non-banned stocks.

Theoretical models on short-selling restrictions predict negative effects on market liquidity and wider bid-ask spreads, as the speed of incorporating negative information into stock prices is lower (Diamond and Verrecchia, 1987). Empirical studies report that banned stocks experienced a substantially increase in bid-ask spreads and lower trading volumes for many markets around the world (Beber and Pagano, 2013; Bessler and Vendrasco, 2021; Boehmer et al., 2013; Boulton and Braga-Alves, 2010; Frino et al., 2011; Marsh and Payne, 2012). Moreover, market makers are less inclined to provide liquidity for smaller stocks due to higher risks resulting from information asymmetries and adverse selection problems (Glosten and Harris, 1988). Therefore, if restrictions in short selling require market makers to hold more of these stocks on inventory, they are more likely to reduce trading in smaller stocks and more volatile stocks that have no options traded (Beber and Pagano, 2013). In contrast, other studies for the U.S. find that the effects are concentrated in larger (Boehmer et al., 2013) and ex-ante more liquid stocks (Autore et al., 2011). Moreover, in countries that implement short-selling restrictions, prices reflect negative information only with a time lag, consistent with lower price efficiency (Bris et al., 2007; Marsh and Payne, 2012; Saffi and Sigurdsson, 2011). Based on the theoretical predictions and empirical observations, we formulate the second hypothesis:

**Hypothesis 2.** When regulators impose short-selling restrictions, the bid-ask spreads for banned stocks widen compared to non-banned stocks.

Another important measure for liquidity is trading volume. Based on the previous arguments, we specify our third hypothesis:

**Hypothesis 3.** When regulators impose short-selling restrictions, the trading volume of banned stocks decreases compared to non-banned stocks.

It seems possible that imposing short-selling bans increase the risk for stock market crashes (Hong and Stein, 2003) and asset price bubbles (Scheinkman and Xiong, 2003), causing excessive volatility. Indeed, Boehmer et al. (2013), Félix et al. (2016) and Beber et al. (2021) find that short-selling bans increase volatility. Based on these theoretical arguments and empirical evidence, we derive our fourth hypothesis:

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2 The ECB decided to increase the volume by €600 billion (June 4, 2020) and by €500 billion (December 10, 2020) to a total of €1,850 billion.
3 Two months later, on 18 May 2020, the German and French governments jointly proposed an economic recovery plan with a €500 billion reconstruction fund, making another important turning point in financial markets’ perception of the fiscal strength to overcome the pandemic in the EU.
Hypothesis 4. When regulators impose short-selling restrictions, the volatility of banned stocks increases compared to non-banned stocks.

Overall, the adoption of short-selling restrictions often does not generate the expected benefits, but rather reduce financial stability, weakens market efficiency, and interferes with the orderly functioning of securities markets. Whether this was the case during the Covid-19 crisis requires a detailed empirical analysis, which we provide in this study.

3. Data and sample description

3.1. Dataset construction

We construct our dataset for 12 European countries for the period from 2 January 2020 to 30 June 2020 by employing the constituent lists of stock indices (as of January 2020) and country-specific research lists of all stocks included in Refinitiv Datastream. This includes the six countries (Austria, Belgium, France, Italy, Greece, and Spain) in which the financial market regulators imposed temporary short-selling bans on all stocks between 18 March and 18 May 2020. The control group consists of six countries (Germany, Netherlands, Portugal, Sweden, Switzerland, and United Kingdom) that did not implement restrictions. The ban prohibits the

Table 1
National 2020 Short-Selling Bans in Europe.

| Country | National Competent Authority                  | Start      | Expiry     |
|---------|-----------------------------------------------|------------|------------|
| Austria | Finanzmarktaufsicht (FMA)                     | 18-Mar-20  | 18-May-20  |
| Belgium | Financial Securities and Markets Authority (FSMA) | 17-Mar-20  | 17-Mar-20  |
| Belgium | Financial Securities and Markets Authority (FSMA) | 18-Mar-20  | 18-May-20  |
| France  | Autorité des Marchés Financiers (AMF)         | 17-Mar-20  | 17-Mar-20  |
| France  | Autorité des Marchés Financiers (AMF)         | 18-Mar-20  | 18-May-20  |
| Greece  | Hellenic Capital Market Commission (HCMC)     | 18-Mar-20  | 18-May-20  |
| Italy   | Commissione Nazionale per le Società e la Borsa (CONSOB) | 13-Mar-20  | 13-Mar-20  |
| Italy   | Commissione Nazionale per le Società e la Borsa (CONSOB) | 17-Mar-20  | 17-Mar-20  |
| Italy   | Commissione Nazionale per le Società e la Borsa (CONSOB) | 18-Mar-20  | 18-May-20  |
| Spain   | Comisión Nacional del Mercado de Valores (CNMV) | 13-Mar-20  | 13-Mar-20  |
| Spain   | Comisión Nacional del Mercado de Valores (CNMV) | 17-Mar-20  | 18-May-20  |

Notes: This table presents the 2020 short-selling bans in Europe. These emergency measures include the creation of new net short positions or increase in existing net short positions for regulated and OTC markets. Dates are from the European Securities and Markets Authority (ESMA). In our analysis, we abstract from the two one-day bans and focus on the two-month period in our analysis.

Table 2
Structure of the Dataset and Samples.

| Country   | Sample I | Sample II | Market Cap (in € million) |
|-----------|----------|-----------|---------------------------|
| U.K.      | 50       | 100       | 2,056,347                 |
| Germany   | 30       | 100       | 1,674,532                 |
| Switzerland | 20     | 100       | 1,491,729                 |
| Netherlands | 25     | 50        | 868,319                   |
| Sweden    | 30       | 50        | 525,512                   |
| Portugal  | 20       | –         | 48,690                    |
| Non-Ban Countries | 175 | 400       | 6,665,128                 |
| France    | 40       | 100       | 2,275,705                 |
| Italy     | 40       | 100       | 597,921                   |
| Spain     | 35       | 100       | 597,592                   |
| Belgium   | 20       | 50        | 327,404                   |
| Austria   | 20       | 50        | 109,495                   |
| Greece    | 20       | –         | 38,690                    |
| Ban Countries  | 175 | 400       | 3,946,445                 |
| Total     | 350      | 800       | 10,611,573                |

Notes: This table presents the structure of our dataset, composition of two different samples and total market capitalization at the end of 2019. First, stocks from the leading stock indices of 12 countries: FTSE 100 (only largest 50), DAX 30, SMI 20, AEX 25, OMX Stockholm 30, PSI-20, and CAC 40, FTSE MIB 40, IBEX 35, BEL 20, ATX 20, FTSE Athes 20. Second, the 800 largest stocks for 10 countries based on market capitalization at the end of 2019, excluding Greece and Portugal due to data quality issues. Every country is categorized as either large market (Germany, Switzerland, UK, France, Italy, Spain) or small market (Netherlands, Sweden, Austria, Belgium) according to the total market capitalization of the largest 100 or 50 stocks, respectively.

Hypothesis 4. When regulators impose short-selling restrictions, the volatility of banned stocks increases compared to non-banned stocks.

There have also been two one-day bans for specific stocks on March 13 (Italy and Spain) and March 17 (Italy, France, and Belgium), but we neglect the two-one day bans and concentrate on the two-month period.
initiation of new and the increase of existing net short positions for regulated and OTC markets. Table 1 contains an overview of the short-selling bans. Our sample period consists of four different periods in 2020: pre-crash (2 January to 19 February), crash (20 February to 17 March), ban (18 March to 18 May) and post-ban (19 May to 30 June).

We follow the recent literature and clean our data with common filters (Jank et al., 2021; Shehadeh et al., 2021; Karolyi et al., 2012; Ince and Porter, 2006). Thus, our daily panel dataset includes only domestic common equities and excludes preferred shares, depositary receipts, REITS, mutual funds and other special type securities. We matched our dataset with stock-level data from Refinitiv Datastream and discard all observations with missing, negative, or zero values in components required for the calculation of the market quality measures. Finally, we also exclude non-trading days, meaning that more than 90 % of the stocks have zero-returns on a given day and given exchange. We omit observations with stock prices of less than 1 (penny stocks) and stocks with more than 80 % of the days with zero returns (non-trading stocks), to avoid distortions from very small and infrequently traded stocks.

3.2. Structure of the dataset and samples

We split our dataset into two samples. The first sample consists of all stocks contained in the leading stock indices of 12 European countries: FTSE 100 (only largest 50), DAX 30, SMI 20, AEX 25, OMX Stockholm 30, PSI-20, and CAC 40, FTSE MIB 40, IBEX 35, BEL 20, ATX 20, FTSE Athex 20. This first sample includes 350 stocks, with 175 stocks for ban and 175 stocks for no-ban countries. The second sample consists of the 800 largest stocks based on market capitalization from 10 European countries. In this sample, we exclude Greece and Portugal due to data quality issues. We apply a specific ranking procedure for the stock selection. Every country belongs either to the large markets (Germany, Switzerland, UK, France, Italy, and Spain) or to the small markets (Netherlands, Sweden, Austria, and Belgium) group based on total market capitalization at the end of 2019. Finally, we select the largest 100 and largest 50 stocks of large and small countries, respectively, which results in 400 stocks for both ban and non-ban country groups. Table 2 provides an overview of the dataset structure and composition of our different samples. In the Internet Appendix, Part I, we provide additional evidence from an analysis of the Euro Stoxx 50 index.

4. Effects of the short-selling ban on market quality

In this section, we investigate the valuation effects (buy-and-hold abnormal returns) for the short-selling ban period (4.1), present the results for the different liquidity and volatility measures (4.2), and discuss additional findings as well as our robustness tests (4.3).

4.1. Stock returns

4.1.1. Buy-and-hold abnormal returns

To analyze how the short-selling ban affected the equity valuations, we calculate buy-and-hold abnormal returns (BHAR) for each stock \( i \) relative to the stock market index \( M \) on a daily basis and create equal-weighted portfolio groups:

\[
BHAR = \frac{1}{n} \sum_{i=1}^{N} \left( \prod_{t=1}^{T} \left( 1 + R_{i,t} \right) \right) - \left( \prod_{t=1}^{T} \left( 1 + R_{M,t} \right) \right)
\]

where \( n \) is the number of stocks, \( R_{i,t} \) is the return of stock \( i \) on day \( t \) and \( R_{M,t} \) is the market return for the same day. As our analysis focuses on European stock markets, the Datastream Europe Total Market equity index is the appropriate benchmark. We analyze different event windows around the day when the ban was imposed (18 March 2020 = Day 0), including the crash as well as the pre- and post-ban periods. Since our focus is on the performance differences between stocks with and without ban, we calculate the BHAR for each group separately.

To identify differences for stocks subject to a shorts-selling ban and to control for other stock-specific factors, we employ the following model:

\[
r_{i} = \beta_{i} BAN_{i,t} + \gamma X_{i,t} + \epsilon_{i,t}
\]

where \( r_{i} \) is a vector of BHARs across various intervals, \( BAN_{i,t} \) is an indicator variable and our primary variable of interest that is one when stocks are banned from short selling, and \( X_{i,t} \) is a vector of control variables. We follow the literature and include market capitalization (MKTCAP), Euro value of trading volume (EVOL), volume-weighted average share price (VWAP), and volatility (VOLA) (Boehmer et al., 2013). These variables capture time-varying effects related to stock valuation, trading volume, price levels and volatility, respectively. We use robust standard errors in the regressions. In the Appendix, Table A1 contains all definitions and descriptions of our variables.

4.1.2. Descriptive evidence

Responding to the projected negative effects of the Covid-19 pandemic on the real economy, equity markets reacted promptly with declining stock prices (Glossner et al., 2022; Liu et al., 2022; Szczysielski et al., 2022; Yarovaya et al., 2022; Zaheer et al., 2022; Fahlenbrach et al., 2021; Ramelli and Wagner, 2020), putting pressure on governments and central banks to react swiftly and appropriately. Six European countries imposed a short-selling ban immediately, as they feared that excessive short selling could accelerate further price declines or even lead to financial market instability, and that this precautionary measure could stabilize stock
In this section, we analyze how successful regulators have been in effectively preventing further stock price declines by restricting short selling. In Fig. 1, we present the valuation effects for the interval (-40; 80) covering 40 days before, during and after the introduction of the short-selling ban on 18 March 2020 (=Day 0). A clear pattern emerges across the three sub-periods. In the interval prior to the event, all stocks perform relatively similar. However, we notice a considerable divergence in performance when the ban became effective, with the group of banned stocks (red) underperforming the group of stocks without restrictions (blue) across the ban and post-ban periods. This pattern is consistent for different market and firm sizes.

Table 3 depicts the results for the 350 constituents of the major stock indices (Panel A) and for the 800 largest stocks (Panel B) and confirms the observation in Fig. 1. Our results reveal that banned stocks for both groups did not only underperform significantly relative to the benchmark (-7.98 % and -4.60 %), but also did significantly underperform compared to stocks without a ban (0.63 % and 1.17 %) over the (-40; 80) interval. To examine whether the effects depend on the size of the stock market, we divide the samples

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**Fig. 1. Buy-and-Hold Abnormal Returns around the Short-Selling Ban in Europe, Notes:** This figure presents the buy-and-hold abnormal returns (BHARs) around the short-selling ban. The samples include 12 major stock indices in Europe (Panel A) and the 800 largest stocks from 10 European countries (Panel B). Panel C depicts quartiles based on year-end 2019 market capitalization. The red (blue) lines represent the countries with (without) ban. Day 0 and Day 40 on the horizontal axis denotes the Start (18.03.2020) and End of Ban (18.05.2020). We separate the BHARs for large markets and small markets based on the total of market capitalization at the end of 2019 (Table 2). BHARs are calculated using the Datastream Europe Total Market Return Index as benchmark. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
### Table 3
Buy-and-Hold Abnormal Returns around the Short-Selling Ban.

| Interval     | Overall                | Large Markets       | Small Markets      |
|--------------|------------------------|---------------------|--------------------|
|              | Ban        | No-Ban        | Diff.   | Ban        | No-Ban        | Diff.   | Ban        | No-Ban        | Diff.   |
| BHAR [-40; 0]| –0.33 %    | –2.91 %       | 2.58 %  | –2.25 %    | –1.19 %       | –1.06 % | –4.78 %    | 0.87 %       | –5.65 %|
| BHAR [0; 40] | –5.80 % ***| 0.70 %        | –6.49 % | –7.24 %    | 2.12 %        | –9.36 % | –1.73 %    | –1.30 %      | –0.43 %|
| BHAR [0; 80] | –6.05 % ***| 2.15 %        | –8.20 % | –6.45 %    | 1.96 %        | –8.40 % | –4.92 %    | 2.42 %       | –7.34 %|
| BHAR [-40; 80]| –7.98 % ***| 0.63 %       | –8.61 % | –7.30 %    | –0.99 %       | –6.31 % | –9.88 %    | 2.88 %       | –12.77 %|

### Panel A: Major Stock Indices from 12 European Countries

| Interval     | Overall                | Large Markets       | Small Markets      |
|--------------|------------------------|---------------------|--------------------|
|              | Ban        | No-Ban        | Diff.   | Ban        | No-Ban        | Diff.   | Ban        | No-Ban        | Diff.   |
| BHAR [-40; 0]| –0.90 %    | –1.50 %       | 0.60 %  | –0.72 %    | –1.66 %       | 0.94 %  | –1.49 %    | –1.06 %       | –0.43 %|
| BHAR [0; 40] | –3.50 % ***| 4.06 %        | –7.56 % | –3.67 %    | 4.21 %        | –7.88 % | –2.95 %    | 3.64 %       | –6.59 %|
| BHAR [0; 80] | –4.65 % ***| 5.56 %        | –10.21 %| –3.66 %    | 3.79 %        | –7.45 % | –7.71 %    | 10.45 %      | –18.15 %|
| BHAR [-40; 80]| –4.60 % ***| 1.17 %       | –5.77 % | –3.59 %    | –0.28 %       | –3.31 % | –7.75 %    | 5.12 %       | –12.87 %|

### Panel B: Largest 800 Stocks from 10 European Countries

| Interval     | Overall                | Large Markets       | Small Markets      |
|--------------|------------------------|---------------------|--------------------|
|              | Ban        | No-Ban        | Diff.   | Ban        | No-Ban        | Diff.   | Ban        | No-Ban        | Diff.   |
| BHAR [-40; 0]| –0.47 %    | –0.50 %       | 0.03 %  | –2.01 %    | –1.56 %       | –0.45 % | –3.32 %    | 4.22 %        | –7.54 %|
| BHAR [0; 40] | –3.01 %    | 2.27 %        | –5.27 % | –4.71 %    | 6.36 %        | –11.07 %| –4.15 %    | 4.28 %        | –8.42 %|
| BHAR [0; 80] | –2.03 %    | 4.89 %        | –6.92 % | –6.43 %    | 1.71 %        | –8.14 %| –6.43 %    | 3.97 %        | –10.38 %|
| BHAR [-40; 80]| –2.70 %    | 2.27 %        | –4.97 % | –3.04 %    | –8.34 %       | –3.91 % | –3.40 %    | 3.39 %        | –6.81 %|

### Panel C: Market Capitalization Quartiles of Largest 800 Stocks

| Interval     | Overall                | Large Markets       | Small Markets      |
|--------------|------------------------|---------------------|--------------------|
|              | Ban        | No-Ban        | Diff.   | Ban        | No-Ban        | Diff.   | Ban        | No-Ban        | Diff.   |
| BHAR [-40; 0]| –1.14 %    | –0.48 %       | –0.66 % | –0.02 %    | –3.40 %       | ** 3.39 %| –4.15 %    | 4.28 %        | –8.42 %|
| BHAR [0; 40] | –3.47 %    | 5.42 %        | –8.89 % | –4.54 %    | 4.85 %        | –10.38 %| –5.54 %    | 4.85 %        | –10.38 %|
| BHAR [0; 80] | –6.21 % ***| 6.12 %        | –12.33 %| –5.91 %    | –2.31 %       | –6.11 %| –6.21 %    | 6.12 %        | –12.33 %|
| BHAR [-40; 80]| –5.31 %    | 3.04 %        | –8.34 % | –5.91 %    | –2.31 %       | –6.11 %| –5.31 %    | 3.04 %        | –8.34 %|

Notes: This table presents the mean buy-and-hold abnormal returns (BHARs) for different intervals around the short-selling ban on 18 March 2020 (Day 0). The samples include the 12 major stock indices in Europe (Panel A) and the largest 800 stocks from 10 European countries (Panel B). Panel C reports the results for quartiles based on year-end 2019 market capitalization. In Panel B and C, we separate the BHARs for subsamples of large markets and small markets based on the total of market capitalization at the end of 2019 (Table 2). BHARs are calculated using the Datastream Europe Total Market Return Index as benchmark. *, **, *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively.
Table 4
Effects of the Short-Selling Ban on Stock Returns.

Panel A: Major Stock Indices

| Overall Sample | Large Markets | Small Markets |
|----------------|--------------|---------------|
| Dependent variable: BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR |
| BAN | 0.0033 | -0.0649*** | -0.0533** | -0.035 | 0.0263 | -0.0986*** | -0.055 | 0.0555 | -0.0448 | 0.0086 | -0.0394 | -0.1057*** |
| | (0.23) | [-3.25] | [-2.08] | [-1.64] | [1.46] | [-3.65] | [1.66] | [0.21] | [-1.74] | [0.02] | [-0.87] | [-2.75] |
| MKTCAP | 0.0000*** | 0.0000* | 0.0000 | 0.0000 | 0.0000** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000*** | 0.0000 | 0.0000* |
| | (2.70) | [1.84] | [-1.25] | [-0.31] | [2.05] | [1.07] | [-1.62] | [-0.99] | [1.64] | [2.82] | [1.00] | [1.91] |
| EVOL | 0.0000 | 0.0000 | 0.0000*** | 0.0000* | 0.0000 | 0.0000*** | 0.0000 | 0.0000 | 0.0000 | 0.0000*** | 0.0000 | 0.0000 |
| | (0.78) | [-1.31] | [2.29] | [1.82] | [-0.07] | [0.76] | [2.10] | [2.03] | [-0.95] | [-1.86] | [0.63] | [-0.47] |
| VWAP | 0.0000*** | 0.0000 | 0.0000 | 0.0000 | 0.0000*** | 0.0000 | 0.0000 | 0.0000 | 0.0000*** | 0.0000* | 0.0000*** | 0.0000*** |
| | (4.22) | [0.43] | [0.34] | [1.55] | [4.47] | [-0.58] | [-0.94] | [0.98] | [1.84] | [4.40] | [4.92] | [4.98] |
| VOLA | -2.5572*** | 1.963 | -4.5697*** | -13.1715*** | -2.0465** | 1.8309 | -5.2865** | -15.7117*** | -4.1576*** | 0.4775 | -3.094 | -9.8095*** |
| | [-3.43] | [1.04] | [-2.41] | [-8.26] | [-2.13] | [1.33] | [-2.00] | [-7.78] | [-3.51] | [0.31] | [-1.04] | [-6.04] |
| CONS | 0.0786** | -0.0305 | 0.0707* | 0.2099*** | 0.037 | -0.029 | 0.0897 | 0.2374*** | 0.1685*** | -0.059 | 0.0167 | 0.1633*** |
| | (2.29) | [-0.91] | [1.77] | [6.20] | [0.83] | [-0.65] | [1.59] | [5.41] | [2.99] | [-1.18] | [0.29] | [3.79] |
| Adj. R² | 0.1114 | 0.0342 | 0.0599 | 0.255 | 0.113 | 0.0623 | 0.0513 | 0.2702 | 0.1534 | 0.1048 | 0.1579 | 0.3969 |
| Obs. | 311 | 310 | 309 | 309 | 204 | 203 | 202 | 202 | 107 | 107 | 107 | 107 |

Panel B: Largest 800 Stocks

| Overall Sample | Large Markets | Small Markets |
|----------------|--------------|---------------|
| Dependent variable: BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR |
| BAN | 0.0203** | -0.0779*** | -0.1038*** | -0.0531 | 0.0331*** | -0.0883*** | -0.0828*** | -0.0319 | -0.0076 | -0.0552 | -0.1469*** | -0.0990*** |
| | (2.11) | [-5.60] | [-5.28] | [-3.00] | [-2.80] | [-5.36] | [-3.64] | [-1.50] | [-0.38] | [-1.93] | [-3.63] | [-3.13] |
| MKTCAP | 0.0000* | 0.0000*** | 0.0000 | 0.0000 | 0.0000* | 0.0000** | 0.0000 | 0.0000 | 0.0000 | 0.0000*** | 0.0000 | 0.0000 |
| | (1.93) | [2.63] | [0.07] | [0.76] | [1.77] | [2.49] | [-0.03] | [1.04] | [-0.23] | [3.19] | [1.08] | [0.58] |
| EVOL | 0 | -0.0000** | 0.0000 | 0.0000 | 0.0000 | -0.0000*** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | (0.88) | [-2.53] | [-1.40] | [-1.30] | [1.00] | [-2.33] | [0.91] | [0.55] | [0.35] | [-1.81] | [0.89] | [0.98] |
| VWAP | 0.0000*** | 0.0000 | 0.0000 | 0.0000 | 0.0000*** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | (3.16) | [1.21] | [0.05] | [1.01] | [3.94] | [1.38] | [0.28] | [2.13] | [3.94] | [2.23] | [2.83] | [2.83] |
| VOLA | -3.0938*** | 3.2175*** | 5.9622*** | -1.9796 | -3.3264** | 4.2678*** | 6.9628*** | -1.1854 | -2.6429** | 1.0421 | 2.8212 | -3.8771 |
| | [-7.50] | [4.03] | [3.67] | [-0.83] | [-6.87] | [4.42] | [3.71] | [-0.41] | [-2.83] | [0.73] | [1.16] | [-1.55] |
| CONS | 0.1031*** | -0.0463* | -0.0699** | 0.0378 | 0.1010*** | -0.0706*** | -0.1019*** | 0.0136 | 0.0957** | -0.0105 | -0.0058 | 0.0629 |
| | (5.53) | [-1.96] | [-2.05] | [0.82] | [4.88] | [-2.59] | [-2.69] | [0.25] | [2.00] | [-0.21] | [-0.09] | [1.09] |
| Adj. R² | 0.094 | 0.0725 | 0.0699 | 0.0274 | 0.1054 | 0.0911 | 0.0634 | 0.0047 | 0.105 | 0.0577 | 0.1464 | 0.2249 |
| Obs. | 722 | 725 | 723 | 721 | 537 | 544 | 540 | 538 | 185 | 181 | 183 | 183 |

Panel C: Market Capitalization Quartiles of Largest 800 Stocks

| Quartile 4 | Quartile 3 |
|------------|------------|
| Dependent variable: BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR |
| [-40; 0] | [0; 40] | [0; 80] | [-40; 80] | [-40; 0] | [0; 40] | [0; 80] | [-40; 80] |
| (continued on next page) |
Table 4 (continued)

Panel C: Market Capitalization Quartiles of Largest 800 Stocks

| Quartile | I     | II    | III   | IV    | Quartile | I     | II    | III   | IV    |
|----------|-------|-------|-------|-------|----------|-------|-------|-------|-------|
|          |       |       |       |       |          |       |       |       |       |
| BAN      | 0.0345| -0.0605**| -0.0504| -0.0238| 0.0098  | -0.0798***| -0.1150***| -0.0909***|
|          | [1.85]| [-2.06]| [-1.33]| [-0.72]| [0.50]  | [-2.85] | [-2.92] | [-2.82]|
| MKTCAP   | 0.0000| 0.0000| 0.0000| 0.0000| 0.0000* | 0.0000  | 0.0000  | 0.0000|
|          | [0.53]| [0.77]| [-1.59]| [-1.16]| [1.89]  | [1.45]  | [0.55]  | [1.30]|
| EVOL     | 0.0000| 0.0000| 0.0000*| 0.0000| 0.0000**| -0.0000**| 0.0000  | 0.0000|
|          | [1.13]| [-0.95]| [1.75]| [1.51]| [2.56]  | [-2.42] | [0.51]  | [1.31]|
| VWAP     | 0.0000***| 0.0000| 0.0000| 0.0000| 0.0000* | 0.0000  | 0.0000  | 0.0000|
|          | [5.00]| [0.84]| [-0.87]| [-0.34]| [1.66]  | [1.03]  | [0.23]  | [0.94]|
| VOLA     | -2.6643***| 0.7821| 0.1424| -9.0701***| -2.6855***| 3.4187**| 0.5970  | -8.9802***|
|          | [-3.29]| [0.49]| [0.04]| [-2.82]| [-3.48] | [2.40]  | [0.22]  | [-4.60]|
| CONS     | 0.0794**| 0.0104| 0.0251| 0.1731***| 0.0705** | -0.0338| 0.0449  | 0.1745***|
|          | [2.09]| [0.22]| [0.36]| [3.17]| [2.00]  | [-0.70] | [0.72]  | [3.91]|
| Adj. R²  | 0.0785| 0.0010| 0.0079| 0.1036| 0.0973  | 0.0797  | 0.03    | 0.1296|
|          |       |       |       |       | 177     | 179    | 178    | 177   |
|          |       |       |       |       |         |       |       |       |
|          |       |       |       |       |         |       |       |       |
|          |       |       |       |       |         |       |       |       |
|          |       |       |       |       |         |       |       |       |
| Quartile 2|       |       |       |       |         |       |       |       |
|          |       |       |       |       |         |       |       |       |
| Dependent variable: | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR | BHAR |
|          |       |       |       |       |       |       |       |       |
| BAN      | -0.0021| -0.1066***| -0.1346***| -0.0949**| 0.0363* | -0.0521| -0.0905**| 0.0034|
|          | [-0.10]| [-3.78]| [-3.58]| [-2.45]| [1.70]  | [-1.65] | [-2.12] | [0.10]|
| MKTCAP   | 0.0000***| 0.0000***| 0.0000***| 0.0000***| 0.0000  | 0.0000  | 0.0000  | 0.0000|
|          | [2.98]| [5.64]| [3.51]| [4.59]| [4.68]  | [1.65]  | [0.56]  | [0.62]|
| EVOL     | -0.0000*| -0.0000***| 0.0000| -0.0000*| 0.0000  | 0.0000  | 0.0000  | 0.0000|
|          | [-1.90]| [-4.44]| [-0.99]| [-1.71]| [-0.32] | [0.55]  | [-1.03] | [0.94]|
| VWAP     | 0.0000| 0.0000| 0.0000| 0.0000*| 0.0000  | 0.0000  | 0.0000  | 0.0000*|
|          | [-1.64]| [-0.30]| [-1.14]| [-1.91]| [0.60]  | [0.94]  | [0.87]  | [1.71]|
| VOLA     | -4.1400***| 5.4871***| 11.289***| 4.7466| -2.4689***| 3.8154***| 8.3342***| 0.6989|
|          | [-4.63]| [2.85]| [4.36]| [0.97]| [-2.84] | [2.64]  | [3.38]  | [0.24]|
| CONS     | 0.1402***| -0.1325***| -0.2320***| -0.1281| 0.0645  | -0.0950*| -0.1570***| -0.0664|
|          | [3.59]| [-2.91]| [-4.10]| [-1.43]| [1.51]  | [-1.82] | [-2.42] | [-1.00]|
| Adj. R²  | 0.1826| 0.2024| 0.2369| 0.1232| 0.0482  | 0.1023  | 0.1068  | 0.0041|
| Obs.     | 182   | 185   | 182   | 181   | 181     | 179    | 181    | 181   |

Notes: This table presents the results for cross-sectional regressions with buy-and-hold abnormal returns (BHARs) across different intervals as dependent variables. The samples include the 12 major stock indices in Europe (Panel A) and the largest 800 stocks from 10 European countries (Panel B). Panel C reports the results for quartiles based on year-end 2019 market capitalization. In Panel B and C, we separate the BHARs for subsamples of large markets and small markets based on the total of market capitalization at the end of 2019 (Table 2). BHARs are calculated using the Datastream Europe Total Market Return Index as benchmark. All variables are defined in Table A1. We report t-statistics based on robust standard errors in parentheses. *, **, *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively.
into larger and smaller markets. For the interval around the event (-40; 80), we observe that the BHAR differences between banned and non-banned stocks increase substantially when we move from larger to smaller stock markets. On average, we find for our two samples of 350 and 800 stocks significant differences between banned and non-banned stocks for larger markets of −6.31 % and −3.31 %, respectively, and for smaller markets of −12.77 % and −12.87 %, respectively. Finally, we differentiate between firm size quartiles (Panel C). The BHAR performance differences between ban and no-ban stocks are larger for smaller firms (quartiles 3, 2 and 1) and significantly different for the two intervals subsequent to the event (0; 40 and 0; 80). Interestingly, for these two post-event intervals, BHARs for banned stocks are always negative, whereas they are positive for non-banned stocks. Only during the pre-event interval (-40; 0) abnormal returns for both groups are negative, which is due to the pandemic-induced dramatic decline in stock prices. These results clearly suggest that the event (ban vs non-ban) separates the stocks into losers and winners or under- and outperformers. Consequently, the introduction of the short-selling ban did not improve stock prices absolutely or relatively but resulted overall in a negative and lower performance for banned compared to non-banned stocks. We also extend our analysis to the Euro Stoxx 50 and other intervals and present supporting evidence in the Internet Appendix, Part I, (Figure IA1-IA2, Table IA1).

4.1.3. Cross-sectional regressions: Short-selling ban effects

In Table 4, we present the findings from the cross-sectional OLS regressions on the BHARs. For banned stocks included in one of the major stock indices, we find again lower returns for the 40- and 80-days period after implementing the ban (Panel A, overall sample). For larger (0; 40) and smaller markets (-40; 80), our results indicate significantly lower BHARs in ban countries by −9.84 % and −10.57 %, respectively.

For the 800 largest stocks, we also document that the short-selling ban negatively affected stock prices, resulting in BHARs of −7.79 % and −10.38 % over the 41-days and 81-days intervals, respectively (Panel B, overall sample). Interestingly, stocks in ban countries achieved abnormal returns that are 2.03 % higher during the 40-days pre-ban period, while they remained lower (−5.31 %) over the longer interval (-40; 80). Importantly, in larger markets, we also observe a relative underperformance of banned stocks compared to non-banned stocks, which becomes somewhat lower with −8.28 % after the ban (0; 80). In contrast, this difference has a higher magnitude in smaller markets (-14.69 %). Finally, we analyze the effects of the short-selling ban for each size quartile and find that the BAN coefficient is more negative in the group of smaller firms (Panel C). Stocks that are banned from short selling realized 7.98 % (Q3) and 10.66 % (Q2) lower BHAR over the (0; 40) event window, while the underperformance is only at 6.05 % in the largest quartile (Q4).

Overall, our results suggest that regulators’ objective of stabilizing stock prices by introducing short-selling restrictions was hardly successful. The ban did not prevent, on average, an underperformance relative to the benchmark (Datasem Europe Total Market Return index) and relative to non-banned stocks. These results become even larger after the ban was initiated. Consequently, we have to reject Hypothesis 1. Our analysis clearly reveals that the beginning of the pandemic resulted in an immediate and substantial stock market decline (-40; 0). This decline continued for banned stock, whereas non-banned stocks performed relatively better. However, other measures besides the ban most likely contributed to the subsequent extreme reversal and recovery. Most importantly, the European Central Bank announced quantitative easing (QE) interventions exactly on the same day when the ban started (18 March 2020) and governments began implementing positive fiscal policy measures (Seven and Yılmaz, 2021). Consequently, the regulatory intervention negatively affected the market environment and firm valuations, as it restricted trading activities and limited investment strategies. Institutional investors that may have adjusted the risk exposure by selling stocks as protective short selling could not continue with their risk minimizing strategy, as this was disallowed, creating the negative performance. Moreover, investors may have avoided investing in shares that could not be quickly sold short if necessary. This may have created extreme downward pressure on these stock prices. Investigating this aspect in more detail, we leave for future research.

Moreover, our findings do not support the “Overvaluation”-Hypothesis of Miller (1977), which predicts that short-selling bans positively bias fundamental values, leading temporarily to higher stock prices during the restrictions. Nevertheless, the previous empirical evidence is rather inconclusive, as there is more (Boulton and Braga-Alves, 2010; Frino et al., 2011; Beber and Pagano, 2013) or less support for Miller’s theory (Beber et al., 2021; Boehmer et al., 2013). However, the theory may not be fully applicable to this situation, as the ban also affected the trading environment and market quality, which we need to consider as well. We examine this issue next.

4.2. Liquidity and volatility

4.2.1. Measures of market quality

We employ four different quantitative measures of market quality: Spreads at €10k, Turnover, Price Range, and Volatility. As liquidity affects the pricing and trading costs of a security as well as the net returns for investors, it is central for measuring market quality. During periods of rapidly, and sharply declining stock prices, liquidity often diminishes. The stock price decline is even more severe when short selling is restricted, as investor instead could sell their shares immediately. To investigate the effects of the short-selling ban on liquidity, we employ price-based (Spreads at €10k) and volume-based (Turnover) measures.

Spreads at €10k is defined as the weighted difference between best bid (PBt) and best ask price (PAt) for an order volume of €10,000 in stock i at time t, expressed in basis points. The weighting factor w_{i,c,t} is based on market turnover at each trading venue c including the primary exchange of the stock and pan-European venues such as Aquis, Cboe BXE, Cboe CXE and Turquoise. The difference widens when liquidity decreases, resulting in higher trading costs:
Panel A: Major Stock Indices from 12 European Countries

Fig. 2. Market Quality Effects of the Short-Selling Ban as Percentage Change (in %), Notes: This figure compares the percentage change of market quality over the sample period from 1 January to 30 June 2020 for each of our three samples. It compares the constituents of the major stock market indices from 12 European countries (Panel A), the 800 largest stocks from 10 European countries (Panel B) and quartiles based on the year-end 2019 market capitalization (Panel C) that are clustered into six ban countries and six no-ban countries (Table 2). The red (blue) lines represent the
countries with (without) the ban. The dotted vertical lines indicate the following key events: (1) February 19, the beginning of the global stock market crash; (2) March 18, the introduction of the ban on short selling in all of the respective countries; (3) May 18, the lift of the ban in these countries. We employ four quantitative measures of market quality as defined in Table A1. We depict the 5-day moving average of the cross-sectional average of each measure. We separate the measures for large markets and small markets based on the total of market capitalization at the end of 2019 (Table 2). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

\[ \text{Spreads at } \epsilon 10k,_{it} = \sum_{c=1}^{n} w_{c,t} \cdot (PA_{c,t} - PB_{c,t}) \]  

(3)

\[ \text{Turnover}_{it} = \frac{\text{VO}_{it}}{\text{NOSH}_{it}} \times 100 \]  

(4)

With respect to stock market volatility, we employ two measures: Price Range and Stock Return Volatility. Usually, high fluctuations of intra-day or daily prices typically causes concerns for investors. However, volatility is also an important indicator for market quality, as it reflects diverging opinions and information between market participants as well as high uncertainties about the accurate valuation of a company. It is therefore an indication of a well-functioning pricing mechanism, especially if volatility declines quickly when the stock prices fully reflect all information. Nevertheless, this process may continue for some time when information arrive continuously over an extended period such as during a pandemic. For both measures, a higher value indicates higher dispersions of prices and returns. We define PriceRange as the highest stock price achieved on a given day (PH_{it}) divided by the lowest price on that day (PL_{it}):

\[ \text{PriceRange}_{it} = \frac{\text{PH}_{it}}{\text{PL}_{it}} \]  

(5)

Volatility is the 20-day rolling standard deviation of the return on a given stock. We obtained daily data of the individual stocks from Refinitiv Datastream and big xyt (Spreads at F 10 k). To mitigate potential effects of outliers, we winsorized all continuous variables by eliminating the observations at the 1st and 99th percentile within a country (Beber and Pagano, 2013). Table A1 contains all definitions and descriptions of our variables.

4.2.2. Descriptive evidence

We are particularly interested in examining the effects of the short-selling ban on market quality measures such as Spreads, Turnover, and Volatility for both smaller and larger markets as well as for different periods. We divide our sample into two groups of stocks from countries with and without bans and investigate four distinct periods: (1) Pre-Crash, (2) Crash, (3) Ban and (4) Post-Ban.

4.2.2.1. Major stock indices. In Panel A, Fig. 2, we present the results of the major stock indices for all 12 countries and distinguish again between larger and smaller stock markets. The graphical analysis indicates the percentage change of market quality over the sample period with January 1, 2020, functioning as the reference point. We observe that Spreads, Turnover, and Volatility sharply increase during the crash period but reverse and start to decline at the ban initiation and remain at a level that is lower than the peak, but still marginally higher than the pre-crisis level. For the different groups, we observe a quite similar behavior in the periods before and during the crash. However, market quality measures start diverging when the ban became effective, with higher spreads, lower turnover, and higher volatility in ban countries. Comparing larger with smaller markets, the overall impression remains unchanged with the percentage changes in spreads being lower in smaller markets. Consequently, the ban failed to achieve its objective, as most market-quality measures for no-ban countries are superior and dominate.

Table 5, Panel A, provides the statistical tests for the evidence observed in Fig. 2, by comparing the differences in our measures over the four periods between countries with and without bans (difference-in-differences; DiD). The turbulence during the crash period affected market quality in both groups negatively (2) - (1)), with a severely higher negative impact on the stocks, which are subsequently banned from short selling. We also find that spreads and volatility increased and turnover decreased at a higher magnitude for banned stocks during the ban period relative to the periods before ((3) - (2) / (1)), which supports our Hypotheses 2, 3 and 4. After the ban, the market quality improvement is more pronounced in ban countries ((4) - (3)), indicating the initially stronger negative effects that the restrictions had on market quality in these countries. Subsequently, these effects began to disappear, suggesting that the markets in these countries also function well if undisturbed by regulatory intervention.

4.2.2.2. Largest 800 stocks. We observe a similar overall pattern for the 800 largest stocks (Panel B, Fig. 2). In general, the market quality of stocks from ban countries is inferior during the period in which the ban was effective. In the post-ban period, all ratios start slowly converging to pre-ban levels. Interestingly, the relative changes in liquidity appear to be lower in smaller markets. In Panel C, we take firm size into account and find that the percentage changes of spreads are relatively smaller when we move from the fourth quartile (largest stocks) to the first quartile (smallest stocks), while turnover reveals no clear pattern. We observe the same effects for volatility, as the relative change for the highest quartile is more pronounced compared to other quartiles, suggesting that higher valued stocks experienced a larger decline in market quality.
Panel B: *Largest 800 Stocks* from 10 European Countries

Fig. 2. (continued).
Panel C: *Quartiles of Largest 800 Stocks* based on Year-End 2019 Market Capitalization

![Graph showing quartiles of largest 800 stocks based on year-end 2019 market capitalization.](image-url)

**Fig. 2.** (continued).
### Table 5

**Market Quality around the Crash and Short-Selling Ban Periods.**

| Measure | Stocks from Ban Countries | Differences between Periods | Differences between Periods |
|---------|---------------------------|-----------------------------|-----------------------------|
|         | Pre-Crash | Crash | Ban | Post-Ban | (2) - (1) | (3) - (2) | (3) - (1) | (4) - (3) |
| Spreads at 10k | 9.6675 | 14.7778 | 18.7961 | 14.5648 | 5.1103 *** | 4.0183 | 9.1286 *** | -4.2312 *** |
| Turnover | 0.2669 | 0.5230 | 0.2983 | 0.3599 | 0.2561 *** | -0.2247 *** | 0.0313 *** | 0.0616 *** |
| Price Range | 1.0209 | 1.0539 | 1.0465 | 1.0383 | 0.0330 *** | -0.0074 *** | 0.0256 *** | -0.0082 *** |
| Volatility | 0.0140 | 0.0251 | 0.0427 | 0.0284 | 0.0111 *** | 0.0176 *** | 0.0286 *** | -0.0142 *** |

| Measure | Control Stocks | Differences between Periods | Differences between Periods |
|---------|---------------|-----------------------------|-----------------------------|
|         | Pre-Crash | Crash | Ban | Post-Ban | (2) - (1) | (3) - (2) | (3) - (1) | (4) - (3) |
| Spreads at 10k | 7.7642 | 11.0175 | 11.5645 | 9.3463 | 3.2534 *** | 0.5470 *** | 3.8004 *** | -2.2183 *** |
| Turnover | 0.2836 | 0.5767 | 0.3917 | 0.3727 | 0.2931 *** | -0.1850 *** | 0.1081 *** | -0.0190 *** |
| Price Range | 1.0190 | 1.0468 | 1.0406 | 1.0318 | 0.0279 *** | -0.0063 *** | 0.0216 *** | -0.0088 *** |
| Volatility | 0.0136 | 0.0218 | 0.0385 | 0.0271 | 0.0082 *** | 0.0167 *** | 0.0248 *** | -0.0113 *** |

| Measure | Difference-in-Differences | Differences between Periods | Differences between Periods |
|---------|---------------------------|-----------------------------|-----------------------------|
|         | (2) - (1) | (3) - (2) | (3) - (1) | (4) - (3) |
| Spreads at 10k | 1.8570 *** | 3.4713 *** | 5.3282 *** | -2.0130 *** |
| Turnover | -0.0371 *** | -0.0397 *** | -0.0767 *** | 0.0806 *** |
| Price Range | 0.0051 *** | -0.0011 *** | 0.0040 *** | -0.0005 *** |
| Volatility | 0.0029 *** | 0.0009 *** | 0.0038 *** | -0.0029 *** |

| Measure | Stocks from Ban Countries | Differences between Periods | Differences between Periods |
|---------|---------------------------|-----------------------------|-----------------------------|
|         | Pre-Crash | Crash | Ban | Post-Ban | (2) - (1) | (3) - (2) | (3) - (1) | (4) - (3) |
| Spreads at 10k | 43.1453 | 65.9578 | 72.2600 | 57.8148 | 22.8125 *** | 6.3022 *** | 29.1477 *** | -14.4452 *** |
| Turnover | 0.1989 | 0.3602 | 0.2052 | 0.2581 | 0.1613 *** | -0.1551 *** | 0.0063 *** | 0.0529 *** |
| Price Range | 1.0237 | 1.0561 | 1.0478 | 1.0397 | 0.0324 *** | -0.0083 *** | 0.0241 *** | -0.0081 *** |
| Volatility | 0.0158 | 0.0245 | 0.0408 | 0.0283 | 0.0087 *** | 0.0163 *** | 0.0250 *** | -0.0125 *** |

| Measure | Control Stocks | Differences between Periods | Differences between Periods |
|---------|---------------|-----------------------------|-----------------------------|
|         | Pre-Crash | Crash | Ban | Post-Ban | (2) - (1) | (3) - (2) | (3) - (1) | (4) - (3) |
| Spreads at 10k | 15.0530 | 21.3691 | 25.2683 | 20.3741 | 6.3161 *** | 3.8992 *** | 10.2153 *** | -29.1477 *** |
| Turnover | 0.2463 | 0.4724 | 0.3510 | 0.3131 | 0.2262 *** | -0.1214 *** | 0.1048 ** | -0.0380 *** |
| Price Range | 1.0240 | 1.0540 | 1.0485 | 1.0373 | 0.0300 *** | -0.0055 *** | 0.0245 *** | -0.0112 *** |
| Volatility | 0.0165 | 0.0243 | 0.0418 | 0.0285 | 0.0077 *** | 0.0175 *** | 0.0252 *** | -0.0133 *** |

| Measure | Difference-in-Differences | Differences between Periods | Differences between Periods |
|---------|---------------------------|-----------------------------|-----------------------------|
|         | (2) - (1) | (3) - (2) | (3) - (1) | (4) - (3) |
| Spreads at 10k | 16.4964 *** | 2.4030 *** | 18.8994 *** | -9.5510 *** |
| Turnover | -0.0648 *** | -0.0337 *** | -0.0985 *** | 0.0999 *** |
| Price Range | 0.0024 *** | -0.0028 *** | -0.0004 *** | 0.0031 *** |
| Volatility | 0.0009 *** | -0.0012 *** | -0.0003 *** | 0.0008 *** |

Notes: This table presents mean values of the market quality measures for banned and control stocks across four different periods: (1) Pre-Crash (January 1 to February 19), (2) Crash (February 20 to March 17), (3) Short-Selling Ban (March 18 to May 18) and (4) Post-Ban (May 19 to June 30). We use daily stock data for the constituents of major stock indices from 12 European countries over the period from January 2 to June 30, 2020. All variables are defined in Table A1. *, **, *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively.

We perform the statistical tests presented in Table 5, Panel B and find that stocks from ban countries had significantly higher spreads and volatility in the crash relative to the pre-crash period ((2) - (1)). Again, the difference-in-difference results indicate that the short-selling ban had severe negative effects on market quality ((3) - (2) / (1)) in these countries, consistent with our Hypotheses 2 and 3. After the ban had expired, we observe market quality improvements ((4) - (3)), which were significantly stronger for stocks from ban countries. This is not surprising and indicates that the market quality declined due to regulatory intervention. It returned to previous levels after the ban ended.

In the Internet Appendix, Part I, we provide several additional analyses based on the Euro Stoxx 50 (Figure IA3, Table IA3), the level of each market quality measures (Figure IA4), and for an extended period from January 2019 to December 2020 (Figure IA5, Table IA4). All previous findings remain qualitatively unchanged.
4.2.3. Panel regressions: Overall market quality effects

To examine the effects of the short-selling ban on market quality, we perform fixed-effects panel regressions that control for stock-specific characteristics and time-varying factors at the stock- and market-level. We estimate the following baseline model:

$$ Y_{it} = \beta_1 BAN_{it} + \gamma X_{it} + \varphi_{it} + \varepsilon_{it} $$  

(6)

where $Y_{it}$ is a vector with our measures of market quality; $BAN_{it}$ is an indicator variable and main variable of interest that takes the value of one when the stock is subject to the short-selling ban and zero otherwise. $X_{it}$ is a vector of control variables as specified in Eq. (2) and $\varphi_{it}$ is a vector of stock dummies that net out unobservable time-invariant effects that are specific to a stock.

Our previous results suggest that the short-selling ban had negative effects on market quality. In Panels A of Table 6 and 7, we present our multivariate results, which confirm the descriptive evidence for the stocks of major stock indices and the largest 800 stocks, respectively. The coefficients of the $BAN$ dummies are positive for $Spreads$, $Price$ $Range$ and $Volatility$, and negative for $Turnover$, all statistically significant at the 1% level. In the Internet Appendix, Part I, regressions for the Euro Stoxx 50 (Table IA3) and over the extended period January 2019 to December 2020 also confirm our results (Tables IA5 and IA6, Panels A). The results provide supporting evidence for our Hypotheses 2, 3 and 4.

4.2.4. Panel regressions: Differential market and firm size effects

To address the issue that the effects of the short-selling ban may depend on the size of the stock market, we estimate the following variant of Eq. (6):

Table 6

| Panel A: Overall Sample | I          | II         | III        | IV         |
|------------------------|------------|------------|------------|------------|
| Dependent variable:    | Spread 10 k| Turnover   | Price Range| Volatility |
| BAN                    | 0.1513***  | -0.2920*** | 0.0113***  | 0.0183***  |
| [6.46]                 | [-7.66]    | [5.59]     | [9.71]     |            |
| MKTCAP                 | -0.0000*** | -0.0000*** | -0.0000*** | -0.0000*** |
| [3.95]                 | [-4.50]    | [-7.71]    | [-8.83]    |            |
| EVOL                   | 0.0000***  | 0.0000***  | 0.0000***  | 0.0000***  |
| [3.91]                 | [13.61]    | [9.44]     | [3.38]     |            |
| VWAP                   | -0.0011*** | -0.0006*   | -0.0001**  | -0.0001**  |
| [-3.74]                | [-1.80]    | [-2.43]    | [-2.19]    |            |
| VOLA                   | 14.9598*** | 11.3323*** |            |            |
| [18.74]                | [11.18]    |            |            |            |
| Stock FE               | yes        | yes        | yes        |            |
| Adjusted $R^2$         | 0.9195     | 0.8015     | 0.3343     | 0.4749     |
| Observations           | 29,660     | 32,252     | 32,252     | 32,252     |

Panel B: Large versus Small Markets

| I          | II         | III        | IV         |
|------------|------------|------------|------------|
| Dependent variable: | Spread 10 k| Turnover   | Price Range| Volatility |
| BAN                    | 0.2178***  | -0.1700*** | 0.0044***  | 0.0029**   |
| [5.60]                 | [-3.75]    | [4.51]     | [2.47]     |            |
| SMALL                  | 0.2510***  | -0.2625*** | -0.0008    | -0.0009    |
| [3.58]                 | [-4.30]    | [-1.00]    | [-1.33]    |            |
| BAN * SMALL            | 0.4415***  | -0.4945*** | 0.0017     | 0.0023     |
| [5.09]                 | [5.92]     | [1.20]     | [1.61]     |            |
| MKTCAP                 | -0.0000*** | -0.0000*** | -0.0000*** | -0.0000*** |
| [3.91]                 | [-14.90]   | [-7.94]    | [-7.20]    |            |
| EVOL                   | -0.0000*** | 0.0000***  | 0.0000***  | 0.0000***  |
| [-7.26]                | [13.12]    | [5.20]     | [3.36]     |            |
| VWAP                   | -0.0001    | 0.0001     | -0.0000*** | -0.0000*** |
| [-1.87]                | [1.26]     | [-4.05]    | [-4.60]    |            |
| VOLA                   | 3.4319     | 14.9345*** |            |            |
| [1.67]                 | [7.29]     |            |            |            |
| Time FE                | yes        | yes        | yes        |            |
| Adjusted $R^2$         | 0.5439     | 0.4672     | 0.5358     | 0.6842     |
| Observations           | 29,660     | 32,252     | 32,252     | 32,252     |

Notes: This table presents the results of fixed-effects panel regressions with measures of market quality as the dependent variables. We use daily data of the leading stock indices from 12 European countries over the period from 2 January 2020 to 30 June 2020 (Table 2). Panel A reports the results for the baseline model and Panel B controls for the market size based on total market capitalization at the end of 2019. We use the natural logarithm of the dependent variables, except for Volatility. All variables are defined in Table A1. The panel regressions include stock-fixed effects. We report $t$-statistics based on robust standard errors clustered at firm-level and time-level in parentheses (Thompson, 2011). *, **, *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively.
Table 7
Effects of Short-Selling Bans on Market Quality – Largest 800 Stocks.

Panel A: Overall Sample

| I | II | III | IV |
|---|---|---|---|
| Dependent variable: | Spread 10k | Turnover | Price Range | Volatility |
| BAN | 0.2137*** | −0.3571*** | 0.0107*** | 0.0171*** |
| | [8.69] | [9.20] | [4.97] | [10.39] |
| MKTCAP | −0.0000*** | −0.0000*** | −0.0000*** | −0.0000*** |
| | [-3.59] | [-5.57] | [-5.56] | [-6.49] |
| EVOL | 0.0000*** | 0.0000*** | 0.0000*** | 0.0000*** |
| | [3.70] | [13.51] | [10.07] | [3.24] |
| VWAP | −0.0004*** | −0.0003*** | −0.0001*** | −0.0000*** |
| | [-4.75] | [-3.73] | [-7.46] | [-6.50] |
| VOLA | 14.1902*** | 10.5801*** | | |
| | [18.06] | [10.25] | | |
| Stock FE | yes | yes | yes | yes |
| Adjusted R² | 0.9293 | 0.8000 | 0.2794 | 0.4418 |
| Observations | 65,703 | 74,608 | 74,608 | 74,608 |

Panel B: Large versus Small Markets

| I | II | III | IV |
|---|---|---|---|
| Dependent variable: | Spread 10k | Turnover | Price Range | Volatility |
| BAN | 0.5154*** | −0.3329*** | 0.0000 | 0.0000 |
| | [8.41] | [-4.58] | [-0.02] | [-0.46] |
| SMALL | 0.0044 | 0.0499 | −0.0032*** | −0.0004 |
| | [0.06] | [0.65] | [-4.50] | [-0.68] |
| BAN * SMALL | 0.2896*** | −0.3980*** | −0.0017 | −0.0002 |
| | [3.56] | [-1.31] | [-0.02] | [-1.62] |
| MKTCAP | −0.0000*** | −0.0000*** | −0.0000*** | −0.0000*** |
| | [-3.55] | [-6.05] | [-5.65] | [-5.22] |
| EVOL | −0.0000*** | 0.0000*** | 0.0000*** | 0.0000*** |
| | [-7.55] | [10.21] | [3.11] | [2.42] |
| VWAP | −0.0001 | 0 | −0.0000*** | −0.0000*** |
| | [-1.61] | [1.49] | [-2.34] | [-1.72] |
| VOLA | −2.5383 | 23.1909*** | | |
| | [-1.23] | [9.32] | | |
| Time FE | yes | yes | yes | yes |
| Adjusted R² | 0.3536 | 0.2683 | 0.395 | 0.5407 |
| Observations | 65,704 | 74,609 | 74,609 | 74,609 |

Panel C: Market Capitalization Quartile Dummies

| I | II | III | IV |
|---|---|---|---|
| Dependent variable: | Spread 10k | Turnover | Price Range | Volatility |
| BAN | 0.3883*** | 0.1313 | 0.0032*** | 0.0017 |
| | [6.38] | [0.15] | [2.73] | [1.43] |
| Q1 | 1.5854*** | −0.1734 | 0.0032*** | 0.0017*** |
| | [16.12] | [-1.60] | [2.75] | [1.99] |
| Q2 | 0.7732*** | 0.138 | 0.0012 | −0.0003 |
| | [10.15] | [1.44] | [1.05] | [-0.30] |
| Q3 | 0.3689*** | 0.2101** | 0.0001 | 0.0002 |
| | [5.47] | [2.30] | [0.93] | [0.21] |
| BAN * Q1 | 0.1279 | −0.6749*** | −0.0070*** | −0.0050*** |
| | [1.37] | [-5.15] | [-4.29] | [-3.50] |
| BAN * Q2 | 0.2753*** | −0.5054*** | −0.0027 | −0.0031** |
| | [3.32] | [-4.89] | [-1.94] | [-2.34] |
| BAN * Q3 | 0.1969*** | −0.5680*** | −0.0036*** | −0.0018 |
| | [2.59] | [-4.85] | [-2.43] | [-1.34] |
| Controls | yes | yes | yes | yes |
| Time FE | yes | yes | yes | yes |
| Adjusted R² | 0.3536 | 0.2683 | 0.395 | 0.5407 |
| Observations | 65,704 | 74,609 | 74,609 | 74,609 |

Panel D: Quartile Subsamples based on Year-End 2019 Market Capitalisation

Short Selling Ban (BAN) Coefficients

| I | II | III | IV |
|---|---|---|---|
| Dependent variable: | Spread 10k | Turnover | Price Range | Volatility |
| Quartile 4 | 0.1874*** | −0.2561*** | 0.0117*** | 0.0168*** |
| | [5.22] | [-6.31] | [5.10] | [8.55] |
We report evidence for the short-selling restrictions in 2008 (Boehmer et al., 2013). The increase in volatility was significantly lower for stocks in the smaller size quartiles during the ban period, also in line with U.S. results in small stock markets (Table 2). As SMALLq,t is perfectly collinear with stock-level fixed effects, we include time fixed effects (ϕjt) as a vector of calendar day dummies that controls for unobservable market-wide trends common to all stocks.

Moreover, we are interested whether the effects depend on the firm size and estimate the following variant of Eq. (7):

\[ Y_{it} = \beta_1 \text{BAN}_{i,t} + \beta_2 \text{SMALL}_{i,t} + \beta_3 \text{BAN}_{i,t} \times \text{SMALL}_{i,t} + \gamma X_{i,t} + \phi_{jt} + \epsilon_{it} \] (7)

where SMAlLq,t is an indicator variable equal to one for each stock that is listed on smaller stock markets (Table 2). As SMAlLq,t is perfectly collinear with stock-level fixed effects, we include time fixed effects (ϕjt) as a vector of calendar day dummies that controls for unobservable market-wide trends common to all stocks.

Moreover, we are interested whether the effects depend on the firm size and estimate the following variant of Eq. (7):

\[ Y_{it} = \beta_1 \text{BAN}_{i,t} + \sum_{j=1}^{k} \beta_{j+1} Q_j \sum_{j=1}^{k} \beta_{j+1} \text{BAN}_{i,t} \times Q_j + \gamma X_{i,t} + \phi_{jt} + \epsilon_{it} \] (8)

where Q denotes dummy variables that represent each size quartile based on the market capitalization at the end of 2019. Since we are concerned about serial correlation and cross-correlation, we estimate robust standard errors (εij) that we cluster at the stock- and time-level in all our regressions (Thompson, 2011). Table A1 contains all definitions and descriptions of our variables.

In Panel B of Table 6, we present the results for the market size analysis of the major stock indices. Columns 1 and 2 indicate that liquidity is not only lower in smaller markets but that the short-selling ban also affected Spreads and Turnover more severely. For volatility, we do not find any statistically significant differences in smaller markets relative to larger markets.

We next analyze the largest 800 stocks in Europe and the results in Panel B of Table 7 reveal a positive (negative) coefficient for the BAN × SMALL interacting term with respect to Spreads (Turnover). These results suggest that the ban more negatively affected the liquidity of stocks in smaller markets. We observe that the coefficient of BAN × SMALL is uninformative for Price Range and Volatility (columns 3 and 4). We also provide robust supporting evidence for an extended period in the Internet Appendix, Part I (Table IA5 to IA6, Panels B).

Finally, we investigate whether the effects of the short-selling restrictions depend on firm size (Panel C and Panel D of Table 7). For this, we incorporate the dummies for the smaller quartiles (Q1, Q2 and Q3) in the panel regressions, with the largest quartile (Q4) as reference point (Panel C). We also divide our second sample into size quartiles based on market capitalization at the end of 2019 and compute the quartiles for each country separately (Panel D). When we move from BAN × Q3 to BAN × Q4 for Spreads at 10k, Turnover, Price Range and Volatility, the positive and negative coefficients of the interaction terms increase and all are statistically significant at the 1 % level. Interestingly, smaller stocks from banned countries had a lower volatility than larger ones. We also perform the regressions for subsamples of each size quartile but only report the estimates of the BAN coefficients (Panel D). The coefficients in column 1 and 2 indicate that the short-selling restrictions affected the liquidity of smaller stocks more negatively relative to larger stocks, confirming our previous results. However, in column 3 and 4 (volatility), stocks with lower capitalization (Q1) experienced a lower increase of volatility during the ban compared to larger stocks (Q3 and Q4). In the Internet Appendix, Part I, we present additional results in Table IA6, Panel C and D that provide consistent evidence over the period 2019–2020.

Overall, we find that the results support our Hypotheses 2, 3 and 4. We observe that the ban affected the liquidity of smaller stocks more negatively, which is consistent with the related literature on the 2008 short-selling ban (Beber and Pagano, 2013). In contrast, the increase in volatility was significantly lower for stocks in the smaller size quartiles during the ban period, also in line with U.S. evidence for the short-selling restrictions in 2008 (Boehmer et al., 2013).

### 4.2.5. Robustness test: Periodic variation in market quality

In addition to our univariate results on changes of market quality between different periods (Table 5), we follow Boulton and Braga-Alves (2010) and employ the relative changes to examine the economic significance of the short-selling ban in a multivariate setting. More specifically, we calculate the differences for (1) the pre-crash period versus the crash period, (2) the ban period versus crash
Table 8: Robustness Tests – Periodic Variation Market Quality.

Panel A: Major Stock Indices

| Relative Changes between Periods                  | Short-Selling Ban Coefficients (BAN) |
|--------------------------------------------------|--------------------------------------|
|                                                  | I     | II    | III   | IV     |
| Crash to Pre-Crash                               |       |       |       |        |
| Spread 10k                                       | 0.0297| 0.0538| 0.0034***| 0.1290***|
| Turnover                                         | [0.98]| [0.79]| [3.23]| [3.03] |
| Price Range                                      | 0.2548***| -0.1574***| 0.0012| 0.0515 |
| Volatility                                       | [7.56]| [-5.22]| [0.84]| [0.89] |
| Ban to Crash                                     | 0.4005***| -0.2721***| 0.0045***| 0.3352***|
| Ban to Pre-Crash                                 | [7.44]| [-4.71]| [4.09]| [3.40] |
| Crash to Pre-Crash                               | -0.0585***| 0.2857***| 0.0017**| -0.0091|
| Post-Ban to Ban                                  | [-4.26]| [11.26]| [2.22]| [-0.50]|

Panel B: Largest 800 Stocks

| Relative Changes between Periods                  | Short-Selling Ban Coefficients (BAN) |
|--------------------------------------------------|--------------------------------------|
|                                                  | I     | II    | III   | IV     |
| Crash to Pre-Crash                               |       |       |       |        |
| Spread 10k                                       | 0.3948| 0.0232| 0.0022***| 0.003  |
| Turnover                                         | [1.21]| [0.34]| [2.40]| [0.08] |
| Price Range                                      | -0.0156| -0.2130***| -0.0018*| 0.0372 |
| Volatility                                       | [-0.17]| [-6.18]| [-1.79]| [0.80] |
| Ban to Pre-Crash                                 | 0.4755| -0.4123***| 0.0009| 0.1398*|
| Ban to Pre-Crash                                 | [1.40]| [-5.89]| [1.01]| [1.68] |
| Crash to Pre-Crash                               | -0.0603***| 0.7768*| 0.0017***| 0.0167|
| Post-Ban to Ban                                  | [-3.84]| [1.86]| [2.27]| [1.07] |

Notes: This table presents the results for cross-sectional regressions with relative changes in market quality across different periods as dependent variables. The periods are: (1) Pre-Crash (1 January to 19 February), (2) Crash (20 February to 17 March), (3) Ban (18 March to 18 May) and (4) Post-Ban (19 May to 30 June). The samples include the 12 major stock indices in Europe (Panel A) and the largest 800 stocks from 10 European countries (Panel B). The regressions use control variables as in Eq. (2) but taking the natural logarithm. All variables are defined in Table A1. We report t-statistics based on robust standard errors in parentheses. *, **, *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively.

period, (3) the ban period versus the pre-crash period, and (4) the post-ban period versus the ban period. We estimate the following model using OLS regressions with robust standard errors:

\[ \Delta Y_i = \beta_1 BAN_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t} \]  

(9)

where \( \Delta Y_i \) is a vector of the relative changes in market quality measures, \( BAN_{i,t} \) is an indicator variable that is one when stocks are banned from short selling, \( X_{i,t} \) is a vector of control variables as specified in Eq. (2) but taking the natural logarithms. In Table 8, we only report the results for the \( BAN \) coefficient. For major stock indices (Panel A), we find that the increase in volatility was larger in ban countries during the crash relative to the pre-crash period. During the ban, liquidity diminishes and volatility increased significantly more for banned stocks compared with the preceding periods. Comparing the post-ban with the ban period, we observe that liquidity recovered more in ban countries, which we interpret as a reverse effect for the larger decline in the previous period. All our additional results confirm all our previous findings for the largest 800 stocks (Panel B).

4.3. Endogeneity: Matched sample and instrumental variable regressions

An important issue in every empirical study are the potential endogeneity concerns, which may affect the causal interpretation of the results. Besides omitted variables and measurement errors, simultaneity bias is a relevant issue in our setting. Specifically, short-selling bans often occur in situations of market distress with excessive volatility and diminishing liquidity (reverse causality). We employ three approaches to address endogeneity issues: First, inclusion of fixed effects in all our regressions to mitigate biases from omitted variables. Second, use of matching procedure to control for the sample selection bias arising from the issue that especially regulators from more vulnerable countries intervened (4.3.1). Third, we apply the instrumental variables (IV) approach to the address the concern that deteriorating market quality was the trigger for regulators’ decisions to impose a short-selling ban (4.3.2).

4.3.1. Propensity score matching

Using propensity score matching without replacement, we construct a matched sample for the 800 largest stocks from countries with and without ban. To find a control stock with similar characteristics for each stock with a ban, we use firm size (market capitalization) and industry (two-digit SIC codes). The matched sample consists of 344 banned and 344 non-banned stocks as counterparts. We still observe a negative liquidity effect of the short-selling ban that was stronger in stocks from smaller markets (Table 9, Panel A). We also confirm that the liquidity decline was higher in smaller stocks, while the volatility increase was lower (Panel B).
variables are defined in Table A1. We report dummies are based on total market capitalization at the end of 2019. We use the natural logarithm of the dependent variables, except for $SMALL_{(\text{Thompson, 2011})}$. *, **, *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively.

We postulate that this risk will limit the country’s ability and financial flexibility to mitigate the impact of the Covid-19 pandemic, making it more inclined to impose protective regulations such as the short-selling ban. The country-specific index of financial stress focuses on the systemic risk in financial markets (equity, bonds, and foreign exchange). We assume that countries with a higher level of systemic risk are more likely to restrict short selling to ensure financial system stability.

We employ instrumental variables regressions with two-stage least squares (2SLS) estimation, where the first stage determines the impact of a ban and the second stage its effect on market quality. In the first stage, the most challenging task is the selection of the instruments than endogenous regressors, we can test for the exogeneity of the instruments using over-identification tests. The Hansen

### Table 9
Endogeneity Tests – Matched Sample.

#### Panel A: Large versus Small Markets

| I | II | III | IV |
|---|---|---|---|
| **Dependent variable:** | Spread 10k | Turnover | Price Range | Volatility |
| BAN | [0.657]*** | [0.47]*** | [0.000] | [0.000] |
| SMALL | [0.49] | [0.11] | [0.000]** | [0.000]** |
| BAN * SMALL | [0.303]*** | [0.4417]*** | [0.0116] | [0.0001] |
| MKTCAP | [0.0000]** | [0.0000]** | [0.0000]** | [0.0000]** |
| EVOL | [0.740] | [0.10] | [0.34] | [0.29] |
| VWAP | 0.0000 | 0.0000 | [0.0000] | [0.0000] |
| VOLA | [2.2647]*** | [24.4090]*** | [0.0012] | [0.0001] |
| Time FE | yes | yes | yes | yes |
| Adjusted $R^2$ | 0.3575 | 0.2672 | 0.3989 | 0.5456 |
| Observations | 59,635 | 67,937 | 67,937 | 67,937 |

#### Panel B: Market Capitalization Quartile Dummies

| I | II | III | IV |
|---|---|---|---|
| **Dependent variable:** | Spread 10k | Turnover | Price Range | Volatility |
| BAN | [0.353]*** | [0.267] | [0.398] | [0.545] |
| Q1 | [1.542]*** | [0.212] | [0.000] | [0.000] |
| Q2 | [0.726]*** | [0.162] | [0.001] | [0.000] |
| Q3 | [0.313]*** | [0.212] | [0.000] | [0.000] |
| BAN * Q1 | 0.1351 | [0.563]*** | [0.007] | [0.005]*** |
| BAN * Q2 | 0.2755*** | [0.465]*** | [0.002] | [0.003]*** |
| BAN * Q3 | 0.2107*** | [0.522]*** | [0.003] | [0.002] |
| Controls | yes | yes | yes | yes |
| Adjusted $R^2$ | 0.5699 | 0.2875 | 0.398 | 0.5484 |
| Observations | 59,635 | 67,937 | 67,937 | 67,937 |

Notes: This table presents the results of fixed-effects panel regressions with measures of market quality as the dependent variables. We use daily data of the largest 800 stocks from 10 European countries over the period from 2 January to 30 June 2020 (Table 2). Panel A controls for the market size (SMALL) and Panel B incorporates the quartiles dummies for firm size (Q1-Q3) with the largest quartile as reference. The market and quartile dummies are based on total market capitalization at the end of 2019. We use the natural logarithm of the dependent variables, except for Volatility. All variables are defined in Table A1. We report t-statistics based on robust standard errors clustered at firm-level and time-level in parentheses (Thompson, 2011). *, **, *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively.

### 4.3.2. Instrumental variables regressions

We employ instrumental variables regressions with two-stage least squares (2SLS) estimation, where the first stage determines the likelihood of a ban and the second stage its effect on market quality. In the first stage, the most challenging task is the selection of the instruments that are highly correlated with the short-selling ban decision, but uncorrelated with the residual error term. In addition, the regulators were more likely to take their decisions based on market-wide and time-variant variables that they used to monitor the current market situation. Similar to Beber and Pagano (2013), we use the 5-year sovereign CDS spreads and the financial stress index of Duprey et al. (2017) as instruments. The monthly CDS spread on sovereign bonds are a timely and market-based proxy for the credit quality and default risk of a country. We postulate that this risk will limit the country’s ability and financial flexibility to mitigate the impact of the Covid-19 pandemic, making it more inclined to impose protective regulations such as the short-selling ban. The country-specific index of financial stress focuses on the systemic risk in financial markets (equity, bonds, and foreign exchange). We assume that countries with a higher level of systemic risk are more likely to restrict short selling to ensure financial system stability.

We confirm the quality of our instruments (presented at the bottom of Table 10). The Kleibergen-Paap LM-Statistics indicate that our instruments are relevant, i.e. highly correlated with BAN, and that they are not weak, as the Kleibergen-Paap and Cragg-Donald Wald F-Tests strongly reject the hypothesis that the instruments can be excluded from the first-stage regression. Since we have more instruments than endogenous regressors, we can test for the exogeneity of the instruments using over-identification tests. The Hansen
J-Statistics show that the instruments pass the test and are unrelated to the residual error term.

The results of our IV panel regressions for our liquidity measures we present in Table 10. Columns 1 and 3, reports the first-stage estimates, where the coefficients differ due to data availability for Spreads at €10k and Turnover. The instruments are statistically significant and have the expected positive sign, supporting the view that the introduction of the short-selling ban was positively associated with sovereign default risk and systemic stress. For the second-stage estimates, the positive coefficient of BAN (estimated) confirms our previous findings for Spreads at €10k, whereas the negative coefficient of BAN is insignificant for Turnover. Overall, the results from the instrumental variable regressions support the causal link from the short-selling ban to Spreads at €10k and mitigate the endogeneity concerns in this relationship. Nevertheless, we remain cautious in interpreting our results as evidence for causality between short-selling bans and liquidity.

5. Determinants of a country imposing a short-selling ban

As a precautionary measure to minimize potential adverse effects resulting from a crisis event, it is important to analyze, determine, and predict which countries are likely candidates to implement a short-selling ban in the future to protect its financial markets and financial systems. Based on the analysis and experience from the current Covid-19 crisis, it appears more likely that countries with relatively weaker economic conditions, lower fiscal capacity (Martin and Nagler, 2021), and a less developed financial system will impose short-selling restrictions. Moreover, regulators have a higher probability of imposing market-wide restrictions when they face an increasing level of systemic risk. Therefore, different indicators may lead to the conclusion that specific policy actions might be necessary to minimize the adverse effects of a crisis and to guarantee a country’s financial stability. However, as our results suggest, imposing short-selling restrictions may come at the cost of lower market quality.

To investigate these issues, we create two different panel datasets for the 12 European countries listed in Table 2: (1) annual data over the period from 2004 to 2019 and (2) daily data between 1 January 2020 and 17 March 2020. Using the following logistic regression model, we identify the determinants of the likelihood that a country would impose a short-selling ban:

\[
Short - Selling\ Ban_c = \gamma X_{c,t} + \phi_{c,t} + \epsilon_{c,t}
\]

where Short-Selling Ban\(_c\) is an indicator variable that is one when the country \(c\) implemented the short-selling ban in 2020, \(X_{c,t}\) is a

| Table 10 | Endogeneity Tests – Instrumental Variables Regressions |
|----------|------------------------------------------------------|
| I | II | III | IV |
| Spread 10k | Second Stage | Turnover | Second Stage |
| **BAN (estimated)** | | First Stage | First Stage | 
| Sovereign SY CDS Spread | 0.0037*** | 0.0039*** | 
| (41.11) | (51.87) | 0.0000*** | 0.0000*** |
| Financial Stress Index | 2.0849*** | 2.0249*** | 0.2113*** |
| (23.69) | (23.39) | 21.2780*** | 
| MKTCAP | 0.0000*** | -0.0000*** | 0.0000*** |
| (2.24) | (-2.59) | (2.36) | (-6.87) |
| EVOL | -0.0000** | -0.0000*** | -0.0000*** |
| (-2.31) | (-8.48) | (-1.85) | (12.02) |
| VWAP | -0.0001*** | -0.0001*** | -0.0001*** |
| (-5.35) | (-3.13) | (-6.35) | (1.96) |
| VOLA | -1.4540*** | -2.0722 | -1.6356*** |
| (-2.89) | (-1.08) | (-3.69) | (7.28) |
| CONSTANT | -0.2176*** | 2.8128*** | -0.2113*** |
| (-18.85) | (44.56) | (-19.97) | (-32.65) |
| Kleibergen-Paap LM-Statistic | 330.7 | 400.8 |
| Kleibergen-Paap Wald F-Test | 1211 | 1932 |
| Cragg-Donald Wald F-Test | 7285 | 8991 |
| Hansen J-Statistic | 0.118 | 0.137 |
| Hansen Chi-sq(1) P-Value | 0.731 | 0.711 |
| Time FE | yes | yes | yes |
| Adjusted R² | 0.349 | 0.287 |
| Observations | 47,352 | 55,447 | 55,447 |

Notes: This table presents the results of instrumental variable regressions with measures of liquidity as the dependent variables. We use daily data of the 800 largest stocks from 10 European countries over the period from 2 January to 30 June 2020 (Table 2). We apply-two-stage least squares (2SLS) estimations, where columns 1 and 3 report the results for the first-stage regressions and columns 2 and 4 for the second-stage regressions. In the first-stage regression, the dependent variable is the indicator variable for the short-selling ban. Our instruments for the ban decision are the monthly 5-year sovereign CDS spreads and the financial stress index at the country level. In the second-stage regression, we use the natural logarithm of the liquidity measures. All variables are defined in Table A1. The regressions are estimated using calendar day dummies to avoid perfect collinearity. We report t-statistics based on robust standard errors clustered at firm-level and time-level in parentheses (Thompson, 2011). *, **, *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively.
vector of explanatory variables and $\phi_{c,t}$ is a vector of year or calendar-day dummies to net out unobservable global trends common to all countries. We use heteroscedasticity robust standard errors in all regressions. The annual dataset includes aggregated variables to capture the macroeconomic (GDP Growth, Inflation, Unemployment), financial system-related (Stock Turnover, Private Credit) and institutional (Institutional Quality) characteristics of a country. Moreover, we employ Current Account and Government Debt as a measure for the fiscal capacity. In the daily dataset, we include the international Oil Price, the VIX and VSTOXX indices, and the U.S. and European inter-bank spreads (TED Spreads) to account for global economic shocks, investor sentiment, and funding conditions. To control for the severity of the pandemic, we introduce the number of Covid-19 Death (as percentage of population) and the Stringency Index of lockdown measures. We use the Sovereign 5-Year CDS Spread as proxy for the government’s financial flexibility and fiscal spending during the pandemic. Table A1 contains all definitions and descriptions of our variables.

In Table 11, Panel A, we present our findings from the annual dataset and observe in all models that countries with higher Inflation and Unemployment rates were more likely to impose a ban. The results for the financial system indicate that a higher trading activity (Stock Market Turnover) and greater bank lending (Private Credit) decreased the likelihood for a ban (column 1). In column 2, we account for a country’s financial flexibility and observe that the coefficient of Government Debt is positive and significant at the 1% level. Furthermore, a higher level of Institutional Quality as measured with the average of government effectiveness and regulatory quality affected the ban decision negatively (column 3). We find further supporting evidence for our ideas when we combine the quality of institutions with the development of the financial system (column 4) or fiscal capacity of a country in one model (column 5).

Table 11
Determinants of the Short-Selling Ban Decision.

Panel A: Annual Data, 2004–2019

|                  | I     | II    | III   | IV    | V     |
|------------------|-------|-------|-------|-------|-------|
| **Dependent variable:** | BAN   | BAN   | BAN   | BAN   | BAN   |
| GDP Growth (ln)  | −0.1729 | −0.5009 | −0.3033 | 0.6544* | −0.3517 |
|                  | [−0.30] | [−1.40] | [−0.83] | [1.70] | [−1.00] |
| Inflation        | 4.0901*** | 1.4626*** | 1.0635*** | 4.2974*** | 1.5888*** |
|                  | [3.14] | [3.05] | [3.02] | [2.94] | [3.04] |
| Unemployment     | 0.9960*** | 0.2509*** | 0.1289* | 0.9586*** | 0.1526* |
|                  | [3.90] | [1.72] | [3.63] | [1.95] | |
| Current Account  | 0.0424 | (0.77) | 0.0108* | |
| Government Debt  | 0.0506*** | 0.0342** | 0.0342** | |
|                  | (4.13) | (2.11) | |
| Stock Market Turnover | −0.0416*** | | |
|                  | [−3.35] | | |
| Private Credit   | −0.1335*** | | |
|                  | [−3.23] | | |
| Institutional Quality | −3.1151*** | | |
|                  | [−3.03] | | |
| Time FE          | yes  | yes  | yes  | yes  | yes  |
| Obs.             | 117  | 157  | 146  | 112  | 145  |

Panel B: Daily Data, 1 January 2020 to 17 March 2020

|                  | I     | II    | III   | IV    | V     |
|------------------|-------|-------|-------|-------|-------|
| **Dependent variable:** | BAN   | BAN   | BAN   | BAN   | BAN   |
| Sovereign 5Y CDS Spread | 0.0469*** | 0.0474*** | 0.0323*** | 0.0553*** | 0.0481*** |
|                  | [11.44] | [11.89] | [6.00] | [12.44] | [7.15] |
| Stringency Index | 0.0925*** | 0.0917*** | 0.0570*** | 0.1100*** | 0.0655*** |
|                  | [6.81] | [6.82] | [4.06] | [7.18] | [3.02] |
| VIX              | −0.0485 | | |
|                  | [−0.75] | | |
| TED Spread       | −0.064 | | |
|                  | [−1.28] | | |
| Oil Price        | 0.0105 | −2.436 | | −4.0254 |
|                  | [0.11] | [−1.47] | | [−1.37] |
| VSTOXX           | −1.4482 | | |
|                  | [−1.54] | | |
| Eurozone TED Spread | 1.3981* | | |
|                  | [1.66] | | |
| Systemic Stress Indicator | −12.9087*** | | |
|                  | [−3.09] | | |
| Covid-19 Death (% pop) | 5.9490*** | | |
|                  | [2.72] | | |
| Time FE          | yes  | yes  | yes  | yes  | yes  |
| Obs.             | 624  | 660  | 495  | 614  | 451  |

Notes: This table presents the results of logit regressions on imposing a short-selling ban in 2020 as dependent variable. We use data from 12 European countries (Table 2). All variables are defined in Table A1. The regressions include time fixed effects and t-statistics based on robust standard errors in parentheses. *, **, *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively.
In Panel B, we present the results from our daily dataset. For all models, we find that the coefficients for Sovereign 5-Year CDS Spread and Stringency Index are positive and highly significant at the 1% level. This indicates that the sovereign default risk and uncertainties due to the lockdown measures increased the likelihood of a short-selling ban on 18 March 2020. In column 1, we account for global market conditions (Oil Price), investor sentiment (VIX) and credit risk in the banking system (TED Spread) and hardly find supporting evidence (insignificant coefficients) for these variables, as other factors than the pandemic in Europe might determine its influence. The same holds for the European version of these indicators using the VSTOXX and Eurozone TED Spread (column 2). Moreover, we observe that countries with higher levels of systemic stress (Systemic Stress Indicator) were less likely to implement a ban (column 3). Most important for our analysis, however, is that the severity of the Covid-19 pandemic was positively associated with the ban decision (column 4). In the full model setting, our results remain unchanged (column 5).

Overall, our findings suggest that the long-term characteristics with which the countries entered the pandemic and the short-term effects of the Covid-19 pandemic significantly affected the likelihood of introducing a short-selling ban. This provides some explanations and hindsight justifications for why the six European countries implemented a ban (Table 2). The characteristics of these countries we can summarize as (1) weaker state of the economy, (2) higher vulnerability to economic crises, (3) less developed financial system and (4) increased level of sovereign default risk. Nevertheless, the important question remains whether the short-selling ban was really required and justified. Another interesting issue to investigate is whether other market mechanisms could have acted as a substitute or a first line of defense for guaranteeing market quality. Consequently, this could preclude the introduction of short-selling bans in the future, because these are costly, as documented above. We address this issue in the next section.

6. Short-selling activities, market manipulation, and financial stability during the Covid-19 crisis

The positive effects that short selling usually have on market quality are well documented in the academic literature. However, restricting short positions could be justified in those instances when a crisis or current market conditions pose a potential threat in the form of market manipulation, illegal insider trading and financial system instability. Therefore, refraining from implementing short-selling restrictions during crisis periods is justified only when regulators are able to guarantee the orderly functioning of securities markets and there is no risk of financial instability. In this section, we discuss potential concerns about short-selling activities (6.1), market manipulation (6.2), and financial stability (6.3) and provide empirical evidence, all related to the Covid-19 crisis. In the Internet Appendix, Part II, we provide a more detailed perspective, additional evidence and suggestions for future research.

6.1. Short-selling activities

6.1.1. Activist short selling versus short-and-distort manipulation

“Negative shareholder activism” has become a recent phenomenon in financial markets. Management often claims that activist hedge funds intentionally disseminate “incorrect” negative information while holding short positions to profit from falling stock prices. For this, activists disclose their concerns in public statements, issue negative research reports and launch short-selling campaigns. This negative activism not only seeks to reveal private information (Appel and Fos, 2022) and to uncover overvaluation or fraud, but also seeks to incite other shareholders to sell the target shares (Bliss et al., 2020; Brendel and Ryans, 2021; Molk and Partnoy, 2022). Interestingly, short sellers more often attack firms with higher information asymmetries that are smaller and have less liquidity, resulting in higher negative returns (Jank et al., 2021; Zhao, 2020). However, this behavior does not constitute market manipulation as long as the information is accurate and verifiable. In contrast, “short-and-distort” is an illegal tactic in which speculators first short the stock and then distribute intentionally false, misleading or negative information about the firm. Consequently, the regulatory environment and quality of enforcement is important for the decision to allow or disallow short selling.

6.1.2. Short-selling activity during the Covid-19 crisis

Greppmair et al. (2021) investigate two key issues associated with the short-selling activity and the economic impact of the Covid-19 crisis. They find that short sellers target financially less liquid firms headquartered in countries with lower credit ratings. This suggests that short sellers attack firms in countries where governments have limited fiscal capabilities, which is crucial in providing the required support to all firms with liquidity problems and ensuring their survival. Considering the severity of the Covid-19 pandemic and the stringency of policy responses, the relationship remains unchanged. Short sellers initiated this trading strategy already-two weeks before the stock market crashed at the end of February 2020 and therefore profited sizably.

In Fig. 3, we present the daily number of reported net short positions in Europe over the period from 1 January to 30 June 2020 and depict the development for countries with and without short-selling bans separately. It displays market size (first row), sectors (second row) and countries (third row) together with two macroeconomic variables (Sovereign 5-Year CDS, Stringency Index).

We discuss circuit breakers as mechanisms to protect financial market participants in the Internet Appendix, Part II.

Whether a negative information is correct or made-up by the short seller is often difficult to verify, at least not immediately. Management will usually argue against it and provide supporting evidence by hiring auditors. In the case of Wirecard and Grenke in Germany, the negative information was confirmed after several months. For Wirecard, the regulators (BaFin) even imposed a short-selling ban, as they judged that the negative information was incorrect, so that hedge funds could profit from falling stock prices. Ultimately, this conjecture turned out to be inaccurate, while also the German central bank (Bundesbank) did not support the short-selling ban, as it did not constitute a threat to the stability of the financial system. For a critique of BaFin’s regulatory intervention in the case of Wirecard and the regulatory enforcement during the 2008 Volkswagen short squeeze, see Allen et al. (2021).
Fig. 3. Daily Reported Net Short Positions in Europe, Notes: These figures present the daily number of reported net short positions over the period from 1 January 2020 to 30 June 2020. We distinguish between countries with (Austria, Belgium, France, Greece, Italy, Spain) and without (Finland, Germany, Netherlands, Norway, Sweden, U.K.) a short-selling ban in 2020. The red (blue) lines represent the countries with (without) the ban. The dotted vertical lines indicate the following key events: (1) February 19, the beginning of the global stock market crash; (2) March 18, the introduction of the ban on short selling; (3) May 18, the lift of the ban. The figure provides an overview by market size, sectors and firm size. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
row), and firm size (third row). Before the Covid-19 crash, the number of reported short positions in ban and no-ban countries followed a similar pattern. However, short-selling activity increased significantly in all markets around 19 February, and peaked between 16 and 18 March 2020. It declined thereafter, but remained at a higher level in no-ban countries, while the positions declined significantly in ban countries. Interestingly, we observe that the number of short positions was higher in larger stock markets. In financial stocks, short selling did not increase excessively, suggesting that short sellers did not expect the crisis to hit banks more severely. The same holds for sectors that strongly depend on favorable views about future growth opportunities in an economy (e.g. IT). In contrast, industrial firms experienced the most pronounced increase in net short positions. With respect to firm size, we find a more intense shorting behavior in stocks with larger capitalization while the development was comparable for mid and small cap stocks. Overall, our descriptive evidence does not suggest that short sellers increased their positions in smaller markets and stocks (i.e. more vulnerable), but rather that they focused on sectors where they expected that the economic shock would be most severe.

The next figure and table are presented in the Internet Appendix, Part I. In Panels A and B of Figure IA6, we document the development of the short positions for the individual countries with and without a short-selling ban. All countries follow mostly the same pattern. We observe that prior to and during the market crash, the number of reported positions was much lower in countries that later imposed a ban, with the exception of France and Italy. Table IA7, contains the average number and value of net short positions reported in European countries across different market periods. We again distinguish between countries with and without a ban. In the crash period, the daily average number of reported short positions almost doubled from 105 to 197 in all countries, whereas the average position declined marginally (0.98 % versus 0.93 %). Interestingly, we observe that short positions increased more in the six countries that later introduced a short-selling ban (from 24 to 48, which is 99 %) compared to no-ban countries (from 81 to 149, which is 84 %). During the ban, average short positions declined more in ban countries (-77 %), but also in no-ban countries (-23 %), indicating that investors reduced or closed their positions in the recovery period. After regulators lifted the ban, the short-selling activity increased again by 35 % in the ban countries. Overall, we do not observe an excessive increase in short-selling activity in ban countries that might justify the decision to restrict short selling.

The observation that the number and the size of short positions changed during periods of high volatility and declining stock prices is not surprising, but rather expected, as many portfolio and fund managers usually adjust their total risk exposure during these periods. Investors’ withdrawals during these periods also require fund managers to rebalance their overall positions and risk exposure for these outflows. Alternatively, funds have either to sell the stocks, possibly causing a much faster and steeper price decline and maybe causing more harm to securities markets, or to buy put options, to sell stock index futures or shorten ETFs. As this is all part of a managers’ optimal portfolio optimization strategies during bear markets and crisis periods (Bessler et al., 2021a, 2021b), this is hardly troublesome or a reason for concern in well-functioning securities markets. Trying to differentiate for each transaction whether these are portfolio-rebalancing activities, speculative or hedging positions is a fruitless endeavor, unless the market participant believably reveals the motivation for the trade. Consequently, there is little empirical evidence that the short-selling activity had to be a major concern for regulators. In contrast, it seems more likely that short-selling restrictions resulted in less informationally efficient markets during the ban period (Lee, 2022), making these countries less attractive for institutional investors in the future.

6.2. Market manipulation

For regulators it is a pivotal task to protect investors especially during turbulent markets and crisis periods when a tremendous volume of news and private information arrives. Trading strategies based on access to privileged information usually results in abnormally high profits. The most common strategies to benefit from illegal activities are insider trading, stock-price manipulation, and the dissemination of false or misleading information (see Putninš, 2020 for an excellent review).

6.2.1. Role of insider trading for market efficiency

One perspective is that insider trading usually facilitates more informationally efficient financial markets, but this may come at a cost. Aussenegg et al., 2018 and Kim et al. (2019) find that purchases and sales by insiders reveal significant private information to the public, especially in countries with active enforcement of insider trading regulation. This effect is stronger for sell orders during crisis periods. The effects are stronger for insider sales that are motivated by private information (i.e. are

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7 The legal form of insider trading is that corporate insiders report the trading activities in their own company to the financial market regulator. In contrast, illegal insider trading is the breach of fiduciary duty and violation of insider-trading laws using material non-public information about the company.
more informative), suggesting that the potential competition from short sellers improve market efficiency. Alternatively, insiders adopt a defensive trading strategy and split their trades over time to escape competition when they anticipate a high presence of short sellers (Gu et al., 2020). Therefore, allowing short selling usually improves market quality as long as trading supervision by regulators and exchanges ensures that market manipulation and illegal insider trading activities are prevented. These topics we address next.

6.2.2. Insider trading and market manipulation during the Covid-19 crisis

During periods of market crisis, such as the start of the Covid-19 pandemic, negative activism as well as insider and short seller trading activities may have become even more attractive, exacerbating stock price declines. In Canada, Italy, Spain, South Korea, and the U.S., insider sales already increased in January and early February 2020, in anticipation of declining stock prices (Anginer et al., 2020). However, corporate insiders already began investing significant amounts of shares in late February 2020, especially at larger firms with higher leverage, revealing their believes, that the economic impact from Covid-19 would be temporary and the recovery would be rapid, as it eventually did. Consequently, stock prices instantaneously and fully reflected information before the ban.

6.2.3. Ex-ante risk of market manipulation

Many international studies highlight the importance of the enforcement of securities laws and regulations against financial market misconduct to promote market integrity and investor confidence (Cumming et al., 2015). Market manipulation and securities fraud not only causes significant financial damage, it also has a negative impact on real investment decisions such as innovation (Cumming et al., 2020).

Therefore, we conjecture that countries with a higher ex-ante risk of financial market misconduct due to weaker securities laws are more likely to impose short-selling bans in response to the Covid-19 crisis. More specifically, we examine the quality of market manipulation and insider trading rules and their legal enforcement. For this, we employ different country-level indices for exchange trading rules (Cumming et al., 2011), private enforcement (Spamann, 2010), public enforcement (Djankov et al., 2008) and legal enforcement (Kaufmann et al., 2011; La Porta et al., 2006). In the Internet Appendix, Part I, Table IIA8, we compare the average and median index values for each group of countries with and without a ban. We observe slightly higher values for no-ban countries, indicating stricter regulation and enforcement. However, the differences are statistically insignificant, except for the Rule of Law, the extent to which actors trust in and abide by rules, and the quality of legal enforcement. Overall, our results indicate that there was ex-ante no significant differences in exchange trading rules across our sample countries. From the regulatory perspective, a relatively higher threat from market manipulation and insider trading was not observable, which does not mean that this is an unlikely reason for

### Table 12

Systemic Stress during the Covid-19 Crisis.

| Country  | Composite Indicator of Systemic Stress (CISS) around the Crash and Short-Selling Ban |
|----------|------------------------------------------------------------------------------------|
|          | Stocks from Ban Countries | Differences between Periods |
|          | Pre-Crash | Crash | Ban | Post-Ban | (2) - (1) | (3) - (2) | (3) - (1) | (4) - (3) |
| Austria  | 0.01 | 0.20 | 0.43 | 0.24 | 0.19 *** | 0.23 *** | 0.42 *** | −0.19 *** |
| Belgium  | 0.01 | 0.15 | 0.40 | 0.17 | 0.14 *** | 0.25 *** | 0.39 *** | −0.23 *** |
| France   | 0.00 | 0.14 | 0.34 | 0.13 | 0.13 *** | 0.21 *** | 0.34 *** | −0.22 *** |
| Greece   | 0.00 | 0.27 | 0.49 | 0.26 | 0.22 *** | 0.26 *** | 0.48 *** | −0.23 *** |
| Italy    | 0.01 | 0.13 | 0.44 | 0.22 | 0.13 *** | 0.30 *** | 0.44 *** | −0.22 *** |
| Spain    | 0.00 | 0.13 | 0.42 | 0.20 | 0.16 *** | 0.25 *** | 0.41 *** | −0.22 *** |
| Ban Countries | 0.01 | 0.17 | 0.42 | 0.20 |                     |
| Control Stocks |                                        |                              |
| Germany  | 0.00 | 0.19 | 0.53 | 0.22 | 0.18 *** | 0.34 *** | 0.52 *** | −0.31 *** |
| Netherlands | 0.02 | 0.19 | 0.30 | 0.12 | 0.16 *** | 0.11 *** | 0.27 *** | −0.17 *** |
| Portugal | 0.00 | 0.15 | 0.42 | 0.20 | 0.14 *** | 0.28 *** | 0.42 *** | −0.22 *** |
| Sweden   | 0.00 | 0.19 | 0.53 | 0.22 | 0.18 *** | 0.34 *** | 0.52 *** | −0.31 *** |
| Switzerland | 0.00 | 0.19 | 0.53 | 0.22 | 0.18 *** | 0.34 *** | 0.52 *** | −0.31 *** |
| United Kingdom | 0.01 | 0.22 | 0.48 | 0.27 | 0.21 *** | 0.25 *** | 0.46 *** | −0.21 *** |
| No-Ban Countries | 0.01 | 0.19 | 0.43 | 0.20 | 0.18 *** | 0.24 *** | 0.42 *** | −0.23 *** |
| Difference-in-Differences | −0.014 | 0.006 | −0.008 | 0.011 |

Notes: This table presents the results for the analysis on financial stability. It reports the mean values for the Composite Indicator of Systemic Stress (CISS) for banned and control stocks across four different periods: (1) Pre-Crash (1 January to 19 February), (2) Crash (20 February to 17 March), (3) Short-Selling Ban (18 March to 18 May) and (4) Post-Ban (19 May to 30 June). We use data from 12 European countries (Table 2). All variables are defined in Table A1. *, **, *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively.

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8 In November 2007, the Directive on Markets in Financial Instruments (MiFID) became effective and harmonized the exchange trading rules with respect to disclosure and transparency at the European Union level.
the ban.

6.3. Financial stability – Development of systemic stress in the financial system

Excessive short-selling activities could have a negative effect on financial stability in crisis periods, which may justify imposing short-selling restrictions in these countries. Therefore, it is important to analyze whether there existed some risk of financial instability. We use the Composite Indicator of Systemic Stress (CISS) of Holló et al. (2012) to investigate (1) whether countries with a ban experienced a higher level of financial stress during the crash period and (2) whether the ban reduced systemic stress. In Table 12, we divide our sample between ban and no-ban countries and compare the average CISS values over four distinct periods: Pre-Crash, Crash, Ban and Post-Ban. The turbulences during the Covid-19 crash substantially increased the systemic stress level in all countries, but with an even lower increase in ban countries. In addition, the difference-in-differences results do not indicate that countries with bans had significantly higher increases in stress levels. We also find that the indicator continued to rise during the ban period, but subsequently dropped to the pre-ban levels. There are no significant differences in this trend between countries with and without a ban. Overall, our results do not suggest that there were more systemic stress in ban countries during the crash, nor that the short-selling ban resulted in more financial stability. Consequently, the risk of financial stress due to the Covid-19 crisis was not a justifiable reason for imposing short-selling restrictions. Moreover, it is the duty of central banks to address financial stability concerns and not that of securities market regulators.

7. Conclusion

The unprecedented economic shock of the Covid-19 pandemic has raised concerns whether organized securities markets could perform their essential functions of providing a fair, efficient and orderly market environment during times of extreme market distress. The interesting question is, whether imposing short-selling restrictions is the adequate remedy for dealing with potential problems. Consequently, it is important to analyze whether and how regulators should intervene in crisis periods to ensure the well-functioning of securities markets and the stability of the financial system. The objective of our study is to examine whether the introduction of a market-wide short-selling ban in six European countries was justified and provided the expected benefits such as stabilizing stock prices, preserving market quality, and restoring investor confidence in financial markets. We first compare stock returns and various measures of liquidity and volatility for six ban and six no-ban countries over the period from 2 January to 30 June 2020. We then address the question which country-specific characteristics determined the likelihood to impose short-selling restrictions during the Covid-19 crisis. Finally, we discuss situations when imposing short-selling restrictions would be important and even justified. In addition, we investigate whether market manipulation is a potential risk and how systemic risk in ban and no-ban countries evolved during the crisis.

Our empirical findings from analyzing the effects of the short-selling ban imposed during the Covid-19 crisis on stock prices and market quality provides sufficient evidence against a ban and support for the economic theories and most of our developed hypotheses. First, the regulators’ aim to boost stock prices failed, as only banned stocks had negative abnormal returns and underperformed non-banned stocks. This pattern holds across all markets and firm sizes rejecting our Hypothesis 1. Second, we find that the regulatory short-selling restrictions were associated with a significant deterioration of liquidity, as evidenced by a widening of bid-ask spreads and a decrease in trading volume (Hypothesis 2 and 3). Our results also indicate that these negative effects on liquidity were stronger for smaller stock markets and for smaller stocks. Third and consistent with Hypothesis 4, we provide evidence that the ban did not stabilize stock prices, as measured by price range and stock return volatility.

In robustness tests, we confirm our main results for relative changes in market quality measures across sub-periods. To address the potential issues of endogeneity, we employed a matched sample based on firm size and industry (self-selection bias) and instrumented the ban decision to overcome the concern that the decline in market quality itself triggered the intervention (simultaneity bias). Our results remain unchanged after considering these endogeneity issues. Overall, our results are robust to alternative economic explanations and statistical techniques. We provide convincing evidence that imposing short-selling bans during the Covid-19 crisis had negative effects on market quality, especially for smaller markets and stocks of smaller firms. These findings are consistent with previous research on the negative effects of short-selling bans during the 2008/2009 global financial crisis (Beber and Pagano, 2013; Boehmer et al., 2013) and the 2011/2012 European sovereign debt crisis (Beber et al., 2021). In additional analyses, we observe that countries with a weaker state of the economy, lower fiscal capacity, lower financial development, and stricter lockdown measures were more likely to restrict short selling. Moreover, our results suggest that ban countries experienced an increase in short-selling activity during the stock market crash, which, however, was not excessive and some activity might be due to the necessary portfolio and risk exposure adjustments of institutional investors. Finally, we do not find a higher ex-ante risk of market manipulation due to a weaker legal environment in ban countries.

Based on the evidence from previous crises, it is quite astonishing that six European regulators imposed short-selling bans during the Covid-19 crisis, whereas at the same time other European countries and the U.S. abstained from implementing restrictions. Official justifications for the regulatory interventions were possible disruptions of orderly functioning securities markets and financial instability resulting from the economic consequences of the Covid-19 pandemic. However, the empirical evidence of this study supports the decision of those countries that refrained from implementing short-selling restrictions despite ample political pressure to do the opposite. This perspective is consistent with the conclusions of Beber et al. (2021), Beber and Pagano (2013), Bessler and Vendrasco (2021), and Pagano (2020). Interestingly, no country imposed a ban during the later Covid-19 waves, which were much more severe and detrimental for the economy, indicating that markets can function well during crisis periods even without regulatory
interventions. One reason is that other mechanisms implemented on an ongoing basis, such as circuit breakers, may already secure orderly markets, protect investors, and prevent excess stock price fluctuations. The only situation in which short-selling restrictions seem justified is when market manipulation and illegal insider trading may pose a serious problem for investors during crises. However, high investor protection standards should be guaranteed in crisis as well as no-crisis periods.

CRediT authorship contribution statement

Wolfgang Bessler: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – review & editing, Visualization. Marco Vendrasco: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – review & editing, Visualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A

See Table A1.

Table A1

Description of Variables.

| Variable                  | Definition / Description                                                                 | Source |
|---------------------------|-----------------------------------------------------------------------------------------|--------|
| Market Quality            |                                                                                         |        |
| Spreads at € 10 k         | Difference between the best bid price (PB) and best ask price (PA) for a volume of EUR 10,000 weighted by market turnover, expressed in basis points. The weighting factor (w_{itc}) is based on turnover at each trading venue c including primary exchanges of the stock and pan-European venues such as Aquis, Choe BXE, Choe CXE and Turquoise. | big xyt |
| Turnover                  | Ratio between the number of traded stocks in 1,000 (VO) and the number of stocks outstanding in 1,000 (NOSH), scaled by 100. | Refinitiv |
| Price Range               | Ratio between the highest price achieved on a given day (PH) and the lowest price achieved on a given day (PL). | Refinitiv |
| Volatility                | Standard deviation of EUR returns on stock prices over a 20-day rolling window.           | Refinitiv |
| BAN                       | Indicator variable that takes the value of one when the stock is banned from short selling on a given day and zero otherwise. | – |
| MKTCAP                    | Market capitalization in EUR is equal to the stock price multiplied by the number of shares outstanding. | Refinitiv |
| EVOL                      | EUR value of all stocks traded (in 1,000) for a stock on a day.                          | Refinitiv |
| VWAP                      | Volume-weighted average price is the ratio of the total value of shares traded to the total volume of shares traded on a given day. | Refinitiv |
| SMALL                     | Indicator variable that takes the value of one when the stock is traded on a smaller stock market based on year-end 2019 total market capitalization. | – |
| Q1, Q2, Q3                | Indicator variable that takes the value of one when the stock belongs to the first, second or third quartiles of year-end 2019 market capitalization. | – |
| Financial Stress Index    | A country-specific index of financial stress focusing on the systemic risk in key segments of financial markets, i.e. equity, bonds and foreign exchange (Duprey et al., 2017). | ECB |
| 5Y CDS Spread             | The premium/spread on a 5-year credit default swap (CDS) contract.                        | Refinitiv |
| Determinants of Short-Selling Ban |                                                                                         |        |
| GDP Growth                | Natural logarithm of GDP growth (annual %). Aggregates are based on constant 2010 USD.     | WDI    |
| Inflation                 | Inflation as measured by the consumer price index that reflects the change in the cost to the average consumer of acquiring a basket of goods and services (annual %). | WDI    |
| Unemployment              | The share of the labor force that is without work but available for and seeking employment (Harmonized ILO definition). | WDI    |
| Current Account           | The sum of net exports of goods and services, net primary income, and net secondary income (% of GDP). | WDI    |
| Government Debt           | Government gross debt (% of GDP).                                                        | WEO    |
| Stock Market Turnover     | Total value of shares traded divided by the average market capitalization in a given year (%). | GFD    |
| Private Credit            | The financial resources provided to the private sector by domestic money banks (% of GDP).  | GFD    |
| Institutional Quality     | The average of the “government effectiveness” and “regulatory quality” governance indicators. | WGI    |
| Sovereign 5Y CDS Spread   | The premium/spread on a 5-year credit default swap (CDS) contract based on the Datastream Sovereign CDS index of a country. | Refinitiv |
| Stringency Index          |                                                                                         | OxCGRT |

(continued on next page)
Table A1 (continued)

| Variable                      | Definition / Description                                                                 | Source                  |
|-------------------------------|-----------------------------------------------------------------------------------------|-------------------------|
| VIX                           | A volatility index based on the implied volatility of S&P 500 index options calculated by the Chicago Board Options Exchange (CBOE). | Refinitiv               |
| TED Spread                    | The spread between 3-month LIBOR based on USD and 3-month treasury bill.                  | FRED                    |
| Oil price                     | The price for Brent crude oil in USD per barrel.                                         | Refinitiv               |
| VSTOXX                        | A volatility index based on the implied volatility of EURO STOXX 50 options calculated by Qontigo. | Refinitiv               |
| Eurozone TED Spread Systemic Stress Indicator | The spread between 3-month EURIBOR and 3-month German government bond yields.             | ECB                     |
| Covid-19 Deaths (%)         | The daily number of new reported deaths of Covid-19 (% of population in million).         | ECDC                    |

Ex-Ante Risk of Market Manipulation

| Insider Trading Rules        | Index that sums dummy variables for front-running, client precedence, trading ahead of research reports, separation of research and trading, broker ownership limit, restrictions on affiliation, restrictions on communications, investment company securities, influencing or rewarding the employees of other firms, and anti-intitimation/coordination. | CJL’11                   |
| Market Manipulation Rules   | Index that sums sub-indices of price manipulation, volume manipulation, spoofing rules, and false disclosure rules. | CJL’11                   |
| Private Enforcement Rules   | The revised anti-director rights index consisting of voting by mail, voting without blocking of shares, calling an extraordinary meeting, proportional board representation, preemptive rights and judicial remedies. | S’10                    |
| Public Enforcement Rules    | Index that captures whether suspect corporate transactions can lead to a fine or jail sentences for the approving entity or offender.                                                                 | DLS’08                  |
| Rule of Law                 | Reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular, the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. | WGI                     |
| Efficiency of the Judiciary | Assessment of the efficiency and integrity of the legal environment as it affects business, particularly foreign firms. | LLS’06                  |

Notes: This table represents the definitions, calculations, and description of the used variables in our analysis. Abbreviations: CJL’11 (Cumming et al. (2011)); DLS’08 (Djankov et al. (2008)); ECB (European Central Bank); ECDC (European Centre for Disease Prevention and Control); FRED (Federal Reserve Economic Data by Federal Reserve Bank of St. Louis); FSI (Financial Soundness Indicators database by International Monetary Fund (IMF)); GFD (Global Financial Development database by World Bank); LLS’06 (La Porta et al. (2006)); S’10 (Spaman (2010)); OxCGRT (Oxford COVID-19 Government Response Tracker by Blavatnik School of Government, University of Oxford); WDI (World Development Indicators database by World Bank); WEO (World Economic Outlook database by International Monetary Fund (IMF)); WGI (Worldwide Governance Indicators database by World Bank).

Appendix B. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.j.intfin.2022.101612.

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