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Analysis of Short-selling Effects Using KOSPI200 and KOSDAQ150 Indexing*

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〈**Abstract**〉

Financial regulators often react to crises by restricting short-selling to stabilize the stock market. In response to the COVID-19 pandemic, the Korean government banned short-selling in 2020. Since 2021, it has allowed partial resumption only for stocks indexed in KOSPI200 and KOSDAQ150. This unique short-selling regime in Korea makes newly indexed or excluded stocks experience exogenous variations in their short-selling availability when the constituents of the two indices are updated. Using this quasi-natural experimental setting, we examine the impact of short-selling permission and ban. The results show that short-selling permission enhances stocks' price efficiencies while short-selling permission and ban do not strongly influence stock return or volatility. Overall, this paper provides empirical evidence supporting the positive role of short-selling, further casting doubts on the reasons behind banning short-selling.

Keywords: Short selling; Regulatory intervention; Quasi-natural experiment; Price efficiency; Emerging market

JEL Classification: G30, G14, G28

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KOSPI200 및 KOSDAQ150 지수 종목 변경을 활용한 공매도 효과 분석*

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〈 요 약 〉

금융위기 기간동안 정책입안자들은 시장의 안정을 위해 공매도 금지를 주장하곤 한다. 코로나19 팬데믹에 대응하기 위해 한국 정부는 2020년 주식시장내 공매도를 전면 금지하였고, 2021년부터 KOSPI200과 KOSDAQ150 지수에 속한 주식에 대해서만 부분적으로 공매도를 허용하였다. 이러한 한국의 특수한 공매도 정책은 두 지수가 최신화될 때, 새로 편입/편출되는 주식에 대해서 외생적으로 공매도를 허용/금지하게 만든다. 본 연구는 이를 준자연실험으로써 활용하여 공매도 허용/금지의 효과를 실증분석하고자 한다. 분석결과, 공매도 허용은 주식가격 효율성에 긍정적인 영향을 준 것으로 나타난다. 반면, 공매도 허용/금지는 주가수익률과 주가변동성에 지대한 영향을 미치지 않았다. 본 연구는 공매도의 긍정적 역할을 지지하는 실증적 증거를 제시함으로써 공매도에 관련된 정책적 시사점을 제공한다.

핵심 단어 : 공매도; 정책개입; 준자연실험; 가격효율성; 신흥시장

JEL 분류기호: G30, G14, G28

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1. Introduction

"Banning short-sellinginterferes with price formation, thereby increasing uncertainty. That can only artificially amplify volatility and probability of default, the opposite effect to that claimed, and hampers the ability of markets to serve the real economy. It is not - and never has been - true that bans have any other, positive effect on market activity or price levels."

- 30 March 2020, The World Federation of Exchanges (WFE)[1] -

WFE criticizes recent bans on short-selling against the stock market crash due to the COVID-19 pandemic.[2] The European Union and a number of emerging countries, such as South Korea, Spain, and France decided to engage in short-selling to protect their capital market. In contrast, the U.S., U.K., and Japan had refused to engage in short-selling in their stock market, as they believe that "there is no evidence that it is a driver of market routs."[3]

Short-selling restrictions havebeen extensively studied in the finance literature, typically since the 2008 financial crisis, however, academicand practical evidence on the effect of short-selling is still controversial (e.g., Jiang et al., 2022). On the one hand, short-sellers who might be sophisticated investors canplay an important and positive role in price efficiency. On the other hand, short-selling activities may manipulate stock prices and destabilize the market, and thus, regulators react to the crisis period by restricting short-selling.

Nevertheless, empirical specification for examiningthe impact of short-selling is challenging because of endogeneity concerns, such as selection bias and reverse causality. Addressing such concerns is difficult without exogenous change in short-selling activities. Thus, the literature has attempted to constructa quasi-natural experiment using the regulatory change on short-selling. For instance, Beber and Pagano (2013) focus on the regulatory interventions imposing bans on short-selling around the world during the 2008 financial crisis. The U.S. short-selling Regulation SHO also can be viewed

1) For more detail, see, https://www.world-exchanges.org/news/articles/world-federation-exchanges-warns-against-short-selling-bans.

2) In addition, WFE mentioned that short-selling bans prevent market participants from trading as effectively as possible, thereby making price information less accurate.

3) Reuter also pointed out the regulatory intervention on short-selling by citing the statement of WFE. See, https://www.reuters.com/article/business/short-selling-bans-not-useful-stock-exchanges-federation-idUSKBN21H0VJ/.

as an exogenous shock, and thus, allows conducting empirical design in prior studies (Deng et al., 2020; Fang et al., 2016; Grullon et al., 2015; Li and Zhang, 2015).

With this regard, the current Korean stock market provides an ideal setting to overcome endogeneity issues because of its unique regulations on short-selling from 2020 to 2021. In March 2020, short-selling activities for all the listed stocks on the Korea Exchange (KRX)[4] were suspended due to the COVID-19 shock. After about 14-months later, since May 2021, short-selling activities have been *allowed but only for stocks* that are components of the following two representative indices in the KRX: KOSPI200 and KOSDAQ150.[5] Therefore, when the constituents of these indices are updated, newly indexed or excluded stocks in 2021 have experienced exogenous shocks in their short-selling availability. By comparing impacts of the index addition or out both in 2020 and 2021, we attempt to examine the relatively pure impacts of short-selling activities in Korea. More specifically, in order to assume that entering in or removing from KOSPI200 and KOSDAQ150 constituents is randomly determined, which is a key condition of a quasi-experimental setting, we restrict our sample into similar stocks in market size and trading volume.In other words, we set the control group as such similar stocks but do not experience inclusion or exclusion at the date of KOSPI200 and KOSDAQ150 constituents change, while the treatment group as the stocks that have entered in or removed from the indices. As a result, the treatment and control groups are basically similar, but after the date of indices'constituents change, only the treated stocks are suddenly available/forbidden for short-selling in the market because of their affiliation changes. Note that although a number of prior studies have investigated short-selling in Korea (e.g., Jung et al., 2013; Lee and Wang, 2022; Wang, 2023), our study is the first attempt to employ this quasi-experimental regulatoryto understand impacts of short-selling permission or ban.

Using this quasi-experimental setting due to the unique short-selling regime change in the Korean stock market, we first confirm that stocks belonging to KOSPI200 or KOSDAQ150 index in 2021 have experienced a significant increase in their short-selling volume, supporting the validity of our empirical design. For instance, if short-sellers in the Korean stock market are not interested at all to short newly indexed stocks,

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4) The KRX comprises two listing venues: the Korea Composite Stock Price Index (KOSPI) and the Korean Securities Dealers Automated Quotation (KOSDAQ).

5) See, for more detailed description, the announcement of the Korean government agency, the Financial Services Commission (FSC), on 3 February at their website: [*FSC Announces Decision on Short-selling Ban*] (https://www.fsc.go.kr/eng/pr010101/75291?srchCtgry=&curPage=&srchKey=sj&srchText=&srchBeginDt=2021-02-01&srchEndDt=2021-02-04).

our empirical strategy could be meaningless; however, we find that such newly indexed stocks have significant short-selling volume immediately after their index inclusion.In addition, short-selling volume for stocks that are excluded from KOSPI200 or KOSDAQ150 index after the index update date immediately drop.

Most importantly, we find that short-selling permission in the Korean stock market enhances the affected stocks' price efficiencies, andthus, it can contribute to improving market efficiency. This finding is also consistent with the view in recent studies that suggest a prominent role of short-selling in price discovery (e.g., Bushman and Pinto, 2024; Luu et al., 2023). Our results further imply that short-selling permission appears to be related to stock price appreciation. However, we find no evidence short-selling permission/ban strongly affects stock volatility, which is contrary to the general argument on short-selling in the Korean stock market.

We ensure that this paper provides practical and policy implications. According to our empirical evidence, short-selling permission appears to improve price efficiency, thereby contributing to the KRX. It suggests that short-sellers (using their information) play an important role in price discovery to some extent. Moreover, our paper shows no evidence that short-selling activities are strictly detrimental to stock returns or volatilities. Although our finding (at least partially) supports the positive side of short-selling in the Korean stock market, we note that its generalization to smaller stocks should be carefully studied further as we fail to find the consistency of evidence with the KOSDAQ-only sample. This suggest that stocks with low liquidity might have different outcomes with short-selling permission/ban.

The remainder of this paper is organized as follows. Section 2 reviews therelated literature on short-selling. Section 3 describes the unique institutional background about short-selling regime in the Korean stock market and our empirical specification. Section 4 presents the empirical results. Section 5 concludes the paper.

2. Related literature

Short-selling is a well-known trading strategy, that is "selling high and buying low." Starting from early studies that theoretically compare the cost and risks ofshort-selling (e.g. Diamond and Verrecchia, 1987; Miller, 1977), the related literature generallyposits that short sellers are sophisticated or informed traders in the market as they will short stock only if they believe that their targeting stocks will compensate for additional costs and risks. Such bearing costs and risks in short-selling are, for example, unlimited loss with stock price incline, which is also recently highlighted by the GameStop episode

(Atmaz et al., 2024), and restrictions on access to proceeds and some legal constraints (Diamond and Verrecchia, 1987).

Miller (1977) argues that overpriced stocks exist in the market if there is disagreement about these values among investors. In addition, if the market restricts pessimistic investors who might want to short such overpriced stocks (which could be viewed as short-selling bans), this overpricing phenomenon is more likely to occur.For instance, if short sellers are allowed to short an overpriced stock before its bad earnings announcement, and they are rational and informed investors, they can cool down such an overpriced stock's price even before its earnings announcement, implying a positive role in price discovery of short sellers.

However, a stream of research argues that short-selling is detrimental in society, as short sellers are indeed uninformed but just predatory traders (in general, speculative institutional investors). As a result, short-selling *per se* is likely to be associated with stock price manipulation, increase in market volatility, and signaling of selling pressure that makes profits for predatory short sellers (Allen and Gale, 1992; Brunnermeier and Oehmke, 2014).

Given the nature of the short-selling strategy, the endogeneity threat is critical in the short-selling literature, as highlighted by Jiang et al. (2022), which is a review paper on short-selling. For instance, it is difficult to argue whether a stock's short-selling pressure causes its subsequent price drop or short-sellers indeed target such a stock that will drop in the near future. Therefore, a large body of empirical studies attempts to address endogeneity concerns by using exogenous change in short-selling activities.

As a result, regulations on short-selling have been extensively studied in the finance literature, particularly exploiting the 2008 financial crisis in which many financial regulators imposed a ban onshort-selling to reduce volatility and to stem the market crash. However, the empirical evidence is mixed or even contradicts the reason for banning short-selling.

Boulton and Braga-Alves (2010) find that short-selling bans, in fact, do not reduce market volatility on average exploiting the US Securities and Exchange Commission's (SEC) temporary restrictions on naked short sales of the stocks of 19 financial firms in July 2008. Saffi and Sigurdsson (2011)use the global sample from 2005 to 2008, and they find that short-selling restrictions are harmful to market efficiency, and the subsequent relaxing of such restrictions does not induce volatility or the extreme stock price drop. Bris et al. (2007) also highlight the positive side of removing short-sale restrictions, using regulatory intervention on whether short-selling is prohibited or practiced in 46 countries. Chang et al. (2007) who examine the Hong Kong sample find that short-selling bans on individual stocks tend to cause overvaluation, in line with the argument of

Miller (1977). More recently, Luu et al. (2023) examine the effect of short-selling in the US market after the COVID-19 pandemic. The authors find that, during the COVID-19 shock in the stock market, short-selling activities are only concentrated on overpriced stocks, suggesting that short-selling plays a role in improving price discoveries insteadof triggering stock market crashes.

In terms of the Korean stock market, several papers have examined the effect of short-selling in the stock market (Jung et al., 2013; Chung and Wang, 2020; Lee and Wang, 2019, 2022; Wang, 2023; Wang et al., 2017; Wang and Lee, 2015). Notably, most research focusing on the Korean sample also exploits the Korean government's intervention in October 2008, which was temporary bans for all forms of short-selling due to the financial crisis. Jung et al. (2013) suggest that short-selling (by individual investors) contributes to price efficiency in the stock market. Wang and Lee (2015) find that short-selling in the Korean stock market is mainly driven by foreign investors, and their short-selling does not induce market volatility. More recently, Wang (2023) examines the predictability of short-selling on future returns in the Korean stocks. Further, the author finds that short-selling is more concentrated for larger firms with better credit grades, in contrast to the US market, and short-selling has a predictivepower on stock returns only for such larger firms.

It is worth to note that, to the best of our knowledge, there is no research yet exploiting short-selling regime changes in the Korean stock market against the COVID-19 pandemic, although there are several prior studies on short-selling using the Korean sample. We will discuss our empirical strategy that exploits the unique institutional setting in Korea around the COVID-19 pandemic in the next section.

3. Institutional background and empirical identification

In March 2020, the Korean government agency, the Financial Services Commission (FSC) decides to engage in short-selling activities in the Korean market. We collect related announcements from press releases of the FSC, summarized in Panel A of Table 1. Specifically, the FSC warns about the worldwide spread of COVID-19 (also, in Korea) and its negative shock on the stock market as well as significant rocketing volatility and short-selling volume. Therefore, they decide to impose a ban on short-selling for the 6-months period as a stock market stabilization instrument. This short-selling ban, however, has continued exceptionally long for about 14-months from March 2020 in Korea. After that, the FSC decided to resume short-selling activities in the KRX, but more importantly, allowing only for KOSPI200 and KOSDAQ150-indexed stocks.

〈Table 1〉 Key information for empirical specification

Note. This table illustrates key information for our empirical identification. Panel A summarizes the Korean government's intervention on short-selling in KRX against the COVID-19 pandemic shock from early 2020 to 2021. Panel B summarizes the regular updates in 2020 and 2021 for KOSPI200 and KOSDAQ150. For these two representative indices, KRX regularly announces update twice in a year (every June and December). Panel C shows the treatment and control groups in our empirical specification around the four regular updates of the indices in 2020 and 2021. In Panel C, *Index_in* (*Index_out*) equals to one for stocks that are newly indexed (excluded) in terms of KOSPI200 and KOSDAQ150, and zero for the control group. We define the control group as ten (five)nearest neighbors with each of the treated stocks by performing the propensity score matching technique among stocks that have not experienced changesin their affiliations for KOSPI200 or KOSDAQ150 index at the dates of the four regular updates of the indices, denoted by *Larger (Smaller) control group.*

Panel A: Short-selling related announcements in 2020 and 2021 by the Korean government

Dates	Information (Source: Press Releases of the Financial Services Commission (FSC); https://www.fsc.go.kr/eng/pr010101)
March 13, 2020	[*Government Unveils Stock Market Stabilization Measures*] The FSC announces that they impose a ban on stock short-selling for a period of six months from March 16 to September 15.
March 16, 2020	Short-selling activities are suspended for all stocks in the Korea Exchange (KRX).
August 27, 2020	[*Temporary Ban on Short Sale to be Extended for Six Months*] The FSC announces that they extend the temporary ban on stock short sale for six months from September 16, 2020, to March 15, 2021, given market volatility amid concerns over a resurgence in COVID-19 cases.
February 3, 2021	[*FSC Announces Decision on Short-selling Ban*] The FSC announces the decision to extend the short-selling ban until May 2, 2021, and to allow a partial resumption of short-selling from May 3, 2021 on KOSPI 200 and KOSDAQ 150 stocks. Because KOSPI 200 and KOSDAQ 150 stocks are familiarto domestic and foreign investors. These indices also have high utilization, such as linked trading between the derivatives market and the stock market. Due to large market capitalization and sufficiently high liquidity, short selling is expected to only have a limited effect on stock price.
May 3, 2021	Short-selling (partially) resumes **only for KOSPI 200 and KOSDAQ 150 stocks.**

Panel B: Regular update for the KOSPI200 and KOSDAQ150 constituents in 2020 and 2021

Dates	KOSPI200 index	KOSDAQ150 index	Short-selling availability	Note
June 12, 2020	Regular inclusion: 11 stocks Regular exclusion: 11 stocks	Regular inclusion: 14 stocks Regular exclusion: 14 stocks	Banned	
December 11, 2020	Regular inclusion: 10 stocks Regular exclusion: 10 stocks	Regular inclusion: 17 stocks Regular exclusion: 17 stocks	Banned	
June 11, 2021	Regular inclusion: 5 stocks Special inclusion: 1 stock Regular exclusion: 6 stocks Special exclusion: 1 stock	Regular inclusion: 16 stocks Regular exclusion: 16 stocks	Only allowed for the indices' constituents	Special update: "SK ie technology" is added after its IPO, and correspondingly, "HDC" is excluded.
December 10, 2021	Regular inclusion: 5 stocks Special inclusion: 1 stock Regular exclusion: 6 stocks Special exclusion: 1 stock	Regular inclusion: 14 stocks Regular exclusion: 15 stocks	Only allowed for the indices' constituents	Special update: "Kakaopay" is added after its IPO, and correspondingly, "LOTTE Himart" is excluded.

Panel C: Available observations for the treatment and control groups at the index's regular update

	Treatment group		Control group for *Index_in* (*Index_in* = 0)		Control group for *Index_out* (*Index_out* = 0)	
	Index_in= 1	*Index_out* = 1				
Dates for regular update	# of stocks entering in the index	# of stocks removing from the index	# of matched stocks (1:10 matching with replacement; *Larger control group*)	#of matched stocks (1:5 matching with replacement; *Smaller control group*)	# of matched stocks (1:10 matching with replacement; *Larger control group*)	# of matched stocks (1:5 matching with replacement; *Smaller control group*)
June 12, 2020	24	22	145	77	90	45
December 11, 2020	26	23	132	71	60	30
June 11, 2021	22	23	102	56	70	35
December 10, 2021	20	21	134	66	50	25
Total	92	82	513	270	270	135

〈Table 2〉 Sample summary

Note. This table illustrates definitions of the variables and summary statistics in Panels A and B, respectively. We winsorize all continuous variables at 1st and 99th percentiles to remove the influence of outliers. Panel C reports the mean difference in stocks' market capitalization and trading volume between the treatment (*Index_in* = 1 or *Index_out* = 1) and the corresponding control groups (*Larger* and *Smaller control group*).

Panel A: Definitions of variables

Variable	Definition
Index_in	Dummy variable equals one for the treated stocks that have newly entered in KOSPI200 or KOSDAQ150 index at the index's regular update, and zero for the control (matched) stocks in which those affiliations are not changed at the index's regular update and satisfied the propensity score matching (the 10 or 5 nearest neighbors).
Index_out	Dummy variable equals one for stocks that have been removed from KOSPI200 or KOSDAQ150 index at the index's regular update, and zero for the control (matched) stocks in which those affiliations are not changed at the index's regular update and satisfied the propensity score matching (the 10 or 5 nearest neighbors).
Y2021	Dummy variable equals one for the year 2021, and zero for 2020. This is the post variable for our quasi-natural experiment design as the Korean unique short-selling regime begins in May 2021.
ln(Market cap.)	Natural logarithm of a stock's market capitalization (in Korean won) at the date of the index's regular update
ln(Trading vol.)	Natural logarithm of a stock's trading volume (in Korean won) at the date of the index's regular update.
KOSPI	Dummy variable equals one for the stock listed on the KOSPI market, and zero for the KOSDAQ market.
Δ_N(Short-selling volume divided by trading volume)	Let A be an average short-selling volume divided by an average trading volume during N trading days before the index's regular update. Let B be similarly defined during N trading days after the index's regular update. The variable is defined as B minus A.
Δ_{60d}(Price delay 1)	We estimate price delay by following one of the measures in Hou and Moskowitz (2005). Using weekly stock returns from 60 trading days the index's regular update, we run the following regression model: $$r_{it} = \alpha_i + \beta_i R_{mt} + \sum_{n=1}^{4} \delta_i^{(-n)} R_{m(t-n)} + \varepsilon_{it}$$ where r_t is the stock's return at week t and R_{mt} is a market return at week t. We use returns of the KOSPI index or the KOSDAQ index as market returns, for KOSPI firms or KOSDAQ firms, respectively. Let R_0^2 be the

Variable	Definition
	R^2 from the above regression without any restrictions, and let $R^2_{\delta=0}$ be the R^2 from the model with restriction of $\delta_i^{(-n)}=0$ for all n. Then, Price delay 1 during the period is defined as follows: $$\text{Price delay}\,1 = 1 - \frac{R^2_{\delta=0}}{R^2_0},$$ Note that if lagged market returns explain the stock's current return, indicating low price efficiency, this measure has a value greater than 0. Let A be Price delay 1 measured using weekly stock returns from 60 trading days before the index's regular update. Let B be similarly defined during 60 trading days after the index's regular update. The variable is defined as B minus A.
Δ_{60d}(Pricedelay 2)	We estimate price delay by following one of the measures in Hou and Moskowitz (2005). At first, we run the above regression model. Then, Price delay 2 is defined as follows: $$\text{Price delay}\,2 = \frac{\sum_{n=1}^{4} n\,\delta_i^{(-n)}}{\beta_i + \sum_{n=1}^{4}\delta_i^{(-1)}},$$ This measure is developed to give more weights to influence of longer lags of market returns. Note that similar to Price delay 1, this measure also has a higher value when influence of lagged market returns is greater or price efficiency is lower. Let A be Price delay 2 measured using weekly stock returns from 60 trading days before the index's regular update. Let B be similarly defined during 60 trading days after the index's regular update. The variable is defined as B minus A.
Stock returns for the next N days	Stock returns during the next N trading days after the date of the index's regular update
Δ_N(Stock volatility)	Let A be a variance of daily stock returns during N trading days before the index's regular update. Let B be similarly defined during N trading days after the index's regular update. The variable is defined as B minus A, scaled by A.

Panel B: Descriptive statistics

Variable	# of obs.	Mean	Std. Dev.	Min	Max
Index_in	869	0.1081		0	1
Index_out	869	0.1116		0	1
Y2021	869	0.4672		0	1
ln(Market cap.)	859	26.5038	1.6578	22.8941	31.6641
ln(Trading vol.)	868	23.4746	1.5991	18.8119	27.2900
KOSPI	869	0.5180		0	1
Δ_{20d}(Short-selling volume divided by trading volume)	800	-0.0027	0.0503	-0.4660	0.4048
Δ_{40d}(Short-selling volume divided by trading volume)	807	0.0000	0.0667	-0.8793	0.4973
Δ_{60d}(Short-selling volume divided by trading volume)	812	0.0043	0.0589	-0.4637	0.8040
Δ_{60d}(Price delay 1)	836	0.0292	0.3251	-0.8324	0.8766
Δ_{60d}(Price delay 2)	844	0.0585	0.3284	-0.8291	0.8692
Stock returns for the next 20 days	852	0.0258	0.0146	-0.2950	0.9119
Stock returns for the next 40 days	857	0.0479	0.2300	-0.3920	1.2104
Stock returns for the next 60 days	853	0.0575	0.3147	-0.4698	2.6151
Δ_{20d}(Stock volatility)	849	0.1935	0.7481	-0.7128	5.1994
Δ_{40d}(Stock volatility)	855	0.1267	0.6263	-0.7922	4.2392
Δ_{60d}(Stock volatility)	852	0.0103	0.5280	-1.0000	4.1745

Panel C. Mean difference between the treatment and control groups

	Variables	Treatment group: (1)		Control group				*t*-statistics (*p*-value)	
				Larger control group: (2)		Smaller control group: (3)		(1) vs. (2)	(1) vs. (3)
		Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.		
Index_in	ln(Market cap.)	26.5783	0.0852	26.4215	0.0633	26.5756	0.0924	1.4760 (0.1428)	0.0207 (0.9835)
	ln(Trading vol.)	24.0620	0.1214	23.8744	0.0585	23.9959	0.0808	1.3915 (0.1666)	0.4529(0.6512)
Index_out	ln(Market cap.)	26.0925	0.0623	26.0838	0.0469	26.0859	0.0520	0.1110 (0.9118)	0.0812 (0.9355)
	ln(Trading vol.)	22.6384	0.0898	22.5000	.0759	22.4652	0.1015	1.1756 (0.2410)	1.2768(0.2031)

This paper focuses on the date of KOSPI200 and KOSDAQ150 constituents change in 2021 as the index-included/excluded firms suddenly experience short-selling permission/ban. Note that constituents of the index are updated in June and December every year in a regular manner (hereafter, the regular update), as summarized in Panel B of Table 1. Nevertheless, still there is a potential concern because the index's regular update might be related to money flow from passive funds in financial institutions. For instance, some passive funds may include only stocks belonging to the KOSPI200 or KOSDAQ150 indices, thus stocks that are indexed or excluded may experience exceptional changes in demand from the passive funds. To address this concern, our empirical strategy is to use the same regular update events that occurred in 2020 as a base.

The only difference inwhether a stock belongs to KOSPI200 or KOSDAQ150 index between 2020 and 2021 is short-selling availability. Thus, most importantly, we can estimate the impact of short-selling permission/ban by comparing the index's regular update (i.e., the index addition/out) in 2020 and 2021.[6] Assuming that entering in or removing from KOSPI200 and KOSDAQ150 constituents among similar stocks around the threshold of such indices is (almost) random, our empirical strategy can be viewed as a quasi-natural experiment. Overall, we implement the following difference-in-difference (DID) specification:

where the dependent variable is a target variable of interest, such as short-selling volume and price efficiency measures. $Index\_change_{it}$ is an indicator that equals one for the treatment group: stocks changing their affiliation at the date of the index's regular update, and more specifically, *Index_in* and *Index_out*, and zero for the control group: stocks that are around KOSPI200 and KOSDAQ150 indices' threshold but are unchanged in terms of their affiliations at the index's regular update. We describe available observations for the treatment and control groups in Panel C of Table 1. More specifically, to construct the control group, we first identify stocks that have not experienced changes in their affiliations for KOSPI200 or KOSDAQ150 index. Among these stocks, we then perform the propensity score matching technique to find ten or five nearest neighbors with each of the treated stocks (hereafter, denoted by *Larger* or *Smaller control group*, respectively).[7] The indicator *Y2021* is the post variable of the unique short-selling regime in the Korean

6) See, Appendix A for the list of stocks that experienced index-in and index-out (i.e., the treatment group) from 2020 to 2021.

7) During matching to obtain the nearest neighbors of each treated stocks, we allow the replacement for better matching quality, so different treated stocks may share the same matched control stocks. Thus, it is natural that size of the *Larger* (or *Smaller*) *control group* could be less than 10 (or 5) times the size of the treatment group.

stock market, which equals to one for observations in 2021 and zero for ones in 2020.

$$Y_{it} = \beta_1 Index\_change_{it} + \beta_2 Y2021 + \beta_3 (Index\_change_{it} \times Y2021) + \Gamma' Control\ variables_{it} + \delta_j + \varepsilon_{it}, \quad (1)$$

It is noteworthy that, since we include observations at the regular update events in 2020, β_1 can represent the impact of the index addition/out in 2020, such as money flow from passive funds. The coefficient of *Y2021* (i.e., β_2) is econometrically identical to year fixed effect, thus, our empirical tables do not mention year fixed effect. Most importantly, our main DID estimator β_3 indicates difference in the effect of the index addition/out between 2020 and 2021, thereby referring to the pure impact of short-selling permission/ban.

Furthermore, we control for the stock's market capitalization and trading volume. To control for market-specific and industry-specific effects, we also include an indicator that equals one for stocks listed on KOSPI and zero for KOSDAQ, and the industry fixed effects (δ_j) based on 17 sections of the Korean Standard Industrial Classification (KSIC).

We manually collect data on KOSPI200 and KOSDAQ150 constituent changes from the KRX announcement,[8] and provide the list of stocks that experienced index-in and index-out (i.e., the treatment group) from 2020 to 2021 in Appendix A. We also obtain stock price and trading data from FN Dataguide. Then, we construct a cross-sectional sample around the regular update in June and December 2020 and 2021 (i.e., four events). All the continuous variables are winsorized at the 1st and 99th levels to reduce the effect of outliers. Panels A and B of Table 2 show the detailed definitions of variables and the descriptive statistics, respectively.

4. Empirical analysis

4.1. Validity test

Before we investigate the impact of short-selling permission/ban, it is necessary to check the validity of our empirical specification. In Panel C of Table 2, we first examine whether our two main control variables (i.e., the stock's market capitalization and trading volume) significantly differ by the treatment and control groups.[9] The first and second

8) See, for more detailed description, the official website of KRX (http://data.krx.co.kr).

rows in Panel C focus on the samples of *Index_in* and *Index_out*, and the last two columns report the *t*-statistics for the mean difference between the treatment group versus the *Larger* or *Smaller control group*, respectively. Both columns show that the *t*-statistics for the mean difference are sufficiently small. Thus, the results of Panel C suggest that the treatment and control groups are basically similar in our sample construction, further supporting the underlying assumption of our empirical strategy.

Next, we examine whether short-selling activities of stocks that have entered in (*Index_in*) or removed from (*Index_out*) KOSPI200 and KOSDAQ150 indices are indeed affected, compared to the control group. For instance, if short-selling volume *per se* of the treated stocks (i.e., newly-entered stocks in KOSPI200 and KOSDAQ150 indices) is unaffected, it may indicate that short-sellers are, in fact, not interested in the treated stocks that are close to around those indices' threshold; if so, our empirical specification could be invalid.

Table 3 presents the results of this validity test.Odd-numbered columns indicate *Larger control group*, whereas even-numbered columns use a more restrictive criterion, *Smaller control group*, for selecting the control group as described in the previous section. Following the literature on short-selling (Diether et al., 2009; Lee and Wang, 2019), we calculate relative short-selling as the trading volume of short-selling divided by the total trading volume, and we take its difference between those for1-, 2-, and 3-months (i.e., 20-, 40-, 60-trading-days) before and after the index's regular update. As we expect, the interaction terms between *Index_in* (*Index_out*) and *Y2021* show positive (negative) estimates, whereas both the standalone estimates of *Index_in* and *Index_out* are insignificant in Table 3. These results imply that belonging to KOSPI200 or KOSDAQ150 index in 2021 is significantly associated with short-selling activities, supporting that our empirical design can be a quasi-natural experiment.

4.2. Main results: Impact of short-selling permission/ban

Table 4 analyzes the impact of short-selling permission/ban on price efficiency. In particular, we adopt two measures of price efficiency proposed by Hou and Moskowitz (2005), also referred to as *price delay* in the literature (e.g., Saffi and Sigurdsson, 2011). Note that a lower value of *price delay* indicates a higher price efficiency, and thus, a more efficient price discovery in the stock market. In Table 4, the dependent variable is the difference in between *price delay* calculated by 3-months (i.e., 60-trading-days)

9) We thank an anonymous reviewer for suggesting this mean difference test between the treatment and control groups.

〈Table 3〉 Effects of short-selling permission/ban on short-selling volume

Note. This table reports the results of validity tests where the dependent variable is short-selling volume changes, the difference in short-selling relative volume between before and after the index updates (based on 20, 40, and 60 trading days). Models (1)-(6) and (7)-(12) examine the impact of short-selling permission and ban, respectively. Definitions of the variables are described in Panel A of Table 2. Parentheses report *t*-statistics based on standard errors adjusted for heteroscedasticity. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Regression models to examine effects of short-selling permission						Regression models to examine effects of short-selling ban					
	$\triangle_{20d}$(Short-selling volume divided by trading volume)		$\triangle_{40d}$(Short-selling volume divided by trading volume)		$\triangle_{60d}$(Short-selling volume divided by trading volume)		$\triangle_{20d}$(Short-selling volume divided by trading volume)		$\triangle_{40d}$(Short-selling volume divided by trading volume)		$\triangle_{60d}$(Short-selling volume divided by trading volume)	
	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Index_in	0.0005	-0.0018	-0.0018	-0.0019	-0.0047*	-0.0041*						
	(0.17)	(-0.70)	(-0.77)	(-0.99)	(-2.20)	(-1.96)						
Y2021	-0.0064	-0.0051	-0.0036	-0.0072	0.0048	0.002	-0.0018	-0.0055	-0.0027	-0.0074	0.0060*	0.0028
	(-1.58)	(-1.07)	(-0.58)	(-1.00)	(1.30)	(0.97)	(-1.34)	(-1.36)	(-0.49)	(-1.13)	(1.83)	(1.46)
Index_in×Y2021	0.0642***	0.0629***	0.0887**	0.0743***	0.0744**	0.0660**						
	(11.61)	(11.15)	(2.90)	(4.22)	(2.43)	(2.97)						
Index_out							-0.0022	-0.0004	0.0042	-0.0022	-0.0011	-0.0042*
							(-0.87)	(-0.26)	(0.57)	(-1.64)	(-0.26)	(-1.91)
Index_out×Y2021							-0.0583***	-0.0554***	-0.0486***	-0.0412***	-0.0476***	-0.0419***
							(-6.88)	(-6.12)	(-6.22)	(-4.65)	(-6.61)	(-6.78)
ln(Market cap.)	-0.0039	-0.0023	-0.0016	-0.001	0.0023	0.0016	0.0023*	0.0006	0.0022	0.0018	0.0063***	0.0053*
	(-1.77)	(-1.39)	(-0.63)	(-0.48)	(1.01)	(0.46)	(1.97)	(0.42)	(1.48)	(0.99)	(3.53)	(2.13)
ln(Trading vol.)	0.0003	-0.0002	0.0049	0.001	0.0038	0.0025	0.0002	-0.0002	0.0021	0.0006	0.0003	-0.0004
	(0.28)	(-0.23)	(1.21)	(1.06)	(1.55)	(1.47)	(0.30)	(-0.22)	(0.84)	(0.41)	(0.31)	(-0.59)
KOSPI	0.0047*	0.0042	-0.0002	0.0018	-0.003	-0.003	-0.0061**	-0.0098***	-0.0098***	-0.0124***	-0.0106***	-0.0144***
	(1.91)	(0.94)	(-0.05)	(0.34)	(-1.13)	(-0.53)	(-2.52)	(-4.91)	(-3.48)	(-3.82)	(-5.74)	(-5.78)
Industry fixed effects	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
R-squared	0.1753	0.1157	0.0922	0.2171	0.1105	0.2814	0.4405	0.1453	0.1442	0.0777	0.0761	0.0743
# of obs.	528	301	533	302	538	307	330	306	537	306	536	305
Model-p	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

〈Table 4〉 Effects of short-selling permission/ban on price efficiency

Note. This table reports the main results where the dependent variable is changes in price efficiency measures. We calculate Hou and Moskowitz's (2005) measures, Price delay 1 or 2, for each stock and take its difference between 60 trading days before and after the index update. Models (1)-(4)and (5)-(8) examine the impact of short-selling permission and ban, respectively. Definitions of the variables are described in Panel A of Table 2. Parentheses report *t*-statistics based on standard errors adjusted for heteroscedasticity. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Regression models to examine effects of short-selling permission				Regression models to examine effects of short-selling ban			
	$\triangle_{60d}$(Price delay 1)		$\triangle_{60d}$(Price delay 2)		$\triangle_{60d}$(Price delay 1)		$\triangle_{60d}$(Price delay 2)	
	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Index_in	0.0139	0.0229	0.0068	-0.0028				
	(0.32)	(0.50)	(0.19)	(-0.08)				
Y2021	-0.2101***	-0.1943***	-0.2852***	-0.2862***	-0.2560***	-0.2695***	-0.3162***	-0.3126***
	(-11.80)	(-8.48)	(-20.60)	(-12.53)	(-12.21)	(-9.92)	(-15.63)	(-11.51)
Index_in×Y2021	-0.1432**	-0.1545**	-0.0971**	-0.0969*				
	(-1.97)	(-2.06)	(-2.93)	(-2.06)				
Index_out					-0.0107	-0.0293	0.0137	0.0137
					(-0.22)	(-0.60)	(0.28)	(0.27)
Index_out×Y2021					0.0311	0.0482	-0.0500	-0.0527
					(0.39)	(0.59)	(-0.69)	(-0.71)
ln(Market cap.)	-0.0028	-0.0086	0.0100	0.0051	-0.0035	-0.0057	-0.0106	-0.0187
	(-0.30)	(-0.71)	(1.93)	(0.64)	(-0.34)	(-0.45)	(-1.10)	(-1.52)
ln(Trading vol.)	-0.0078	-0.0075	-0.0111**	-0.0185**	0.0024	-0.0001	-0.0032	-0.0126
	(-1.13)	(-0.82)	(-2.52)	(-3.09)	(0.29)	(-0.01)	(-0.41)	(-1.17)
KOSPI	0.0102	-0.0032	-0.0137	-0.0054	0.0419*	0.0511*	-0.0009	-0.0034
	(0.55)	(-0.13)	(-0.98)	(-0.46)	(1.80)	(1.70)	(-0.04)	(-0.12)
Industry fixed effects	Included	Included	Included	Included	Included	Included	Included	Included
R-squared	0.1704	0.1739	0.1924	0.1841	0.1937	0.2193	0.2842	0.2809
# of obs.	556	322	561	325	348	217	348	213
Model-p	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

before and after the index's regular update. In columns (1) - (4), β_3 (i.e., the interaction terms between *Index_in* and *Y2021*) is negatively estimated on price delay measures at least at the 10% significance level, suggesting that short-selling permission appears to improve the affected stocks' price efficiencies. We find no evidence that short-selling ban significantly influences price efficiency in our empirical design (columns (5) - (8)). The results in Table 4 are generally consistent with the prior literature revealing the positive impact of short-selling on price efficiency (Beber and Pagano, 2013; Saffi and Sigurdsson, 2011).

Next, we examine whether the affected stocks by short-selling permission/ban exhibit different patterns of stock returns or volatilities. Market participants in the Korean stock market (typically, retail investors) often argue that short-selling should be banned because, for example, foreign investors intensively short-sell Korean stocks and take earnings out of the Korean stock market. It is not difficult to see news suggesting that short-selling is one significant factor of market meltdown.

Table 5 presents the results where we focus on stock returns for 1-, 2-, and 3-months (i.e., 20-, 40-, 60-trading-days) after the index's regular update. In columns (1) - (6), the treatment group in 2020 (i.e., *Index_in*) is likely to have negative returns compared to the control group. However, β_3 (i.e., *Index_in* × *Y2021*) in these columns generally have significantly positive coefficients; we cautiously interpret that this could be due to the improved price discovery (as shown in Table 4), but it needs to be studied further. In addition, β_3 for *Index_out* shows the opposite direction in columns (7) - (12), although the statistical significance levels are relatively weak.

We conclude that the results of Table 5 contradict the general belief about short-selling in the Korean stock market. On the one hand, at the very least, short-selling permission is not destroying stock returns on average; instead, we find that it could be positively related to stock returns. On the other hand, there is no evidence that short-selling ban could be helpful to protect stock returns. Our interpretations are consistent with Saffi and Sigurdsson's (2011) argument that relaxing short-selling constraints does not lead to negative stock returns.

Table 6 examines the impact of short-selling permission/ban on stock volatility. To measure the change in stock volatility around the index's regular update, we calculate a variance of daily stock returns during 1-, 2-, and 3-months (i.e., 20-, 40-, 60-trading-days) before and after the index's regular update. We take its difference (between before and after value) and standardize by its before value. Here, we find that the treated stock's volatility by short-selling permission does not show significant

〈Table 5〉 Effects of short-selling permission/ban on stock returns

Note. This table reports the main results where the dependent variable is stock returns for the next 20, 40, and 60 trading days after the index updates. Models (1)-(6) and (7)-(12) examine the impact of short-selling permission and ban, respectively. Definitions of the variables are described in Panel A of Table 2. Parentheses report *t*-statistics based on standard errors adjusted for heteroscedasticity. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Regression models to examine effects of short-selling permission						Regression models to examine effects of short-selling ban					
	Stock returns for the next 20 days		Stock returns for the next 40 days		Stock returns for the next 60 days		Stock returns for the next 20 days		Stock returns for the next 40 days		Stock returns for the next 60 days	
	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Index_in	-0.0534***	-0.0536**	-0.1415**	-0.1442**	-0.2044**	-0.2126**						
	(-3.80)	(-2.80)	(-2.84)	(-2.40)	(-3.00)	(-2.58)						
Y2021	-0.0443**	-0.029	-0.1359***	-0.1424***	-0.2059***	-0.2297***	-0.0166	0.0164	-0.0976***	-0.0600***	-0.1309**	-0.1053**
	(-2.83)	(-1.36)	(-4.67)	(-4.48)	(-6.92)	(-5.41)	(-1.83)	(0.94)	(-4.24)	(-3.52)	(-3.47)	(-3.08)
Index_in×Y2021	0.0554***	0.0391	0.1076*	0.1162**	0.1735**	0.2028**						
	(3.25)	(1.66)	(1.98)	(2.31)	(2.42)	(2.86)						
Index_out							-0.0008	0.0112	0.0256	0.0867**	0.0273	0.1105
							(-0.05)	(0.64)	(0.59)	(3.34)	(0.30)	(1.51)
Index_out×Y2021							-0.0382*	-0.0682*	-0.0723*	-0.0960*	-0.0467	-0.0641
							(-2.08)	(-2.06)	(-2.13)	(-2.30)	(-0.66)	(-1.04)
ln(Market cap.)	-0.0035	0.0031	-0.002	0.0024	-0.0154*	-0.0173	-0.004	-0.0065	-0.0173	-0.0348*	-0.0297	-0.0481**
	(-0.41)	(0.32)	(-0.22)	(0.18)	(-1.92)	(-1.40)	(-1.24)	(-1.15)	(-1.10)	(-2.28)	(-1.44)	(-2.47)
ln(Trading vol.)	0.0213***	0.0132	0.0303**	0.0226*	0.0600***	0.0573***	0.0142**	0.0263***	0.0304***	0.0353**	0.0396***	0.0344**
	(3.72)	(1.67)	(2.80)	(1.88)	(4.14)	(4.92)	(2.90)	(4.13)	(6.11)	(3.20)	(5.40)	(2.46)
KOSPI	0.0013	0.0117	-0.0160*	-0.0047	-0.0018	0.0483	0.0215*	0.0337**	0.0518	0.0529	0.0643	0.0838
	(0.14)	(0.45)	(-1.85)	(-0.18)	(-0.16)	(1.63)	(2.06)	(2.49)	(1.41)	(1.01)	(1.16)	(1.83)
Industry fixed effects	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
R-squared	0.0505	0.0417	0.104	0.1144	0.1394	0.1573	0.0655	0.124	0.1667	0.1833	0.1794	0.1797
# of obs.	558	323	563	327	558	321	354	221	356	221	354	220
Model-p	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000

〈Table 6〉 Effects of short-selling permission/ban on stock volatility

Note. This table reports the main results where the dependent variable is changes in stock volatility. We calculate a variance of daily stock returns for each stock and take its ratio of the difference between before and after the index updates (based on 20, 40, and 60 trading days) to the before value. Models (1)-(6) and (7)-(12) examine the impact of short-selling permission and ban, respectively. Definitions of the variables are described in Panel A of Table 2. Parentheses report t-statistics based on standard errorsadjusted for heteroscedasticity. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Regression models to examine effects of short-selling permission						Regression models to examine effects of short-selling ban					
	Δ_{20d}(Stock volatility)		Δ_{40d}(Stock volatility)		Δ_{60d}(Stock volatility)		Δ_{20d}(Stock volatility)		Δ_{40d}(Stock volatility)		Δ_{60d}(Stock volatility)	
	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group	Larger control group	Smaller control group
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Index_in	-0.3435***	-0.4736***	-0.2671**	-0.3214**	-0.3103***	-0.4002***						
	(-8.67)	(-5.32)	(-2.70)	(-2.57)	(-8.06)	(-3.87)						
Y2021	-0.5797***	-0.8387***	-0.2127**	-0.3096	-0.0436	-0.182	-0.5345***	-0.5078***	-0.1882**	-0.2859**	0.0165	-0.0225
	(-5.52)	(-7.53)	(-2.70)	(-1.19)	(-1.42)	(-1.16)	(-3.77)	(-3.86)	(-2.71)	(-2.49)	(0.26)	(-0.21)
Index_in×Y2021	0.2279	0.4846**	0.1838	0.2772	0.1455	0.2838						
	(1.57)	(2.99)	(0.89)	(0.73)	(1.38)	(1.31)						
Index_out							-0.2250***	-0.2829***	-0.0692	-0.1042**	-0.1715	-0.0639
							(-3.52)	(-7.70)	(-1.18)	(-2.60)	(-1.85)	(-0.78)
Index_out×Y2021							0.2541	0.1859	-0.0054	0.0842	0.0725	0.0963
							(1.66)	(1.04)	(-0.05)	(0.47)	(0.69)	(0.59)
ln(Market cap.)	-0.0335	-0.0206	-0.0417	0.0115	-0.0031	0.0423	-0.1034*	-0.0424	-0.0464	-0.0168	0.0003	0.0091
	(-0.69)	(-0.43)	(-1.46)	(0.25)	(-0.14)	(1.33)	(-2.14)	(-0.92)	(-1.12)	(-0.43)	(0.01)	(0.33)
ln(Trading vol.)	0.0135	-0.0055	0.0462**	0.0159	0.0342	0.0115	0.0405	0.0477	0.0326	0.0275	0.0304	-0.0009
	(0.42)	(-0.20)	(2.89)	(1.28)	(1.74)	(0.33)	(1.03)	(0.85)	(1.54)	(0.80)	(1.68)	(-0.04)
KOSPI	-0.0338	-0.0143	-0.0397	-0.0871*	-0.0867*	-0.1294***	-0.0288	-0.0324	-0.0742	-0.1246	-0.0981	-0.0853
	(-0.51)	(-0.26)	(-1.21)	(-2.10)	(-1.98)	(-6.67)	(-0.46)	(-0.23)	(-1.34)	(-0.84)	(-1.72)	(-0.87)
Industry fixed effects	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
R-squared	0.1359	0.165	0.0662	0.0697	0.0427	0.0502	0.1661	0.1857	0.1051	0.2063	0.0718	0.133
# of obs.	558	325	566	328	564	328	350	218	350	218	353	221
Model-p	0.0000	0.0000	0.0000	0.0000	0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0304	0.0000

changes on average during all the three periods (see, β_3 in columns (1) - (6)). *Index_out* × *Y2021* also shows insignificant coefficients in columns (7)-(12), concluding that short-selling ban also has no significant impact on stock volatility.

Taken together for Tables 5 and 6, we repeatedly note that our empirical evidence is against the general belief about short-selling in the Korean stock market. For instance, if short-selling activities are associated with (inappropriate) selling pressure, and thus, negatively influence stock price, short-selling permission/ban could be bad/good news for shareholders. However, we rather find the opposite results which are weakly positive (negative or insignificant) stock returns even after short-selling permission (ban). The results on stock volatility, regardless of whether the event is *Index_in* or *Index_out*, are also not strong enough to claim the detrimental role of short-sellers.Note that our results are also consistent with prior studies that suggest the absence of evidence for speculative short-sellers in the Korean stock market (Jung et al., 2013; Wang and Lee, 2015).

Notably, our empirical evidence suggests that short-selling permission in the Korean stock market improvesprice efficiency. In addition, we argue that stock returns and volatility of the treatment groups are not strongly affected compared to the control groups in our empirical setup. Thus, we argue that there is no strongevidence supporting the evil side of short-selling in the Korean stock market, such as dropping stock price, limiting market efficiency, and destabilizing market by predatory short sellers; rather, our study supports the bright side by suggesting an important role of short-selling for price efficiency and discovery (Beber and Pagano, 2013; Saffi and Sigurdsson, 2011).

4.3. Robustness tests

As robustness tests, we first exclude firms that were newly listed on the exchange within six months before the index's regular updates. This exclusion is because the largest shareholders cannot sell their shares for six months after initial public offerings(IPOs), which might skew our analysis. We identify 22 newly listed firms around the analytic events, as reported in Appendix B. After excluding these firms from our sample, we find that the previous results in Tables 3, 4, 5, and 6 maintain similar patterns of significance (untabulated).

Second, we reperform the previous tests for the KOSPI-only or KOSDAQ-only sample. In these untabulated results, we find that the KOSPI-only sample exhibits qualitatively similar patterns likewise our reported empirical tables. However, the same tests for the KOSDAQ-only sample show insignificance in most of the key coefficients.We cautiously

argue that this insignificant result could be due to the relatively large instability of the KOSDAQ market (in terms of both stock price and volatility). Thus, one might argue that the impact of short-selling permission and ban could differ in the KOSDAQ market. Since our study cannot completely resolve this point, a deeper study is necessary in the future because stocks in the KOSDAQ market could have different characteristics relative to the KOSPI market.

5. Conclusion

In November 2023, the Korean FSC again decided to suspend short-selling activities in the Korean stock market. This suspension will continue to March 2025, and until that time, the Korean government is aiming to build the system to monitor speculative short sellers. With this regard, ourpaper can provide both academic and practical implications, by attempting to employ the recent regulation changes on short-selling in the Korean stock market.

First, we suggest that the current regime in the Korean stock market can be an ideal setting to construct academic research on the impact of short-selling. More specifically, we adopt a quasi-natural experiment design using the constituents change in KOSPI200 and KOSDAQ150 indices in 2020 and 2021, aiming to overcome potential endogeneity concerns. Since endogeneity threat is critical in the short-selling literature, this novelapproach alleviates such concerns and enables us to examine thepure impact of short-selling permission/ban.

Second, our empirical analysis shows evidencethat at least some short-sellers play an important role in price discovery, rather than its detrimental role in society. In particular, short-selling permission in the Korean stock market appears to enhance the affected stocks' price efficiencies, and thus, it can contribute to improving market efficiency. Notably, in line with our results, recent studies on short-selling also suggest the positive role of short-selling (e.g., Bushman and Pinto, 2024; Luu et al., 2023).

Third, there is no clear evidence that short-sellers are predatory traders on average in Korea. In our empirical results, we never findthat short-selling activities are harmful to the stock market, neither from the perspective of stock returns nor volatilities. This result is also consistent with prior studies, which strongly suggestthe absence of evidence for speculative short-sellers in the Korean stock market (Jung et al., 2013; Wang and Lee, 2015).

Recently, in June 2024, Morgan Stanley Capital International (MSCI) announced that South Korea failed to include in its index of the developed market.[10] In particular, MSCI

pointed out that the Korean government's intervention in short-selling ban in November last year is not desirable. This MSCI view is in linewith one from the WFE statement in March 2020 (as illustrated in the Introduction). Consistent with these views, our paper concludes that banning short-selling might not be helpful for stabilizing the market, further casting doubts on the reason for banning short-selling. Yet, some future studies are required to check whether short-selling rules towards smaller stocks also show the same pattern of empirical evidence in this paper.

10) South Korea is currently classified as the emerging market index of MSCI. For more detail, see, https://www.hankyung.com/article/2024062135581

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Appendix A. Stocks in the treatment group (in Korean)

Treatment group	*Index-in* = 1	*Index-out* = 1
June 12, 2020	HMM	에스엘
	포스코케미칼	신라젠
	F&F	넥슨게임즈
	한진칼	효성중공업
	KG스틸	한국쉘석유
	아시아나항공	동양
	케어젠	남양유업
	차바이오텍	한양이엔지
	화승엔터프라이즈	JW홀딩스
	유진테크	현대리바트
	아이티엠반도체	하이록코리아
	더블유게임즈	대덕
	쿠쿠홈시스	세종텔레콤
	상상인	AK홀딩스
	KH바텍	태웅
	우리기술투자	아스트
	다우데이타	이엠코리아
	셀리버리	에스엠코어
	이베스트투자증권	우리산업
	유비쿼스홀딩스	SGC이테크건설
	태영건설	강스템바이오텍
	코윈테크	코스맥스엔비티
	현대바이오랜드	
	브이티지엠피	
December 11, 2020	하이브	동아쏘시오홀딩스
	카카오게임즈	세아베스틸지주
	한화시스템	남해화학
	키움증권	동아에스티
	씨에스윈드	바텍
	두산퓨얼셀	우리기술투자
	솔브레인	CJ프레시웨이
	대웅	디오
	피엔티	한라홀딩스
	대주전자재료	롯데푸드
	신풍제약	성우하이텍
	지누스	모두투어
	엘앤씨바이오	인바디
	삼양식품	지노믹트리
	코리아센터	휴온스글로벌
	상아프론테크	성광벤드
	메드팩토	대교
	에스앤에스텍	나스미디어
	한국기업평가	코윈테크
	동국S&C	연우
	제이앤티씨	파워로직스
	노바렉스	미래컴퍼니
	서울바이오시스	한국전자금융
	남선알미늄	
	알서포트	
	레몬	

Treatment group	*Index-in* = 1	*Index-out* = 1
June 11, 2021	SK바이오사이언스	케어젠
	SK아이이테크놀로지	골프존
	대한전선	SPC삼립
	효성첨단소재	삼양사
	효성티앤씨	빙그레
	심텍	한일현대시멘트
	하나머티리얼즈	사람인에이치알
	티에스이	신흥에스이씨
	동원산업	애경산업
	삼강엠앤티	HDC
	파크시스템스	한국기업평가
	박셀바이오	이지홀딩스
	데브시스터즈	클리오
	젬백스	노바렉스
	두산테스나	태영건설
	우리기술투자	남선알미늄
	바이넥스	비츠로셀
	에프에스티	에스티큐브
	성우하이텍	드림어스컴퍼니
	유니슨	에이치엘사이언스
	아주IB투자	현대바이오랜드
	아이큐어	브이티지엠피
		네오팜
December 10, 2021	현대중공업	이노션
	카카오페이	F&F홀딩스
	메리츠금융지주	삼양식품
	에스엘	LX홀딩스
	HK이노엔	엔케이맥스
	PI첨단소재	롯데하이마트
	명신산업	일양약품
	원익QnC	LX하우시스
	SBW생명과학	메디포스트
	바이오니아	HLB테라퓨틱스
	에코프로에이치엔	동국S&C
	코미코	크리스탈지노믹스
	한국비엔씨	유비쿼스홀딩스
	티케이케미칼	와이솔
	압타바이오	위닉스
	그래디언트	슈피겐코리아
	코나아이	아이큐어
	휴온스글로벌	유틸렉스
	엠투엔	텔콘RF제약
	셀리드	레몬
		케이피엠테크

Appendix B. Stocks those are newly-listed within 6 months at the index update date (in Korean)

Stock	Index's regular update	
	Year	Month
현대중공업	2021	12
카카오페이	2021	12
SK바이오사이언스	2021	6
SK아이이테크놀로지	2021	6
하이브	2020	12
F&F	2021	6
카카오게임즈	2020	12
솔브레인	2020	12
DL이앤씨	2020	12
DL이앤씨	2021	6
대덕전자	2020	6
티와이홀딩스	2020	12
HK이노엔	2021	12
PI첨단소재	2021	12
KCC글라스	2020	6
LX홀딩스	2021	6
에코프로에이치엔	2021	6
엠씨넥스	2021	6
엠씨넥스	2021	12
제이앤티씨	2020	6
서울바이오시스	2020	6
켄코아에어로스페이스	2020	6