



# Do IPOs matter for price limits? Evidence from Taiwan

Yensen Ni<sup>a</sup>, Paoyu Huang<sup>b,\*</sup>

<sup>a</sup> Department of Management Sciences, Tamkang University, 25137 Taipei, Taiwan

<sup>b</sup> Department of International Business, Soochow University, 100 Taipei, Taiwan



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## ABSTRACT

Given that the price limit hit is prominently displayed on the screen of the Taiwan Stock Exchange (TWSE), we explore whether price limits occur in initial public offering (IPO) firms according to the assumption that the sentiments of investors tend to be aroused by firms issuing IPOs and the price limit hit. Results reveal that price limits often occur in IPO stocks. The above phenomena do not only occur during the IPO issuing year, but may also be extended to the following year. We infer that several IPO firms tend to manipulate share prices, especially for technology and high-underpricing IPO firms. The results of this study may be interpreted from the sentiments of investors via the viewpoint of behavioral finance.

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## 1. Introduction

Price limits originate from market-scale and political concerns in Taiwan. These limits prevent the sharp increase or decrease in stock prices caused by unexpected internal or external factors. The price limit system mitigates share price overreaction and excessive speculation that result from emergent events. When the price of a stock hits the price up-limit (down-limit), that is, when the share price of a stock rises (falls) by 7%, the stock is highlighted in bold red (green) on the screen of the Taiwan Stock Exchange (TWSE) as well as in other financial channels in Taiwan. This condition might stimulate the sentiments of investors. Therefore, price limits are designed to reduce potential share price volatilities because the sentiments of investors stimulated by stock price limits might enhance rather than mitigate stock price volatilities. However, this topic has been rarely investigated in previous studies.

We argue that share prices are likely to be “twisted” by the price limit system in Taiwan. For example, investors may fail to buy (sell) the stock with a price that rises (falls) drastically to the

price up-limit (down-limit). In other words, the price limit system may force investors to buy high and sell low in TWSE.<sup>1</sup> The Securities and Futures Bureau of the Financial Supervisory Commission discloses information on stocks that decrease abnormally or increase continuously. Furthermore, instead of regular trading for these stocks, the bureau postpones the trading time up to 30 min. However, we claim that the volatility of these stocks may not be mitigated because market participants are likely to be attracted to these stocks because of their movement.

Huang (1998) revealed that significant price reversals in Taiwan follow either a price up-limit or down-limit after the size effect is adjusted. Phylaktis, Kavussanos, and Manalis (1999) showed that price limits slow down the adjustment of share prices to prevent unexpected shocks. Kim and Limpaphayom (2000) reported that stocks that are volatile, actively traded, and have small market

<sup>1</sup> Investors may fail to buy shares as the price of a stock rises to the up-limit because shareholders may expect a stock price increase that may discourage them from selling their own shares. As a result, investors may buy the share at a higher price. Likewise, shareholders may fail to sell their shares as the stock price decreases to its down-limit because investors may expect a stock price decline that may discourage them from buying new shares. Therefore, shareholders may sell their own shares at a lower price.

\* Corresponding author. Tel.: +886 23111531x3421.

E-mail addresses: [ysni@mail.tku.edu.tw](mailto:ysni@mail.tku.edu.tw) (Y. Ni), [hpy@scu.edu.tw](mailto:hpy@scu.edu.tw) (P. Huang).

capitalization frequently hit price limits in Taiwan and Thailand. Therefore, price limits appear to moderate the volatilities of share prices. By contrast, [Chen \(1993\)](#) revealed that price limits may not significantly reduce price volatilities in Taiwan. [Kim \(2001\)](#) found that stock volatility is usually high for markets that set restrictive price limits, a finding that contradicts conventional wisdom and the views that are held by most regulators. In other words, we aim to address the inconsistent findings on the capability of the price limit to mitigate stock price volatility.

[Chan, Kim, and Rhee \(2005\)](#) revealed that price limits fail to improve price discovery for stock trading in share markets. [Kim and Park \(2010\)](#) reported that regulators impose rules on price limits; however, these rules are likely to be manipulated because the sentiments of investors are stimulated. We argue that the sentiments of investors are easily aroused by initial public offerings (IPOs). For example, the underpricing of IPOs ([Boulton, Smart, & Zutter, 2011](#); [Chambers & Dimson, 2009](#); [Liu & Ritter, 2011](#)), the over-subscription of shares before the issuance of IPOs ([Ellul & Pagano, 2006](#); [Low & Yong, 2011](#)), and the occurrence of honeymoon effects immediately after IPO issuance ([Chiang, Qian, & Sherman, 2010](#); [Kandel, Sarig, & Wohl, 1999](#); [Lee, Taylor, & Walter, 1996](#)) appear to be connected with the sentiments of investors.

As a result, we determine whether price limits are affected by IPOs. Specifically, we argue that price limits and IPOs may be manipulated because the sentiments of investors are likely to be aroused by price limits ([Kim & Park, 2010](#)) and IPO issuance ([Aggarwal & Wu, 2006](#)).

In addition, we argue that several IPO firms may increase their share prices to price up-limits to attract investors who pursue high share prices. Similarly, several IPO firms may reduce their share prices to price down-limits to encourage investors to sell or even short-sell stocks. Furthermore, given that shareholders and underwriters tend to sell shares at relatively high prices immediately after the issuance of IPOs, share prices can be reduced to price down-limits later on.

This study is motivated by several concerns. First, price limits affected by IPO shares are worth investigating because IPO shares often appeal to market participants. Second, we suspect that insiders and even the stakeholders of IPO firms may manipulate share prices via the stock price limit system. A price limit of 7% is regulated by TWSE. When the share price of a stock increases (declines) by 7%, this stock is highlighted in bold red (green) on TWSE and financial channels. We argue that these phenomena may arouse the sentiments of market participants. We then explore whether price limits are often observed by IPO firms because of the above-mentioned concerns.

Previous studies have revealed that the subsequent performances of IPO shares appear to be disappointing ([Aggarwal & Rivoli, 1990](#); [Coakley, Hadass, & Wood, 2007](#); [Derrien, 2005](#)). [Lowry, Officer, and Schwert \(2010\)](#) reported that the inferior subsequent performances of IPO firms may have resulted from the information asymmetry between IPO firms and individual investors, especially that arising from issues related to corporate governance and financial statements. Therefore, we further examine whether price limits are affected by IPO firms during the issuing year and in the subsequent year.

We also review relevant studies on corporate governance and financial statements because we suspect that firms with corporate governance and financial issues tend to manipulate their share prices to price limits. This manipulation may arouse the sentiments of investors and even exploit considerable profits from share markets.

With regard to corporate governance issues, we argue that the decisions of enterprises are often made by the board. Therefore, we focus on the variables related to board structure. [Agrawal and](#)

[Mandelker \(1990\)](#) and [Claessens and Fan \(2002\)](#) reported that several firms whose controlling shareholders hold a high percentage of outstanding shares can enhance their corporate governance; however, other firms might manipulate their corporate resources against the interests of small shareholders ([Chin, Gary, Lee, & Lin, 2006](#); [Fan & Wong, 2005](#); [La Porta, Lopez-de-Silanes, & Shleifer, 1999](#); [Shleifer & Vishny, 1997](#)). [Demsetz \(1983\)](#) proposed that managers with a few shares may indulge their preferences if they can control the firm effectively. [Lee and Yeh \(2004\)](#) argued that high compensation is often allocated to directors who obtain loans by pledging most of their shares. [Cochran, Wood, and Jones \(1985\)](#) and [Mehran \(1995\)](#) also reported that independent directors with professional experience enhance the function of the board.

In terms of financial statements, [Louis and White \(2007\)](#) indicated that share prices are often affected when new financial reports are released. [Barton and Paul \(2002\)](#) reported that share prices increase when firms exhibit improved asset management. Meanwhile, a firm's financial risk declines if the firm has a relatively high current ratio ([Borokhovich, Brunarski, Crutchley, & Simkins, 2004](#); [Dahlquist & Robertsson, 2001](#); [He & Ng, 1998](#)). [Ou and Penman \(1989\)](#) and [Holthausen and Larcker \(1992\)](#) suggested that firms that employ high leverage enhance the financial risks and weaken the performance of share price ([Cai & Zhang, 2011](#)). We argue that price limits seldom occur in large-scale firms because share prices are less volatile in these firms ([Blanchard & Simon, 2001](#); [Duffee, 1995](#)).

After reviewing relevant studies, we control board structure variables, such as directors' holding, managers' holding, directors' pledge, board size, and independent director dummy. We also control financial and other controlling variables, such as current ratio, debt ratio, asset turnover ratio, profit margin, and firm scale. We include current- and previous-year IPOs because price limits may be affected by concerns regarding the performance of firms after the issuance of IPOs ([Aggarwal & Rivoli, 1990](#); [Coakley et al., 2007](#); [Derrien, 2005](#)). Moreover, we classify IPO firms into high- and low-underpricing firms and include trading volume, beta, and financial crisis dummy as controlling variables. We then explore whether price limits often occur in IPO firms after controlling the above-mentioned variables.

With regard to the global stock price limit system, the 7% price limit in Taiwan is different from the price limits set in other countries. In fact, price limits in other countries are seldom set as 7%; the limit in Taiwan is much lower than that in other countries. Therefore, our data may be regarded as unique data. We argue that share prices may not be easily manipulated by price limits in other countries that implement the price limit system. However, we suspect that stock prices of TWSE-listed and even IPO firms may be easily manipulated by price limits because they stimulate the sentiments of investors.

Price limits often occur in IPO firms in the issuance year and even in the following year because IPO firms still appeal to market participants even immediately after IPO issuance. Thus, we argue that the share prices manipulated by IPO firms are likely occurred resulting from the sentiments of investors aroused. In addition, we also reveal that firms with few price limit hits have good asset management, high profitability, low debts, and many independent directors. Therefore, price limits are seldom observed by firms with good financial performance and corporate governance.

This study contributes to existing literature in several ways. First, we reveal that price limits often occur in IPO firms at the issuance year and even at the following year. In addition, IPOs are often observed by high-underpricing and technology firms because of the attention provided by investors. These outcomes might result from the aroused sentiments of investors in terms of behavioral

finance. Second, we explore price limits by considering price limit,<sup>2</sup> price up-limit, and price down-limit ratios, which were seldom investigated in previous related studies. Third, we argue that

$$Y_{ji,t} = \beta_0 + \beta_1 \text{IPO current-year dummy}_{i,t} + \beta_2 \text{IPO previous-year dummy}_{i,t} + \beta_3 \text{director's holding ratio}_{i,t} + \beta_4 \text{manager's holding ratio}_{i,t} + \beta_5 \text{director's pledge ratio}_{i,t} + \beta_6 \text{board size}_{i,t} + \beta_7 \text{independent director dummy}_{i,t} + \beta_8 \text{current ratio}_{i,t} + \beta_9 \text{debt ratio}_{i,t} + \beta_{10} \text{asset turnover ratio}_{i,t} + \beta_{11} \text{profit margin}_{i,t} + \beta_{12} \text{firm scale}_{i,t} + \varepsilon_{i,t}, \quad j = 1, 2, 3, \dots$$

several IPO firms, especially those with inferior financial performance and corporate governance, tend to manipulate share prices.

The rest of this paper is organized as follows. Section 2 presents the data and methodology. Section 3 presents the descriptive statistics, analyses, and empirical results. Section 4 provides the conclusions.

## 2. Data and methodology

### 2.1. Data

The stocks listed in TWSE belong to technology, financial, and traditional sectors. We collected 5640 firm-year observations over

$$Y_{ji,t} = \beta_0 + \beta_1 \text{IPO high-underpricing current-year dummy}_{i,t} + \beta_2 \text{IPO low-underpricing current-year dummy}_{i,t} + \beta_3 \text{IPO previous-year dummy}_{i,t} + \beta_4 \text{director's holding ratio}_{i,t} + \beta_5 \text{manager's holding ratio}_{i,t} + \beta_6 \text{director's pledge ratio}_{i,t} + \beta_7 \text{board size}_{i,t} + \beta_8 \text{independent director dummy}_{i,t} + \beta_9 \text{current ratio}_{i,t} + \beta_{10} \text{debt ratio}_{i,t} + \beta_{11} \text{asset turnover ratio}_{i,t} + \beta_{12} \text{profit margin}_{i,t} + \beta_{13} \text{firm scale}_{i,t} + \beta_{14} \text{trading volume}_{i,t} + \beta_{15} \text{beta}_{i,t} + \beta_{16} \text{2008 dummy}_{i,t} + \varepsilon_{i,t}, \quad j = 1, 2, 3, \dots$$

the period 2005–2012 as our samples. Among these observations, 2775 were collected from the technology sector, 259 from the financial sector, and 2606 from the traditional sector. We selected technology firms listed in TWSE as our samples because more than 70% of the IPO firms during the data collection period and approximately 50% of the firms listed in TWSE are technology firms. We then explored the traditional sector, which includes several sub-industries, such as plastic, steel, cement, food, textile, motor, biochemistry, rubber, automobile, and construction. We also examined stocks in the financial sector for comparison although this sector has a special capital structure.

We employed the board structure, financial statements, IPOs, and other controlling variables obtained from the Taiwan Economic Journal, Market Observation Post System, and TWSE. These variables are presented in Table 1.

### 2.2. Models

We employed price limit, price up-limit, and price down-limit ratios as dependent variables. We then explored whether price limits are affected by IPO variables by incorporating board structure, financial statements, and firm scale as controlling variables.

Before processing our models, we determined the presence of multicollinearity among the independent variables. No multicollinearity was detected because the variance inflation factor values of the variables are less than 4.

We propose that censored panel data models are more appropriate to use than multiple regression models and other panel models because of the firm-year observations employed and the data characteristics concerned. Thus, Model 1 is expressed as follows:

where  $Y_{1i,t}$  is the price limit ratio,  $Y_{2i,t}$  is the price up-limit ratio, and  $Y_{3i,t}$  is the price down-limit ratio.

Aside from the variables employed in Model 1, we argue that price limits, regarded as a stock volatility proxy, may be affected by trading volume, exchange volatility, and financial crisis. Therefore, we incorporated trading volume, beta, and the 2008 financial crisis dummy as controlling variables. The role of IPO pricing relative to the original value presents another significant concern because IPO underpricing may be affected by the sentiments of investors and may even contain unrevealed information. Therefore, we classified IPO current-year into IPO high-underpricing current-year and IPO low-underpricing current-year<sup>3</sup> for further investigation. We then expanded Model 1 into Model 2, which is expressed as follows:

where  $Y_{1i,t}$  is the price limit ratio,  $Y_{2i,t}$  is the price up-limit ratio, and  $Y_{3i,t}$  is the price down-limit ratio.

## 3. Descriptive statistics, analysis, and empirical results

### 3.1. Descriptive statistics

We collected 5640 firm-year observations for firms listed in TWSE over the period of 2005 of 2012. Table 2 presents the means, standard deviations, minimums, and maximums for the variables employed. The dependent variables include price limit, price up-limit, and price down-limit ratios, and the independent variables include IPOs, board structure, financial statement, and other controlling variables as illustrated in Table 1.

Table 2 shows that the price limit, price up-limit, and price down-limit ratios are all less than 5%. This result indicates that price limits may not be easily hit without releasing information or even share price manipulated. In addition, price up-limits occur more often than price down-limits, with ratios of approximately 3.02% and 1.47%, respectively. With regard to the board structure and financial statement variables, the director's pledge ratio is 11.24% on the average; however, its maximum is up to 100%. Therefore, proxy problems may exist in several firms listed in TWSE. The debt and current ratios are below 40% and 2.745%, respectively, a result that indicates that most of the firms listed in TWSE are

<sup>3</sup> We set 20% as the benchmark for IPO underpricing to classify IPO firms into high-underpricing and low-underpricing firms, which could classify IPO firms into two groups rather equally. In this study, the IPO high-underpricing dummy is set to 1 for the IPO firms issued at high underpricing (over 20%) in the current year and is set to 0 otherwise. The IPO low-underpricing dummy is set to 1 for IPO firms issued at low underpricing (below 20%) in the current year and is set to 0 otherwise.

<sup>2</sup> Price limit ratio is the sum of price up-limit ratio and price down-limit ratio.

**Table 1**  
Definitions of the variables employed.

Variables	Definition
<b>Price limit variables</b>	
Price limit ratio	Days of a stock with closing prices that hit the price limits, including up- and down-limits, over total trading days in a year
Price up-limit ratio	Days of a stock with closing prices that hit the price up-limits over total trading days in a year
Price down-limit ratio	Days of a stock with closing prices that hit the price down-limits over total trading days in a year
<b>IPO variables</b>	
IPO current-year dummy	IPOs issued in this year are set to 1; otherwise, 0
IPO high-underpricing current-year dummy	IPOs issued in this year at high underpricing are set to 1; otherwise, 0
IPO low-underpricing current-year dummy	IPOs issued in this year at low underpricing are set to 1; otherwise, 0
IPO previous-year dummy	IPOs issued in the previous year are set to 1; otherwise, 0
<b>Board structure variables</b>	
Directors' holding ratio	Total shareholding of directors over total outstanding shares
Managers' holding ratio	Total shareholding of managers over total outstanding shares
Directors' pledge ratio	Pledged shares of directors over shareholding of directors
Board size	Total number of directors
Independent director dummy	Firms with independent director(s) are set to 1; otherwise, 0
<b>Financial statement variables</b>	
Current ratio	Current assets over current liabilities
Debt ratio	Total debts over total assets
Asset turnover ratio	Total sales over total assets
Profit margin	Gross profit over total sales
<b>Other controlling variables</b>	
Trading volume	ln(trading volume)
Beta	Beta coefficient for stocks listed in TWSE
2008 dummy	Financial crisis year dummy
Firm scale	ln(market value)

conservative in terms of the leverage employed. The mean asset turnover ratio and profit margin are 0.903 and 0.205, respectively, which are higher than the median asset turnover ratio and profit margin of 0.784 and 0.172, respectively. These increased mean values can be attributed to the excellent performance of several firms.

### 3.2. Empirical results and analysis

#### 3.2.1. Models and expanded models

We employed price limits, including price limit, price up-limit, and price down-limit ratios, as dependent variables. Afterward, we explored whether price limits are affected by IPOs, including IPO current-year and previous-year dummies. We also employed variables related to financial statements, board structure, and firm scale as controlling variables. We then explored whether price limits are affected by IPOs and other relevant variables in Model 1.

We argue that the price limit, as one of the stock volatility proxies, might be affected by trading volume, exchange volatility, and financial crisis. Therefore, we incorporated trading volume, beta, and 2008 financial crisis dummy as controlling variables. The role of IPO pricing relative to the original value also presents a significant concern because IPO underpricing may contain unrevealed information. Therefore, we classified IPO current-year into IPO high-underpricing current-year and IPO low-underpricing current-year. Aside from the variables employed in Model 1, we incorporated trading volume, beta, and 2008 financial crisis dummy in Model 2. We also divided IPO into IPO high-underpricing current-year and IPO low-underpricing current-year in Model 2. Table 3 presents the results of Models 1 and 2.

Table 3 shows that the IPO variables, including the IPO current-year and IPO previous-year dummies, affect the price limit variables, including price limit, price up-limit, and price down-limit ratios. By employing the IPO high-underpricing current-year and IPO low-underpricing dummies instead of the IPO current-year dummy, we found that both variables affect price limits. However, the IPO high-underpricing current-year dummy significantly affects the price limit variables compared with the IPO low underpricing current-year dummy. This result may be due to the sentiments of investors, which are easily aroused by price limit hit and IPO issuance at high underpricing.

**Table 2**  
Descriptive statistics.

Variables	Obs.	Mean	Median	Std. dev.	Min.	Max.
Price limit ratio (%)	5640	4.488	2.419	5.942	0	98
Price up-limit ratio (%)	5640	3.019	1.619	4.385	0	98
Price down-limit ratio (%)	5640	1.469	0.405	2.435	0	17.671
IPO current-year dummy	5640	0.017	0	0.131	0	1
IPO high-underpricing current-year dummy	5640	0.009	0	0.096	0	1
IPO low-underpricing current-year dummy	5640	0.008	0	0.089	0	1
IPO previous-year dummy	5640	0.018	0	0.135	0	1
Directors' holding ratio (%)	5640	22.220	18.53	14.265	0.12	98.07
Managers' holding ratio (%)	5640	0.972	0.28	2.015	0	22.78
Directors' pledge ratio (%)	5640	11.238	0	19.652	0	1
Board size	5640	5.090	5	2.217	0	14
Independent director dummy	5640	0.401	0	0.490	0	1
Current ratio	5640	2.745	1.764	5.837	0.106	187.896
Debt ratio	5640	0.385	0.362	0.200	0.001	1.752
Asset turnover ratio	5640	0.903	0.784	0.646	0.0002	8.979
Profit margin	5640	0.205	0.172	0.199	−6.148	1.649
Firm scale	5640	15.577	15.408	1.458	10.612	21.645
Trading volume (million shares)	5640	19.720	19.79	1.577	13.82	24
Beta	5640	0.931	0.946	0.329	−1.108	3.293
2008 financial crisis dummy	5640	0.122	0	0.327	0	1
ADR dummy	5640	0.008	0	0.091	0	1
China dummy	5640	0.053	0	0.224	0	1

**Table 3**  
Results for price limits obtained by using censored panel data models.

Dependent variables	Eq. (1) Price limit ratio		Eq. (2) Price up-limit ratio		Eq. (3) Price down-limit ratio	
Independent variables	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
IPO current-year dummy	0.0354*** (0.0067)		0.0241*** (0.0049)		0.0114*** (0.0037)	
IPO high-underpricing current-year dummy		0.0841*** (0.0072)		0.0603*** (0.0059)		0.0306*** (0.0031)
IPO low-underpricing current-year dummy		0.0539*** (0.0081)		0.0384*** (0.0066)		0.0189*** (0.0036)
IPO previous-year dummy	0.0249*** (0.0064)	0.0212*** (0.0051)	0.0150*** (0.0046)	0.0146*** (0.0041)	0.0138*** (0.0034)	0.0094*** (0.0022)
Directors' holding ratio	0.0049 (0.0093)	0.0746*** (0.0097)	0.0215*** (0.0081)	0.0626*** (0.0083)	0.0152*** (0.0040)	0.0187*** (0.0033)
Managers' holding ratio	−0.0532 (0.0584)	0.1240** (0.0532)	0.0255 (0.0466)	0.1106** (0.0438)	0.0662** (0.0271)	0.0248*** (0.0200)
Directors' pledge ratio	0.0108* (0.0060)	−0.0096* (0.0053)	0.0055 (0.0047)	−0.0055 (0.0044)	0.0077 (0.0128)	−0.0039* (0.0020)
Board size	−0.0025*** (0.0007)	−0.0042*** (0.0007)	−0.0028*** (0.0006)	−0.0037*** (0.0006)	−0.0006** (0.0003)	−0.0010*** (0.0002)
Independent director dummy	−0.0088*** (0.0027)	−0.0103*** (0.0026)	−0.0097*** (0.0022)	−0.0095*** (0.0021)	0.0006 (0.0012)	−0.0003 (0.0009)
Current ratio	−3.53e−06** (1.79e−06)	−3.77e−06** (1.49e−06)	−2.03e−06 (1.34e−06)	−2.25e−06* (1.20e−06)	−3.47e−06*** (1.09e−06)	−2.69e−06*** (7.75e−07)
Debt ratio	0.0235*** (0.0066)	0.0189*** (0.0067)	0.0235*** (0.0057)	0.02417*** (0.0057)	−0.0099 (0.0029)	−0.0041* (0.0022)
Asset turnover ratio	−0.0009 (0.0022)	−0.0068*** (0.0022)	8.83e−06 (0.0018)	−0.0052*** (0.0019)	−0.0008 (0.0009)	−0.0023*** (0.0007)
Profit margin	−0.0191*** (0.0057)	−0.0126** (0.0052)	−0.0108** (0.0045)	−0.0103** (0.0044)	−0.0119*** (0.0027)	−0.0028*** (0.0019)
Firm scale	−0.0103*** (0.0010)	−0.0202*** (0.0012)	−0.0044*** (0.0008)	−0.0130*** (0.0010)	−0.0038*** (0.0004)	−0.0099*** (0.0004)
Trading volume		0.0311*** (0.0001)		0.0230*** (0.0009)		0.0127*** (0.0005)
Beta		0.0001 (0.0029)		−0.0014 (0.0023)		0.0056*** (0.0013)
2008 financial crisis dummy		0.0740*** (0.0019)		0.0263*** (0.0015)		0.0545*** (0.0008)
Constant	0.2088*** (0.0000)	−0.2571*** (0.0204)	0.0997*** (0.0131)	−0.2199*** (0.0170)	0.0753*** (0.0066)	−0.0966*** (0.0069)
Wald chi-square	235.86	3253.4	142.22	1417.95	181.18	6301.42
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

We employed price limit, price up-limit, and price down-limit ratios as dependent variables, the results of which are shown in Eqs. (1), (2) and (3), respectively. The independent variables employed in Model 1 include the IPO current-year dummy, IPO previous-year dummy, directors' holding ratio, managers' holding ratio, directors' pledge ratio, board size, independent director dummy, current ratio, debt ratio, asset turnover ratio, profit margin, and firm scale. Aside from the variables employed in Model 1, we included trading volume, beta, and 2008 financial crisis dummy in Model 2. We also utilized IPO high-underpricing current-year and IPO low-underpricing current-year dummies in Model 2. The standard errors of the estimated coefficients are shown in parentheses. Columns (1a)–(3a) show the empirical results for Model 1, and columns (1b)–(3b) show the empirical results for Model 2. Statistical significance is set at 10%, 5%, and 1% levels as denoted by \*, \*\*, and \*\*\*, respectively.



**Table 4**

Results for price limits obtained by using censored panel data models with concerning outliers.

Dependent variables	Eq. (1) Price limit ratio		Eq. (2) Price up-limit ratio		Eq. (3) Price down-limit ratio	
Independent variables	(1a) 1% excluded	(1b) 5% excluded	(2a) 1% excluded	(2b) 5% excluded	(3a) 1% excluded	(3b) 5% excluded
IPO high-underpricing current-year dummy	0.0658*** (0.0063)	0.0441*** (0.0053)	0.0503*** (0.0044)	0.0346*** (0.0040)	0.0198*** (0.0028)	0.0072*** (0.0024)
IPO low-underpricing current-year dummy	0.0450*** (0.0067)	0.0365*** (0.0054)	0.0316*** (0.0049)	0.0214*** (0.0040)	0.0175*** (0.0030)	0.0105*** (0.0024)
IPO previous-year dummy	0.0134*** (0.0044)	0.0133*** (0.0034)	0.0104*** (0.0031)	0.0100*** (0.0025)	0.0055*** (0.0019)	0.0043*** (0.0015)
Directors' holding ratio	0.0591*** (0.0070)	0.0480*** (0.0052)	0.0457 (0.0050)	0.0320*** (0.0037)	0.0180*** (0.0028)	0.0148*** (0.0021)
Managers' holding ratio	0.1477*** (0.0413)	0.0846*** (0.0316)	0.0944*** (0.0299)	0.0565** (0.0232)	0.0283* (0.0171)	0.0248* (0.0128)
Directors' pledge ratio	−0.0120** (0.0042)	−0.0078** (0.0032)	−0.0080*** (0.0030)	−0.0045* (0.0023)	−0.0029* (0.0017)	−0.0022* (0.0013)
Board size	−0.0030*** (0.0005)	−0.0020*** (0.0004)	−0.0024*** (0.0003)	−0.0014*** (0.0002)	−0.0008*** (0.0001)	−0.0006*** (0.0001)
Independent director dummy	−0.0064*** (0.0019)	−0.0037** (0.0014)	−0.0055*** (0.0014)	−0.0026** (0.0010)	−0.0007 (0.0008)	−0.0006*** (0.0001)
Current ratio	−3.94e−06*** (1.23e−06)	−2.68e−06*** (9.76e−07)	−2.38e−06*** (8.86e−07)	−2.10e−06*** (7.22e−06)	−2.38e−06*** (6.55e−07)	−1.42e−06** (4.66e−07)
Debt ratio	−0.0020 (0.0058)	−0.0048 (0.0036)	−0.0004 (0.0034)	−0.0006** (0.0025)	−0.0036* (0.0019)	−0.0028* (0.0014)
Asset turnover ratio	−0.0057*** (0.0015)	−0.0028** (0.0011)	−0.0035*** (0.0011)	−0.0023*** (0.0008)	−0.0014** (0.0006)	−0.0011** (0.0005)
Profit margin	−0.0086** (0.0040)	−0.0034 (0.0030)	−0.0031 (0.0028)	−0.0014 (0.0022)	−0.0025 (0.0016)	−0.0017 (0.0012)
Firm scale	−0.0196*** (0.0009)	−0.0161*** (0.0007)	−0.0138*** (0.0006)	−0.0111*** (0.0006)	−0.0085*** (0.0002)	−0.0066*** (0.0003)
Trading volume	0.0275*** (0.0010)	0.0216*** (0.0008)	0.0198*** (0.0007)	0.0145*** (0.0006)	0.0111*** (0.0004)	0.0083*** (0.0003)
Beta	−0.0005 (0.0026)	0.0036* (0.0020)	−0.0037** (0.0019)	−9.72e−06 (0.0016)	0.0063*** (0.0011)	0.0065*** (0.0008)
2008 financial crisis dummy	0.0669*** (0.0017)	0.0500*** (0.0015)	0.0246*** (0.0012)	0.0215*** (0.0010)	0.0473*** (0.0007)	0.0318*** (0.0007)
Constant	0.1955*** (0.0158)	0.1443*** (0.0123)	−0.1441*** (0.0118)	−0.0886*** (0.0088)	−0.0849*** (0.0060)	−0.0603*** (0.0047)
Wald chi-square	3280.46	2535.30	1780.30	1592.61	5846.30	3265.4
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

We employed price limit, price up-limit, and price down-limit ratios as dependent variables, the results of which are shown in Eqs. (1), (2) and (3), respectively. The independent variables employed include directors' holding ratio, managers' holding ratio, directors' pledge ratio, board size, independent director dummy, current ratio, debt ratio, asset turnover ratio, profit margin, firm scale, trading volume, beta, and 2008 financial crisis dummy. As for the IPO variables, we included IPO high-underpricing current-year, IPO low-underpricing current-year, and IPO previous-year dummies. The standard errors of the estimated coefficients are shown in parentheses. Columns (1a)–(3a) show the empirical results obtained by using the data excluding 1% outlier in both sides, and columns (1b)–(3b) show the empirical results obtained by using the data excluding 5% outlier in both sides. Statistical significance is set at 10%, 5%, and 1% levels as denoted by \*, \*\*, and \*\*\*, respectively.

**Table 5**  
Results for price limits obtained by using censored panel data models with concerning sub-industries.

Dependent variable	Eq. (1) Price limit ratio			Eq. (2) Price up-limit ratio			Eq. (3) Price down-limit ratio		
	Traditional (1a)	Electronic (1b)	Banking (1c)	Traditional (2a)	Electronic (2b)	Banking (2c)	Traditional (3a)	Electronic (3b)	Banking (3c)
High discount IPO current-year dummy	0.026 (0.018)	0.091*** (0.008)	0.095*** (0.032)	0.022 (0.015)	0.061*** (0.006)	0.095*** (0.024)	0.001 (0.007)	0.038*** (0.004)	−0.063 (22.041)
Low discount IPO current-year dummy	0.029* (0.017)	0.058*** (0.009)		0.021 (0.014)	0.039*** (0.007)		0.016** (0.006)	0.022*** (0.004)	
IPO previous-year dummy	0.016 (0.012)	0.019*** (0.006)	0.004 (0.029)	0.012 (0.010)	0.012*** (0.005)	0.003 (0.022)	0.003 (0.005)	0.010*** (0.003)	−0.065 (28.102)
Directors' holding ratio	0.065*** (0.014)	0.095*** (0.016)	0.029** (0.014)	0.044*** (0.012)	0.089*** (0.013)	0.021** (0.010)	0.020*** (0.004)	0.022*** (0.005)	0.014* (0.008)
Managers' holding ratio	−0.048 (0.072)	0.295*** (0.081)	0.666 (0.579)	−0.053 (0.061)	0.286*** (0.065)	0.392 (0.442)	0.011 (0.025)	0.030 (0.032)	0.518* (0.299)
Directors' pledge ratio	−0.016** (0.008)	−0.012 (0.008)	0.033*** (0.007)	−0.010 (0.007)	−0.007 (0.007)	0.021*** (0.005)	−0.005* (0.003)	−0.008** (0.003)	0.018*** (0.003)
Board size	−0.003*** (0.001)	−0.006*** (0.001)	−0.001 (0.001)	−0.003*** (0.0010)	−0.005*** (0.001)	−0.001 (0.001)	−0.0003 (0.0003)	−0.002*** (0.0004)	0.0001 (0.0004)
Independent director dummy	−0.009** (0.004)	−0.013*** (0.004)	−0.001 (0.005)	−0.010*** (0.004)	−0.010*** (0.003)	−0.001 (0.004)	−0.0002 (0.001)	−0.002* (0.001)	−0.001 (0.003)
Current ratio	−3.50e−06** (1.65e−06)	−4.20e−06 (8.05e−06)	−8.68e−07 (2.31e−06)	−2.08e−06 (1.37e−06)	−4.91e−06 (6.37e−06)	−6.09e−07 (1.76e−06)	−2.20e−06*** (7.68e−07)	9.48e−07 (3.28e−06)	−8.82e−07 (1.41e−06)
Debt ratio	0.046*** (0.011)	0.018 (0.011)	0.045* (0.024)	0.042*** (0.009)	0.017* (0.009)	0.040** (0.019)	0.005 (0.003)	−0.001 (0.0044)	0.017 (0.012)
Asset turnover ratio	−0.013*** (0.004)	−0.007** (0.003)	0.006 (0.008)	−0.007*** (0.003)	−0.006** (0.002)	0.006 (0.006)	−0.006*** (0.001)	−0.002** (0.001)	0.002 (0.004)
Profit margin	−0.024*** (0.009)	−0.002 (0.012)	−0.011*** (0.004)	−0.018** (0.008)	0.003 (0.010)	−0.009*** (0.003)	−0.002 (0.003)	−0.001 (0.004)	−0.004* (0.002)
Firm scale	−0.022*** (0.002)	−0.018*** (0.002)	−0.006** (0.003)	−0.015*** (0.002)	−0.010*** (0.002)	−0.005** (0.002)	−0.010*** (0.001)	−0.010*** (0.001)	−0.003* (0.001)
Trading volume	0.029*** (0.002)	0.034*** (0.002)	0.005** (0.003)	0.022*** (0.001)	0.024*** (0.001)	0.003* (0.002)	0.010*** (0.001)	0.016*** (0.001)	0.003** (0.001)
Beta	0.024*** (0.005)	−0.020*** (0.004)	0.038*** (0.009)	0.017*** (0.004)	−0.016*** (0.003)	0.026*** (0.007)	0.015*** (0.002)	−0.003* (0.002)	0.025*** (0.005)
2008 financial crisis dummy	0.063*** (0.003)	0.086*** (0.003)	0.078*** (0.006)	0.023*** (0.002)	0.030*** (0.002)	0.029*** (0.005)	0.047*** (0.001)	0.063*** (0.001)	0.056*** (0.003)
Constant	−0.214*** (0.033)	−0.320*** (0.028)	−0.079* (0.044)	−0.179*** (0.028)	−0.262*** (0.023)	−0.046 (0.034)	−0.051*** (0.010)	−0.141*** (0.010)	−0.071*** (0.024)
Wald chi-square	1954.70	1682.22	320.61	783.42	680.03	148.81	2184.91	3497.27	478.88
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

We employed price limit, price up-limit, and price down-limit ratios as dependent variables, the results of which are shown in Eqs. (1), (2) and (3), respectively. The independent variables include directors' holding ratio, managers' holding ratio, directors' pledge ratio, board size, independent director dummy, current ratio, debt ratio, asset turnover ratio, profit margin, firm scale, trading volume, beta, and 2008 financial crisis dummy. As for the IPO variables, we included the IPO high-underpricing current-year, IPO low-underpricing current-year, and IPO previous-year dummies. The standard errors of the estimated coefficients are shown in parentheses. Columns (1a)–(3a) show the results for the traditional sector, columns (1b)–(3b) show the results for the technology sector, and columns (1c)–(3c) show the results for the banking sector. Statistical significance is set at 10%, 5%, and 1% levels as denoted by \*, \*\*, and \*\*\*, respectively.

**Table 6**

Results for price limits obtained by using censored panel data models with ADR and China-concept stocks.

Dependent variables	Independent variables	Eq. (1)	Price limit ratio	Eq. (2)	Price up-limit ratio	Eq. (3)	Price down-limit ratio
High discount IPO current-year dummy		0.0838***	(0.0073)	0.0601***	(0.0059)	0.0303***	(0.0031)
Low discount IPO current-year dummy		0.0536***	(0.0081)	0.0382***	(0.0066)	0.0187***	(0.0036)
IPO previous-year dummy		0.0209***	(0.0051)	0.0144***	(0.0041)	0.0092***	(0.0022)
Directors' holding ratio		0.0742***	(0.0097)	0.0623***	(0.0083)	0.0184***	(0.0033)
Managers' holding ratio		0.1222**	(0.0532)	0.1092**	(0.0437)	0.0243	(0.0120)
Directors' pledge ratio		−0.0090*	(0.0053)	−0.0050	(0.0044)	−0.0035*	(0.0020)
Board size		−0.0042***	(0.0007)	−0.0037***	(0.0006)	−0.0010***	(0.0002)
Independent director dummy		−0.0103***	(0.0026)	−0.0096***	(0.0022)	−0.0003	(0.0009)
Current ratio		−3.83e−06***	(1.49e−06)	−2.29e−06*	(1.20e−06)	−2.74e−06***	(7.78e−07)
Debt ratio		0.0184	(0.0067)	0.0213***	(0.0057)	−0.0045**	(0.0022)
Asset turnover ratio		−0.0068**	(0.0022)	−0.0052***	(0.0019)	−0.0023***	(0.0010)
Profit margin		−0.0129**	(0.0053)	−0.0106**	(0.0044)	−0.0030	(0.0019)
Firm scale		−0.0197***	(0.0012)	−0.0126***	(0.0010)	−0.0096***	(0.0005)
Trading volume		0.0312***	(0.0011)	0.0230***	(0.0009)	0.0127***	(0.0005)
Beta		−0.0002	(0.0029)	−0.0015	(0.0023)	0.0055***	(0.0013)
2008 financial crisis dummy		0.0744***	(0.0019)	0.0265***	(0.0015)	0.0547***	(0.0008)
ADR dummy		−0.0434*	(0.0237)	−0.0394*	(0.0225)	−0.0161***	(0.0059)
China-concept dummy		−0.0184*	(0.0094)	−0.0166*	(0.0089)	−0.0045**	(0.0023)
Constant		−0.32647***	(0.0205)	−0.2251***	(0.0171)	−0.1004***	(0.0069)
Wald chi-square		3261.79		1424.19		6310.64	
Probability		0.0000		0.0000		0.0000	

We employed price limit, price up-limit, and price down-limit ratios as dependent variables, the results of which are shown in Eqs. (1), (2) and (3), respectively. The independent variables include director's holding ratio, managers' holding ratio, directors' pledge ratio, board size, independent director dummy, current ratio, debt ratio, asset turnover ratio, profit margin, firm scale, trading volume, beta, and 2008 financial crisis dummy. As for the IPO variables, we included the IPO high-underpricing, IPO low-underpricing, and IPO previous-year dummies. We also included ADR and China-concept dummies in our models. That is, the ADR dummy is set to 1 for firms that issue ADR in the U.S. stock exchange and is set to 0 otherwise. The China-concept dummy is set to 1 for firms whose revenue mainly comes from Chinese markets and is set to 0 otherwise. The standard errors of the estimated coefficients are shown in parentheses. Columns (1)–(3) show the results obtained by incorporating the ADR and China-concept dummies into Eqs. (1), (2) and (3). Statistical significance is set at 10%, 5%, and 1% levels as denoted by \*, \*\*, and \*\*\*, respectively.

Several financial statement and board structure variables also affect price limits. For example, asset turnover ratio, profit margin, firm scale, current ratio, and independent director dummy are negatively related to price limit ratios, whereas debt ratio is positively related to price limit ratios. Price limits seldom occur in large-scale firms probably because of the difficulty of hitting price limits because of the considerable amount of outstanding shares. Consistent with our cognitions, the 2008 financial crisis dummy and trading volume are positively related to stock price limits. Firms with few price limit hits have improved asset management, high profitability, low debts, and independent directors. This finding indicates that price limits seldom occur in firms with good financial performance and corporate governance. Eqs. (1) and (2) have similar results probably because the samples overlapped in employing price limit and up-limit ratios as dependent variables.

### 3.2.2. Models with outliers

Table 2 shows that the mean limit ratio is far below the maximum value. Therefore, the presence of outliers is a significant concern. To prevent the results from being influenced by a small number of firms, we further explored whether price limits are affected by IPO and other controlling variables by excluding 1% and 5% outliers in both sides<sup>4</sup>.

Table 4 shows that both IPO high-underpricing current-year and IPO low-underpricing current-year dummies still affect the price limit variables even after excluding the outliers. The IPO high-underpricing current-year dummy is more significantly related to price limits than the IPO low-underpricing current-year dummy. The results in Table 4 are similar to those in Table 3. Asset turnover ratio, profit margin, firm scale, current ratio, and independent

director dummy are negatively related to price limit ratios and thus indicate that price limits are seldom observed in firms with good financial performance and corporate governance. As expected, the 2008 financial crisis dummy and trading volume positively affect stock price limits.

### 3.2.3. Models with sub-industries

The 5640 firm-year observations collected from TWSE over the period of 2005–2012 comprise 2775 observations from the technology sector, 259 observations from the financial sector, and 2606 observations from the traditional sector.

Aside from presenting the results of using all TWSE-listed firms, we also explored whether price limits are affected differently by IPOs in the technology, financial, and traditional sectors. The empirical results are shown in Table 5.

Table 5 shows that both the IPO high-underpricing current-year and IPO low-underpricing current-year dummies affect the price limit variables for the technology sector. The IPO high-underpricing dummy affects price limits more significantly than the IPO low-underpricing dummy. However, different results were obtained for the traditional and banking sectors. Price limits mainly occur in IPO firms that fall under the technology sector because technology stocks are more appealing to Taiwanese investors, which may be attributed to the relatively high trading volume of this sector. Therefore, the sentiments of investors may be easily aroused by the stock price limits that result from the IPO issuance of technology firms.

We also found that independent director dummy, asset turnover ratio, profit margin, firm scale, and current ratio are negatively related to price limit ratios. This result indicates that price limits are seldom observed in firms with good financial performance and corporate governance. The 2008 financial crisis dummy and trading volume positively affect stock price limits as well.

<sup>4</sup> According to the distribution of price limit variables, we set 1% and 5% outliers in the left or right side.



### 3.2.4. Models with further concerns

Several firms listed in TWSE issue American deposit receipts (ADRs) listed in the U.S. whose stock exchange do not adopt a price limit system. Several listed firms in TWSE are called China-concept stocks because their revenue mainly originates from China, whose stock exchange adopts a price limit system. Unlike the U.S. Stock Exchange, only a few foreign firms are listed in TWSE. Therefore, we utilized China-concept stocks as a proxy for firms that operate in countries whose stock exchange adopts a price limit system. We also utilized firms that issue ADRs in the U.S. as a proxy for firms that operate in countries whose stock exchange does not adopt a price limit system. We further explored whether these stocks have different price limit hits. The empirical results are presented in Table 6.

After expanding our models by incorporating the ADR and China-concept dummies, the empirical results reveal that turnover ratio, profit margin, firm scale, current ratio, and independent director dummy are negatively related to the price limits. This result indicates that price limits are seldom observed in firms with good financial performance and corporate governance. Table 6 shows that these two dummies negatively affect price limit, price up-limit, and price down-limit ratios. Most of the firms probably have sound financial performance and corporate governance; otherwise, these firms would not be cross-listed in the U.S. stock exchange nor gain most of their revenues from China. These results correspond with the argument that price limits seldom occur in firms with inferior financial performance and corporate governance.

## 4. Conclusion

By employing firm-year data collected from 2005 to 2012, we investigated whether price limit hit is affected by IPO firms. We employed censored panel data models after controlling the board structure, financial statements, and other relevant controlling variables. We obtained several impressive findings, which are discussed in the following paragraphs.

First, we found that price limits often occur in IPO firms during the IPO issuance year or in the following year. We also found that IPO firms with high underpricing would affect price limits more significantly than IPO firms with low underpricing. These results remain robust when outlier issues are considered. Second, firms with few price limit hits have a good asset management, high profitability, low debts, and many independent directors. Therefore, price limits are seldom observed in firms with good financial performance and corporate governance. Third, the results are obvious in the technology sector rather than in the traditional and financial sectors. The sentiments of investors may be easily aroused by technology firms that issue IPOs because technology stocks are appealing to investors in Taiwan. Fourth, we employed firms cross-listed in the U.S. stock exchange and China-concept stocks as proxies for firms that operate in countries whose stock exchange does not adopt and adopt price limits, respectively. These two proxies negatively affect the price limit variables. This result appears to be consistent with the finding that price limit seldom occurs in firms with inferior financial performance and corporate governance.

This study contributes to exiting literature in several aspects. First, we explored whether price limits are affected by IPOs according to our assumption that the sentiments of investors tend to be aroused by the issued IPOs and the price limits shown on bold red or green in TWSE and other financial channels. This subject is relatively under-investigated in previous studies. Second, we deliberately employed price limits by including price limit, price

up-limit, and price down-limit ratios as dependent variables to help market participants further understand price limits. Third, we argued that IPO stocks remain appealing to market participants even after IPO issuance. Therefore, IPO firms may manipulate share prices by means of the sentiments of investors because price limit hit and IPO issuance may arouse the sentiments of investors from the viewpoint of behavioral finance. Fourth, we revealed that price limit hits seldom occur in firms with good asset management, high profitability, low debt ratio, and independent directors. In other words, price limits seldom occur in firms with good financial performance and corporate governance. Thus, market participants holding IPO shares and shares with frequent stock limit hits must be cautious.

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