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ARE KOREAN INDIVIDUAL INVESTORS IRRATIONAL IN INITIAL PUBLIC OFFERING (IPO) MARKET? AN EXPLANATION FROM THE WINNER'S CURSE PERSPECTIVE

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ABSTRACT

Individual investors are often regarded as irrational sentiment investors whose investment behaviour is affected by psychological factors. This study measures the actual investment return of individual investors who participated in initial price offering (IPO) stock investment in the Korean market from the short-term and long-term perspective and investigates the relationship with IPO characteristics that affect the investment sentiment of individual investors. Even though the underpricing of IPO stocks on the first day of listing on average reached 31% over the past 13 years, individual investors in the Korean stock market earned very little actual return on IPO stock investment. The market-adjusted return on IPO stock investment on the first day was about −0.5%, and even if they held IPO stocks for one year after listing, it was only 3.4%. The so-called winner's curse, in which individual investors are allocated relatively many overvalued stocks appears to be present in the Korean IPO market. The allocation of IPO stocks by individual investors depends on several factors that reflect individual investors' sentiment, such as past performance of previous IPOs, past industrial returns, institutional investors' investment intent, offering size, an upward revision of the offer price, and issuing firm's financial soundness. It was found that the higher the individual allocation rate, the lower the short-term investment return on the first trading day, confirming the winner's curse risk of individual investors.

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However, in the long run, a reversal of returns was observed, in which the long-term returns of IPO stocks with high individual allocation rates rose. In order to mitigate the winner's curse risk, it is desirable to reform IPO pricing mechanisms and allocation rules in a way that reduces the asymmetry of information between institutional and individual investors and reflects the subscription demand of individual investors.

Keywords: individual investor, initial public offering, sentiment, winner's curse, return reversal

INTRODUCTION

In 1999, Korea introduced a book-building mechanism to determine IPO offer price, replacing the previous fixed pricing system. In the current system, however, only institutional investors can participate in the book-building process to determine the offer price. Once the final offer price is determined through the book-building, individual investors make a subscription at the determined final offer price. Furthermore, there is a pre-determined limit on the number of shares allocated to individual investors.

Unlike Korea, however, in Asian markets such as Hong Kong, Taiwan, and Japan, the demand of individual investors can be reflected in the determination of the offer price as the final offer price is determined after both of the book-building for institutional investors and the subscription of individual investors are completed. In the case of Japan and Taiwan, individual investors are allowed to participate in the book-building procedure. Therefore, the subscription rate of individual investors can affect the public offering price. In addition, the amount of IPO shares allocated to individual investors can be increased in accordance with the size of the individual subscription rate in Hong Kong and Taiwan (McGuinness, 2009; Hsieh, 2012; Chang et al., 2017; Kutsuna & Smith, 2004; Che-Yahya & Matsuura, 2021).

The offer price determined without reflecting the excess demand of individual investors shows a deviation from the fair price, which causes serious underpricing of the IPO stocks with high subscriptions by individual investors. In this sense, Korean individual investors face the problem of the winner's curse due to regulatory constraints on the formation of the offer price and allocation of public offering stocks, as a result, Korean individual investors could not realise actual investment profits through IPO stock investment.

By investigating the actual returns obtained by individual investors from IPO stock investment in the Korean market, this study attempts to present evidence that empirically verifies the winner's curse problem of individual

investors in the Korean market, in which individual investors are less allocated with IPO stocks that are undervalued compared to their fundamental value and more allocated with overvalued.

On the other hand, individual investors are generally regarded as sentiment investors who tend to increase stock price volatility by overreacting to market conditions. In particular, individual investors' over-optimism in the IPO market has been known to cause a stock price bubble in the early stage of trading, subsequently resulting in a long-term price reversal. If this is true, it is expected that there will be a significant difference in the short- and long-term investment performance of Korean individual investors.

In order to verify this conjecture, this study first identifies the factors that influence individual investors' demand for IPO stocks and then examines the effects of these factors on the short and long- term investment returns of individual investors.

Since there are few studies related to the performance of IPO stocks by individual investors in the Korean stock market, this paper contributes to the research related to the Korean stock market in that it associates the short- and long-term performance of individual investors with their trading behaviours influenced by market sentiment.

KOREAN STOCK MARKET AND THE IPO BUSINESS IN KOREA

The Korean stock market is largely composed of two markets on the Korea Exchange (KRX). One is the KOSPI market, where large-cap companies and blue-chip stocks are listed, and the other is the KOSDAQ market, where stocks of SMEs and venture companies are mainly traded. As of the end of 2019, the KRX is the world's 15th largest stock exchange in terms of market capitalisation, and the number of listed companies in the KOSPI market is 778, with a market capitalisation of USD 127 billion. There are 1,327 companies listed on the KOSDAQ market with a market capitalisation of USD 21 billion. Out of a total of 698 sample companies, 124 companies are KOSPI market listed and 574 companies are KOSDAQ market listed.

IPOs in the Korean market are made roughly in the following ways. First, a company wishing to go public signs a firm-commitment contract with the lead underwriter, and the lead underwriter conducts due diligence on the company and then submits the registration documents including the indicative offer price range to the financial supervisory authority. At the same time, an IPO

company must meet the listing requirements required by the KRX. After that, the book-building process is conducted for institutional investors to determine the offer price. The final offer price is determined by the issuer and the lead underwriters based on the results of book-building. Individual investors estimate market demand and make their investment decisions by observing the book-building procedure and determination of offer price. After receiving subscriptions from the investors, IPO stocks are allocated in a pre-determined ratio. Institutional investors receive more allocation of public offering stocks than individual investors as a reward for revealing information related to the fair value of IPO stocks in the book-building process. The allocation of IPO stocks in the Korean stock market is determined in advance by laws and KRX listing regulations. For IPO companies listed on the KOSPI market, 20% of public offering shares must be allocated to the employee stock ownership plan (ESOP). In the case of KOSDAQ-listed companies, the allocation of IPO shares to ESOP is discretionary and is made usually within 20%. Twenty percent of IPO shares are allocated to individual subscribers, and the remaining 60% to 80% of IPO shares are allocated to institutional investors. Only institutional investors who have placed a market bid or a limit bid equal to or higher than the final offer price in the book-building procedure are allocated IPO stocks. Individual investors are allocated proportionally according to their subscription size, but the lead underwriter has discretion in allocating public offerings to institutional investors. When under-subscription by one investor group takes place, the other groups or the underwriters take over the remaining shares.

LITERATURE REVIEW

Earlier studies have suggested that individual investors performed poorly in IPO stocks investment compared to institutional investors. Reasons for this include their exposure to adverse selection risk, limited information processing capabilities, and irrational investment behaviours such as over- confidence and a high tendency to trade based on sentiment.

According to Rock (1986), the IPO companies tolerate the undervaluation of offer prices to attract uninformed investors such as individual investors, who are at a disadvantage compared to informed investors for IPO success. Nevertheless, it was documented that uninformed investors could not earn excess returns through IPO investment because they are allocated relatively large numbers of overvalued stocks. This winner's curse phenomenon has been observed in IPOs in various countries. Koh and Walter (1989) in the Singaporean market, Keloharju (1992) in the Finnish market, and Amihud et al. (2003)

in the Israeli market reported that in IPOs with the undervalued offer price, individual investors are less likely to receive much allocation due to excessive oversubscription. In the Taiwanese stock market, Chen and Kao (2006) compared the results of auctioned IPOs in which institutional investors can participate with the results of fixed priced IPOs in which only individual investors can participate and insisted that excluding institutional investors' subscription in the fixed priced IPOs mitigates the winner's curse problem by allowing individual investors to be allocated more undervalued IPO stocks. In the Malaysian stock market, Yong (2011) compared private placement IPOs that allocate public offerings for institutional investors only and general IPOs in which individual investors participate. As expected, the average initial returns (about 19%) of the private placement IPOs is significantly lower than the average initial return (about 29%) of the non-private placement IPOs, indicating that individual investors demand a higher premium in absence of informed investors.

On the other hand, Boehmer et al. (2006) argued that there is a positive relationship between institutional investors' allocation rate of IPO stocks and long-term performance and that the longer their holding period of IPO stocks, the higher the long-term returns of those stocks, thereby insisting that institutional investors have private information related to IPO stocks. Conversely, Field and Lowry (2009) insisted that the reason institutional investors outperform individuals in the short- and long-term in their IPO stocks investment is not because they have private information that individuals do not know or have the ability to monitor IPO companies, but rather because they better interpret public information available to anyone.

In addition, Ritter (1991) said that the long-term underperformance of IPO stocks compared to the market is due to the over-optimism of investors, and IPO companies exploit this sentiment of individual investors when selecting the timing of IPOs. Krigman et al. (1999) reported that most of the trading of extra hot IPO stocks on the first day was made by individual investors, and the proportion of trading by institutional investors for these stocks was very small. However, these extra hot IPO stocks turned out to have the worst long-term performance of any other IPO stocks.

Ofek and Richardson (2003) argued that compared to institutional investors, individual investors' excessive investment in internet stocks and their optimistic buying behaviour caused the technology stock bubble in the early 2000s. Derrien (2005) also insisted that individual investors are sentiment investors whose investment behaviours are influenced by stock market conditions. When individual investors are optimistic about the stock market, their

subscriptions for IPO stocks increase, but individual investors' oversubscription produces the stock price surge and the subsequent share price decline in the aftermarket. According to Ljungqvist et al. (2006), individual investors are overly optimistic about the prospects of IPO stocks in a particular industry, and institutional investors take advantage of individual investors' preferences to dispose of their allocated stocks immediately after listing to individual investors. Cornelli et al. (2006) also said that if individual investors show unreasonably high investment demand for IPO stocks in the pre-IPO market, institutional investors dispose of their allocated offerings by taking advantage of the stock price increase on the first trading day. In the subsequent period, as the stock price declines, individual investors are reported to lose money. Chan (2010) recorded that the higher the individual's net purchase of popular IPO stocks with undervalued offer prices, the higher the return on the day of listing, while Da et al. (2011) also reported that IPO stocks with high interest from individual investors on the *Google* produced lower long-term returns despite higher returns on the first day.

In the Korean market, Chung et al. (2017) considered the subscription rate and turnover rate of individual investors' IPO stocks as a measure that reflects the investment sentiment of individual investors before and after the IPO, respectively. The higher the subscription competition and the more individual investors trade in IPO stocks after listing, the higher the return on the first day of listing. But shares of IPO stocks for which individual investors actively traded fell from the third day of listing, showing negative returns for a month, and their long-term returns were also low.

HYPOTHESES

Previous studies have shown that individual investors face a serious problem of adverse selection because they do not have information compared to institutional investors, and therefore, they are allocated a lot of relatively overvalued IPO stocks compared to undervalued ones. For this reason, it has been recorded that individual investors cannot achieve positive excess return through IPO investment (Rock, 1986; Beatty & Ritter, 1986; Michaely & Shaw, 1994; Amihud et al., 2003). As individual investors' subscription competition for IPO stocks intensifies, the expected investment loss of uninformed investors due to the adverse selection problem increases, so individual investors want more discounts on offer prices, and thus it is expected that there is a negative relationship between the first-day return and the proportion of IPO stocks allocated to individual investors. In other words, the higher the subscription rate

of individual investors, the higher the IPO return on the first day is expected. Therefore, by testing H1 and H2, this study attempts to verify whether individual investors can achieve excess returns by participating in IPO stock investments in the Korean stock market and whether individual investors' actual return on IPO stock investments would increase with the subscription competition.

H1: Individual investors cannot raise excess returns on the first day of listing through IPO investment.

H2: The more individual investors subscribe to IPO stocks, the higher the IPO investment return of individual investors on the first day of listing.

Also, there are studies that individual investors' irrational buying behaviours, which are based on their over-confidence, create stock prices that deviate from the fair values and are associated with poor long-term investment performance (Ofek & Richardson, 2003; Cornelli et al., 2006; Dorn, 2009). This study tries to verify the hypothesis that individual investors' excessive investment demand for IPO stocks causes a stock price bubble at the beginning of the listing, which leads to a subsequent long-term decline in stock prices, and that individual investors will achieve poor long-term performance.

H3: The higher the competition rate for individual investors' subscriptions, the lower the long-term IPO return.

DATA AND METHODOLOGY

Data

The sample of this study covers a total of 698 IPO companies, except for special acquisition purpose companies (SPAC) and foreign companies, listed on the KRX from July 2007 to 2019. On 15 May 2007, the Korean financial supervisory authority announced a plan to reform the IPO business, including autonomy of the offer price and allocation of IPO stocks. This study targets IPOs that submitted a registration statement after 18 June 2007, when the plan was implemented. IPO companies were identified using the KRX's corporate disclosure site (http://kind.krx.co.kr), and detailed information related to the public offering was provided by the Korean financial supervisory service's electronic disclosure system (http://dart.fss.or.kr). The information on the returns of listed companies used in this study was obtained from the database

of FnGuide Co. and information on financial statements was obtained from TS-2000 of the Korea listed companies association.

Research Methods

The measurement of the individual investor's actual IPO investment return should reflect the individual investor's subscription competition rate to the IPO stocks. The allocation weighted holding period return (AWHPR), as presented by Amihud et al. (2003), measures the actual return on IPO investment relative to the subscription margin deposited by an individual investor at the time of subscription. The subscription deposit was not required for institutional investors, but 50% of the investment funds should be deposited for individual investors at the time of subscription throughout the sample period. It is assumed that the allocation of IPO shares to individual investors is proportional to the subscription margin, and the limit of the subscription amount per person does not exist. In this case, AWHPR for j IPO stock from day one to day T is calculated as follows:

$$\text{AWHPR}(1, \text{T}) = 2 \times ALLOC_j \times \prod_{t=1}^{\text{T}} (1 + R_{j,t}) - \textit{interest cost} \qquad (1)$$

The ALLOC in (1) is the inverse of the individual investors' subscription rate which is the ratio of the number of IPO shares subscribed by individual investors to the number of shares allocated to them. When an IPO is undersubscribed, ALLOC in (1) is assumed to be one. The interest cost refers to the opportunity cost of the subscription deposit from the subscription date to the payment date. Relative to the benchmark, the allocation weighted holding period excess returns (AWHPER) are also calculated as follows:

$$\text{AWHPER}(1, \text{T}) = 2 \times ALLOC_j \times \prod_{t=1}^{\text{T}} [(1 + R_{j,t}) - (1 + R_{BM,t})] - \textit{interest cost} \qquad (2)$$

This study calculates both market-adjusted excess return and industry-adjusted excess return using market index return and industry return as two benchmarks. To investigate changes in short- and long- term returns of IPO stocks after listing, this study measures the average AWHPR and AWHPER of IPO stocks on the first day of listing and from the second day to one year after listing, respectively.

RESULTS

Table 1 shows basic statistics related to IPO companies' public offering characteristics and company status. IPO companies formed a wide spectrum from large companies to very small start-ups in terms of assets and sales, and on average, it took about 15 years from corporate foundation to initial public offering. When measuring the degree of discount of the offer price by the close to offer returns on the first day of listing, it was found that the offer price of Korean IPO companies was undervalued by about 31% on average.

Table 1
Basic statistics of IPO characteristics in the Korean stock market

	Mean	Median	Max	Min	S.D.
Offer price (Korean Won)	17,385	11,000	235,000	1,300	22,347
Proceeds (Korean billion Won)	68.4	19.6	4,888	1.4	263.6
Corporate age (months)	178	142	1,020	8	126
The institutional book-building participation rate	226.15	91.36	5,992.90	0.53	353.24
Individual investor's subscription rate	452.28	368.31	2,344.125	0.19	420.08
IPO underpricing	0.31	0.17	1.60	−0.37	0.46
Assets (Korean billion Won)	509.7	41.9	121,667	3.9	5,251.7
Sales (Korean billion Won)	217.5	46.9	25,294	0	1154.6
The fraction of institutional allocation	0.69	0.70	0.90	0.19	0.08
The fraction of individual allocation	0.20	0.20	0.61	0.05	0.03
The fraction of ESOP allocation	0.11	0.10	0.2	0	0.08

Note: Assets and sales data are based on the financial statements from the previous year of the IPO.

Table 2 presents the changes in the returns of IPO stocks and the average short and long-term investment performance of individual investors after listing of IPO stocks. The HPR in Table 2 represents the simple holding period return for each investment horizon of IPO stocks, and $AWHPER_m$ and $AWHPER_d$ represent the market-adjusted and industry-adjusted allocation weighted holding period excess return, respectively. Previous studies have recorded that most of the profits from IPO investments occur on the first day of listing. Panel A of Table 2 shows the mean values of HPR and individual investors' AWHPR and AWHPERs on the first day. On the first day of listing, the average HPR reached about 31%, which is the percentage increase of the closing price relative to the offer price, which is the same as the average degree of underpricing of the offer price. An average of –0.5% of AWHPR and

AWHPERs were also observed, indicating that individual investors on average suffered investment losses on the first day of the IPOs. This evidence denies the possibility of excess profit through IPO stock investment by individual investors, so H1 could not be rejected.

Table 2
Aftermarket performance of individual investors according to subscription rates

Quartile grouping by individual investors' subscription rate						
	Full sample	Group 1 (lowest)	Group 2	Group 3	Group 4 (highest)	*p*-value G4 – G1
Panel A. Day 1 returns						
HPR	0.3115	0.0368	0.2302	0.3715	0.6077	<0.01
AWHPR	−0.0051	−0.0247	0.0020	0.0012	0.0010	0.04
$AWHPER_m$	−0.0052	−0.0252	0.0021	0.0012	0.0010	0.04
$AWHPER_d$	−0.0050	−0.0244	0.0021	0.0012	0.0010	0.04
IND_BUY	0.9336	0.9072	0.9207	0.9453	0.9615	<0.01
T&F_BUY	0.0582	0.0816	0.0704	0.0484	0.0323	<0.01
Panel B. Day 2 to one-year returns						
HPR	−0.0100	0.1357	−0.0030	−0.0484	−0.1240	<0.01
AWHPR	0.0384	0.1559	−0.0010	−0.0005	−0.0004	0.01
$AWHPER_m$	0.0345	0.1587	−0.0005	−0.0005	−0.0005	0.01
$AWHPER_d$	0.0372	0.1692	−0.0004	−0.0005	−0.0004	0.01
Panel C. Day 1 to one-year returns						
HPR	0.2569	0.1774	0.2126	0.2900	0.3475	0.10
AWHPR	0.0336	0.1324	0.0011	0.0008	0.0006	0.01
$AWHPER_m$	0.0345	0.1353	0.0016	0.0008	0.0005	0.01
$AWHPER_d$	0.0372	0.1460	0.0018	0.0008	0.0006	0.01
Subscription rate of individual investors	452.28	12.01	208.35	554.48	1035.09	<0.01
N	698	174	175	175	174	

This study further divided IPO stocks into quartiles according to the individual's subscription rate for IPO stocks to compare any changes in HPR, AWHPR and AWHPERs among the four groups. As expected, the HPR on the first day increased by an average of 57%p more in the IPO stocks (G4), which were most preferred by individual investors, compared to the stocks (G1), the least preferred by individual investors. The means of AWHPR and

AWHPERs of the top 25% subscription group (G4), which was driven by strong demand for IPO shares by individual investors, were mere 0.1%, respectively. However, those of the bottom 25% subscription group (G1) were about −2.5%, which is lower by 2.6%p on average compared to the top 25% stocks, and the difference was significant at the 5% level. Nevertheless, the average values of AWHPR and AWHPERs of Groups 2 and 3 are positive and even higher than those of the top 25% group 4. Such results do not show evidence that the more competitive subscription is, and the more popular IPO stocks are, the higher the IPO investment returns, as suggested in H2. But it can be said that individual investors interested in realising profits through short-term selling on the first day should not at least invest in stocks with low subscription competition if they want to avoid losses through IPO investments.

Panel A of Table 2 also shows two variables, IND_BUY and T&F_BUY. The IND_BUY is the ratio of the number of stocks purchased by individual investors to the total trading volume on the first day, and T&F_BUY is the ratio of the number of shares purchased by local institutions and foreign investors to the total trading volume on the first day. Dorn (2009) argued that the number of IPO stocks purchased by individual investors on the first day is a proxy variable that reflects their favorable sentiment toward IPO stocks better than the net purchases figure because the amount of selling is affected by the return on the first day. Due to such overconfidence of individual investors, he insisted that the stocks preferred by individual investors underperformed in the long run compared to stocks that individual investors avoided. Similar to his argument, Korean individual investors tended to buy more IPO stocks they preferred on the first day. The difference between the IND_BUY ratios of G4 and G1 reached 5.4%p on average, and this difference was significant at the 1% level. In contrast, local institutional investors and foreign investors made considerably fewer purchases on the day of listing, and the T&F_BUY ratio was highest in G1 stocks (8.2%), which had the lowest preference for individual investors. On the other hand, this ratio was the lowest in G4 stocks (3.2%), where individual investors showed the highest preference.

In Panel B of Table 2, the HPR, AWHPR and AWHPERs for one year from the second day of listing are calculated separately. During this period, IPO stocks, on average, fell by 1% approximately, while their stock price rose significantly on the day of listing. In particular, G4 stocks, which had the largest share price increase on the first day, showed the largest share price decline (−12.4%), whereas the G1 shares, which had the smallest share price increase on the first day rose by 13.6%, unlike other three group shares. This result suggests the aftermarket price reversal of the IPO stocks in the Korean stock market.

The AWHPR was positive 3.8% on average, unlike the negative return (−0.5%) on the first day. In particular, the average $AWHPER_m$ and $AWHPER_d$ of IPO stocks with the lowest 25% of the subscription rate (G1) were 16% and 17%, respectively, compared to −2.5% and −2.4% on the first day of listing. Such a reversal of returns was also observed in the G4 stocks with high subscription competition, but the degree was not so great. This result means that, as assumed in H3, a return reversal occurs in IPO stocks, especially in unpopular IPO stocks with low subscription competition rates of individual investors.

Panel C of Table 2 presents the long-term HPR, AWHPR, and AWHPERs for one year after listing. On average, IPO stocks have risen by about 26% in the first year after listing. Individual investors are found to reap an average excess return of 3% to 4% compared to stocks in the market or industry for one year through IPO stock investments. Group 1 stocks, which had low subscription rates by individual investors, earned an average annual return of 13%, while Group 4 stocks, which had high subscription rates, only earned less than 0.1%. Ironically, when investing in IPOs that individual investors avoid like Group 1 stocks, even though the first-day return was low, the long-term return was better than investing in stocks that were popular at the time of IPO.

For comparison purposes, the results of Table 2 in the Korean market are compared with the results of previous studies conducted in other regions of Asia. Currently, Asian countries implement various IPO pricing mechanisms such as fixed price, auction, and book-building, or use the hybrid mechanism that mixes these methods. Compared to the book-building, in the fixed price method in which an issuing company and underwriters determine the offer price in advance, the adverse selection risk of uninformed investors is presumed to be relatively higher and the degree of discount of the offer price is expected to be higher. In this regard, Pettway and Kaneko (1996) observed an average first-day return of 70% in the fixed price system used until April 1989 in the Japanese IPOs. Now, the Japanese stock market uses both the auction and the book-building method, and Kaneko and Pettway (2003) reported that among the IPO stocks listed on JASDAQ from 1993 to 2001, the initial return of the auction-priced IPO shares was about 11%, compared to 48% of the book-built IPO stocks. They argued that the book-building mechanism increases the wealth of the selected investors of the underwriter at the expense of the issuer's increased money left on the table. Derrien and Womack (2003) insisted that the auction mechanism incorporates more information from the current market conditions into IPO pricing and that it is associated with less underpricing as well as a lower variance of underpricing than the book-building procedure. The Taiwanese stock market currently uses all three methods of the fixed price,

hybrid auction, and hybrid book-building. Hsieh (2012) compared the first-day returns of IPO stocks offered by three procedures through a study from 1997 to 2009. According to his study, the fixed price method and the auction method recorded an average of 18.3% and 22.4%, respectively, and the book-building method recorded the highest 50.8%.

Table 3 classifies all IPOs into three groups according to the investment hotness based on the open to offer returns on the first trading day and compares the aftermarket performance of individual investors among groups. In the Korean stock market, the opening price is determined by the call auction method, which aggregates buy and sell orders for one hour before the start of the trading to derive the optimal equilibrium price. Also, for IPO stocks, only limit orders can be placed within the range of the lowest 90% to the highest 200% of the offer price in this opening price formation hour. Chung et al. (2017) insisted that the open to offer returns on the first day of listing reflects investors' pre- market sentiment. Therefore, this study uses the open price on the first day relative to the offer price as a criterion for classifying the investment hotness. If the first day's open to offer returns are greater than 0.3, it is classified as a hot IPO. If it is between 0 and 0.3, it is classified as a neutral IPO, and IPO stocks with negative open to offer returns are classified as cold IPOs. In this way, this study attempts to investigate the difference in the short- and long-term returns of individual investors in the aftermarket according to IPO hotness without mixing the premarket sentiment with the aftermarket sentiment.

As expected, the subscription of individual investors was high in the order of hot IPOs, neutral IPOs, and cold IPOs. On the first day, the stock prices of hot IPOs rose 71% on average, while the neutral IPO stocks and cold IPO stocks showed price changes of only about 13% and −9%, respectively. Accordingly, the AWHPR and AWHPERs of hot IPOs were about 0.7%, whereas the cold IPOs had a low return of about −4.7%. Therefore, the hot IPOs achieved an average of about 5.4%p higher excess return than the cold IPOs. Similar to the results in Table 2, individual investors bought more hot IPO or neutral IPO stocks on the first trading day than cold IPO stocks, whereas local institutional investors and foreign investors bought more cold IPO stocks than hot IPO stocks, indicating different trading behaviours between two groups. Meanwhile, a reversal of returns was observed between hot IPOs and cold IPOs during the period from the second day after listing to one year. For a year from the second day after listing, hot IPO stocks fell by an average of about 10%, while cold IPO stocks rose by about 12%. The average AWHPR and AWHPERs of cold IPOs are at 10% and 11%, respectively, whereas the average AWHPR and AWHPER of hot IPOs were only about −0.1% during the same period.

In terms of long-term return for one year after listing, individual investors achieved an excess return of about 5–6% through investment in neutral IPOs and cold IPOs, while they only achieved an excess return of about 0.6% in hot IPO investment. As a result, it is shown in Table 3 that individual investors who make IPO investments in an overheated sentiment turn out to reap rather low returns in the long run.

Table 3
Aftermarket performance of individual investors according to IPO hotness

Criteria	Hot IPO	Neutral IPO	Cold IPO	
	Open to offer returns on day 1 > 0.3	0 ≤ Open to offer returns on day 1 ≤ 0.3	Open to offer returns on day 1 < 0	*p*-value hot − cold
Panel A. Day 1 returns				
HPR	0.7094	0.1271	−0.0871	<0.01
AWHPR	0.0069	0.0133	−0.0471	<0.01
$AWHPER_m$	0.0069	0.0129	−0.0470	0.01
$AWHPER_d$	0.0069	0.0131	−0.0467	0.01
IND_BUY	0.9395	0.9413	0.9147	0.01
T&F_BUY	0.0538	0.0510	0.0742	0.04
Panel B. Day 2 to one-year returns				
HPR	−0.1036	0.0041	0.1199	<0.01
AWHPR	−0.0008	0.0038	0.1008	0.02
$AWHPER_m$	−0.0009	0.0037	0.1058	0.02
$AWHPER_d$	−0.0010	0.0039	0.1127	0.01
Panel C. Day 1 to one-year returns				
HPR	0.4883	0.1329	0.0459	<0.01
AWHPR	0.0058	0.0573	0.0481	0.27
$AWHPER_m$	0.0056	0.0557	0.0536	0.22
$AWHPER_d$	0.0056	0.0586	0.0604	0.15
Subscription rate of individual investors	698.23	368.42	168.14	<0.01
N	288	228	182	

In the next step, this study attempts to examine the relationship between the factors affecting the IPO investment sentiment and individual investors' short- and long-term performance on IPO investment through regression analysis. Table 4 describes the variables included in the regression analysis.

Table 4
Variables affecting investor's sentiment and their descriptions

Variables	Description
ALLOCT	Logistic transformation of ALLOC (individual investor's allocation rate to IPO stock) in the method presented by Amihud et al. (2003)
IR	Industry-adjusted initial return of IPO stock on the first trading day calculated as close to offer returns
AWHPERd(1)	Individual investors' allocation weighted holding period industry-adjusted excess return on the first trading day
AWHPERd(2,365)	Individual investors' allocation weighted holding period industry-adjusted excess return from the second trading day to one year
YRDIS	Median of IPO underpricing for a year before IPO
PINDURET1	Past industry return for two weeks before IPO subscription
PINDURET2	Past industry return for two weeks before IPO listing
PROCEED	IPO proceeds
INSTDEM	Institutional demand for IPO shares measured by the number of institutional bids in book-building to the number of IPO shares allocated to institutions.
PUPDATE	Offer price revision calculated as offer price to the midpoint of filing range suggested in the book-building minus one
PPLUS	Dummy variable having a value of one if offer price revision is positive
OWNERP	The proportion of shares owned by major shareholders of IPO companies
AGE	Length in months from corporate foundation to IPO
TECH	Dummy variable having a value of one if IPO company belongs to high-tech industries such as IT, electronics, bio-medical industries.
VENTURE	Dummy variable having a value of one if IPO company is venture capital-backed.
NU	Number of underwriting syndicate members
URANK	Lead underwriters' quality measured by Aggarwal et al.'s (2002) method
DEBT	Debt to assets ratio of IPO company one year before the IPO
EBITDA	EBITDA to assets ratio of IPO company one year before the IPO
INDFLIP	The flipping activity of individual investors on the first trading day, which is calculated as the number of IPO shares sold by individuals to total trading volumes on the first day

ALLOCT is the logistic transformation value of the individual investor's allocation rate ($ALLOC_j$) to the public offering stock j in such a way that $ALLOCT_j = Ln[(ALLOC_{j+a})/(1-ALLOC_{j+a})]$ where a is equal to 1/2N. It reflects individual investors' sentiment and their demand for IPO stocks. The higher the subscription competition rate, the lower it is. YRDIS is the median of initial returns on IPOs that occurred for the past year. PINDURET1 and PINDURET2 are past industry returns for two weeks before IPO subscription and listing respectively. As recorded in previous studies (Helwege & Liang, 2004, Derrien, 2005, Baker & Wurgler, 2006, Kaustia & Knupfer, 2008), investor's sentiment toward IPOs is affected by the stock market environment and the success of previous IPOs. The size of the offering amount (PROCEED) represents the uncertainty associated with the success of the IPO, and investors require more risk premium for the smaller IPOs that are more speculative and thus demand more discounts on the offer price (Beatty & Ritter, 1986). In the book-building process, if institutional investors show a strong investment intent (INSTDEM) toward IPO stocks and this raises the offer price (PUPDATE and PPLUS), the demand for IPO stocks will be high, which in turn has a positive effect on the investment sentiment of individual investors (Hanley, 1993; Lowry & Schwert, 2002). The higher the ownership ratio (OWNERP) of the major shareholders, the greater the increase in their asset value due to the share price rise above the offer price. Therefore, a positive relationship is expected between the initial return on the first day and the ownership ratio of the major shareholders (Loughran & Ritter, 2002; Aggarwal et al., 2002). Since the age of a company (AGE) reflects the amount of information available to evaluate the fair value of an IPO company, the older the company, the closer the offer price will be to the fair value compared to the start-ups. Therefore, it is expected that there is a negative relationship between age and aftermarket returns (Loughran & Ritter, 2004). In the case of high-tech companies (TECH), the asymmetry of information related to the fair value is expected to be high. Therefore, to compensate for the problem of adverse selection in which uninformed investors are allocated a lot of overvalued IPOs, a further discount to the offer price is required. In this regard, a positive relationship is expected between TECH and investment returns after listing (Ofek & Richardson, 2003). VENTURE and URANK represent the certification effect of the venture capitalists and underwriters for each IPO company (Carter & Manaster, 1990, Megginson & Weiss, 1991). The more the investment banks are included in the IPO underwriting syndicate, the more useful information related to market demand for IPO stocks is produced, and the diversification in marketing channels for IPO stocks increases investor subscriptions (Corwin & Schultz, 2005).

Table 5
Regression analysis of the IPO variables with individual investor's allocation and aftermarket performance

Dependent Variables	(1)	(2)	(3)	(4)
	ALLOCT	IR	$AWHPER_d$ (1)	$AWHPER_d$ (2,365)
Intercept	−19.741***	3.869***	−0.096	0.794*
	(−7.72)	(8.34)	(−1.05)	(1.78)
ALLOCT		−0.024***	−0.010***	0.053**
		(−5.41)	(−2.95)	(2.52)
YRDIS	−2.296***	−0.176*	0.022	−0.131
	(−3.93)	(−1.75)	(1.36)	(−1.13)
PINDURET1	−5.538***			
	(−2.96)			
PINDURET2		0.971***	0.177***	
		(3.75)	(3.26)	
LN(PROCEED)	0.946***	−0.166***	0.001	−0.036**
	(8.79)	(−9.42)	(0.36)	(−2.00)
LN(1+INSTDEM)	−0.890***	0.043***	−0.002	0.003
	(−9.92)	(3.19)	(−0.50)	(0.32)
PUPDATE	2.634***	0.550***	−0.003	0.226
	(2.75)	(3.41)	(−0.10)	(1.31)
PPLUS	−1.165***	0.020	−0.011	−0.027
	(−3.34)	(0.39)	(−0.95)	(−0.60)
OWNERP	0.153	0.236**	0.027	0.072
	(0.24)	(2.17)	(1.12)	(0.91)
LN(1+AGE)	−0.120	0.005	−0.010	0.015
	(−0.72)	(0.22)	(−1.60)	(0.70)
TECH	−0.122	−0.041	−0.009*	0.078**
	(−0.63)	(−1.30)	(−1.78)	(1.96)
VENTURE	0.079	−0.102***	−0.001	0.033
	(0.40)	(−3.15)	(−0.21)	(1.10)
LN(1+NU)	−1.457***	0.184***	0.025*	0.067
	(−3.93)	(3.56)	(1.82)	(1.25)
URANK	−0.806	0.504***	0.012	0.164
	(−0.92)	(3.72)	(0.42)	(1.06)

(*continue on next page*)

Table 5 (*continued*)

Dependent Variables	(1)	(2)	(3)	(4)
	ALLOCT	IR	$AWHPER_d$ (1)	$AWHPER_d$ (2,365)
DEBT	0.746* (1.77)	−0.048 (−1.32)	−0.020** (−2.36)	0.006 (0.12)
EBITDA	0.468 (1 .19)	−0.213*** (−3.29)	−0.037** (−2.36)	0.051 (0.84)
INDFLIP		−0.619*** (−4.37)	0.065*** (3.69)	
Adj. R^2	0.39	0.30	0.15	0.11
N	698	698	698	698

Note: The numbers in the parentheses are White (1980)'s heteroscedasticity-consistent *t*-statistics and *, **, *** denote significance at 10%, 5%, 1% level, respectively.

In column (1) of Table 5, the allocation rate of individual investors (ALLOCT) was used as the dependent variable, and the relationship between the variables was investigated. The YRDIS and PINDURET1 variables are found to have a strong negative relationship with the ALLOCT variable. The better the initial returns on the first day over the past year (YRDIS) and the higher the stock price of the industry in which the IPO company belongs ahead of the subscription (PINDURET1), the higher the individual investors' interest in the IPO subscriptions, which makes it more difficult to allocate IPO stocks to individual investors. Also, the larger the public offering size (PROCEED), the higher the allocation of IPO shares to individual investors. In the case of IPO stocks with high interest from institutional investors (INSTDEM), the subscription rate of individual investors increased, resulting in lowering the allocation rate of individual investors. In addition, the higher the final offer price through the book-building process of institutional investors (PUPDATE), the lower the subscription competition of individual investors and therefore the higher the individual allocation rate. On the other hand, the upward revision of the final offer price (PPLUS) has a positive effect on individual investors' investment sentiment, increasing their subscriptions, and consequently lowering the individual allocation rate. Meanwhile, as the number of underwriting companies (NU) participating in IPO syndicates increases, the diversification of sales channels for public offerings increases individual investors' participation in subscriptions, leading to a lower individual allocation rate. If an IPO company has a poor financial structure before listing (DEBT), individual investors avoid subscription, and in this case, it will be easier for individual investors to receive allocations.

In column (2), the industry-adjusted initial return (IR) on the first day of listing increased as the allocation rate of individual investors (ALLOCT) decreased. As in Rock (1986), the higher the demand for investment in IPO stocks, the more uninformed investors demand a discount on the offer price, and this is consistent with the expectation that the underpricing of the offer price will lead to a high return on the first day of listing. While the strong industry return (PINDURET2) just before listing had a positive effect on initial returns, excessive undervaluation of past IPO stocks (YRDIS) rather reduced the initial returns on the first day. Also, the larger the offering size (PROCEEDS), the lower the first-day return. This is evidence of adverse selection in that the larger the offering size, the higher the individual allocation rate and the higher the probability that individual investors will be allocated overvalued IPO stocks. As institutional investors who participated in the book-building reveal their willingness to invest (INSTDEM), the higher the likelihood of an upward revision of the final offer price (PUPDATE), thus inducing a more favorable investment sentiment for the values of the IPO stocks, which has a positive effect on the return on the first day. Besides, the higher the ownership percentage (OWNERP) of major shareholders that will be locked up for at least one year after listing, the more limited the supply of stocks to be released in the aftermarket. Therefore, it has a positive effect on the first-day return. Also, in the case of IPO companies supported by venture capital (VENTURE), the offer price discount was relatively small due to the positive certification effect, resulting in a low return after listing. The reputation of the lead underwriters (URANK), and the number of underwriting syndicate members (NU) were also found to have a strong positive effect on the initial return. The strong operating cash flow (EBITDA) of the year immediately before the listing was associated with a higher offer price and subsequently lowered the return on the day of listing. In addition, as in previous studies (Krigman et al., 1999), it was found that the short-term selling behaviour (INDFLIP) of individual investors on the first day of listing lowered the initial return.

In columns (3) and (4) of Table 5, the relationships between the IPO variables and the short-term and long-term returns of individual investors were examined. In column (3), it was found that the allocation rate of individual investors (ALLOCT) had a strong negative effect on the actual investment return ($AWHPER_d(1)$) of individual investors on the day of listing. In other words, this suggests that if individual investors have a low subscription rate and are allocated a large number of IPO stocks, they are subject to the risk of adverse selection of receiving relatively overvalued IPO stocks. This can be seen as a result of supporting H2 once again, as it implies that the IPO stocks are overvalued and individual investors lose money by investing in IPO stocks

after listing if individual investors receive more allocations of public offering stocks. It was also found that the higher the stock price of the same industry (PINDURET2) before listing, the better the individual investor's return. Therefore, if individual investors are interested in increasing the short-term investment return, it would be desirable to invest in IPO stocks with a favourable industry return before listing. For companies in the high-tech industry (TECH), the offer price seemed overvalued, which lowered the investment return for individual investors on the first day. Also, when the sales of IPO stocks are made through a large number of underwriting agencies (NU), competition for the subscription of undervalued IPO stocks increases, and thus it will increase the actual return of individual investors on the day of listing. The financial status and profitability of IPO companies were also found to affect the individual investor's return. Because individual investors avoid companies with high debt (DEBT) ratios before listing, the competition rate for subscriptions decreases. As such, they are allocated more overvalued IPO shares and suffer short-term losses as a result. Also, as shown in the result of column (2), the offer price of companies with strong profitability (EBITDA) before listing tends to be overvalued, so individual investors who invested in these stocks suffered losses on the day of listing. It is generally known that a lot of flipping occurs in hot IPO stocks (Aggarwal, 2003; Krishnan et al., 2006), where the offer price is undervalued and the stock price is expected to rise a lot on the day of listing. As expected, there was a positive relationship between the increase in individual short-term profit-taking activity (INDFLIP) and the short-term return of individual investors.

Column (4) of Table 5 shows the relationship between the long-term investment return of individual investors over the period from the second day of listing through one year ($AWHPER_d$ (2,365)) and IPO variables. Contrary to the effect on the investment return ($AWHPER_d$ (1)) on the first day, the increase in the allocation rate (ALLOCT) of individual investors turned out to increase the long-term return on investment ($AWHPER_d$ (2,365)) of IPO stocks. This result seems to be related to a long- term reversal of returns after the first day of listing between popular IPO stocks, which had overheated subscription competition by individual investors, and unpopular IPO stocks, which had relatively low subscription competition. This fact can also be said to support H3 that assumes a reversal of short- and long-term returns of IPO stocks. Also, the long-term investment return of individual investors for one year after the first day of listing was found to be better as the IPO size (PROCEED) was smaller and IPO companies belong to the high-tech industry (TECH).

In conclusion, despite the high initial return on IPO stocks on the first day of listing, individual investors hardly earned excess profits from IPO stock investment. In particular, investing in popular IPO stocks in which oversubscription occurs would inevitably lead to a lower return on IPO investments in the long run than investing in unpopular stocks at the time of offering.

CONCLUSION

This study investigates the long- and short-term investment performance of individual investors on IPOs that occurred in the Korean stock market from mid-2007 to the end of 2019. Individual investors are often regarded as irrational sentiment investors whose investment behaviour is influenced by psychological factors, unlike institutional investors. Therefore, according to previous studies, individual investors who are exposed to the risk of the winner's curse cannot raise excess returns through IPO investments. This study measures the actual investment returns of individual investors who participated in IPO subscriptions in the Korean stock market from the short- and long-term perspective and investigates the relationship between IPO characteristics affecting the investment sentiment of individual investors and their performance.

The results of this study are as follows. First of all, the individual investor's allocation-weighted market (or industry) adjusted excess return (AWHPERs) was only −0.7% on average on the first day of listing. Although the underpricing of IPO stocks on the first day of listing on average reached about 31% over the sample period, individual investors in the Korean stock market earned very little actual return on IPO stock investment. When the IPOs are divided into quartiles according to the subscription rate of individual investors, the AWHPER on the first day for individual investors who invested in IPO stocks with the highest subscription rate was about 2.5%p higher than the stocks with the lowest subscription rate, indicating that individual investors are allocated more overvalued IPO stocks than undervalued stocks. Therefore, the winner's curse hypothesis was undeniable in the Korean IPO market.

However, since the second day of listing, the stock price reversal between popular IPO stocks and unpopular stocks occurred, so AWHPER for one year after listing reached about 14% on average for stocks with the lowest subscription competition, but investing in stocks with the highest subscription competition yielded a poor return on average of less than 0.1%.

These results are consistent with the findings obtained from the sentiment-based investment behaviour of individual investors observed in the international IPO market studies. In the short term, the investment demand of individual investors is concentrated on popular IPO stocks. However, the relatively strong return of popular IPO stocks compared to unpopular IPO stocks has not been sustained in the long term. Rather, those IPO stocks, where individual investors showed a lukewarm investment demand, delivered much stronger investment performance in the long run. This is because the short-term price surges that occurred in popular IPO stocks shortly after the listing has gradually eased in the long term, whereas prices of unpopular IPO stocks have risen in the long term.

Through regression analysis, this study found that the factors related to investment sentiment affect the short- and long-term return on investment of individual investors. Above all, the lower the competition for individual investor's subscriptions and the higher the number of IPO shares allocated to individual investors, the lower the actual return for individual investors on the day of listing. It was a result of reconfirming the hypothesis of the winner's curse that individual investors face in IPO stock investment. On the contrary, the long-term individual investor's return on IPO stock investment showed a positive relationship with the allocation rate, indicating a reversal of the returns between popular and unpopular stocks.

In summary, individual investors are suffering losses due to adverse selection in IPO stock investments in the Korean market, and the reasons include asymmetric information between individual and institutional investors related to the fair value of IPO stock, over-confidence of individual investors, and their irrational trading behaviours based on sentiment. In order to reduce the individual investors' loss due to adverse selection in IPO investment, it is important to provide transparent information in determining the offer price as much as possible and reduce the information asymmetry related to the fair value of the IPO stock between individual investors and institutional investors. Therefore, the issuing companies and the lead managers should more faithfully provide the information concerning a basis for the determination of the offer price. Considering the fact that the lower the individual subscription rate, the more likely overpriced the offer price, and the higher the individual subscription rate, the severer the underpricing of the offer price, Korean financial supervisory authorities, underwriters, and issuing firms should also consider ways to allow the participation of individual investors in the determination of offer price, such as individual investors' participation in the book-building. As many countries are using multiple pricing mechanisms such as book-building, auction, fixed price,

and hybrid ones rather than one method, along with the current book-building process, implementing the French-style auction system, which reflects the demand of both institutional and individual investors and thus helps reduce the underpricing of the offer price, can also be considered. In addition, in order to reduce the adverse selection risk faced by individual investors, it would be desirable to consider a new allocation plan reflecting the subscription demand of individual investors.

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