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Penny Stocks: A Handy Tool for Enhancing Fund Performance?

Inwook Song
Korea Fund Ratings Co., Republic of Korea

Young K. Park*
Business School, Sungkyunkwan University, Republic of Korea

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Abstract

This study analyzes the characteristics of penny stocks and the benefits of including them in fund portfolios. First, we show that penny stocks provide abnormal returns that are not explained by traditional factor models; the liquidity factor seems to account for the excess performance. Second, we find that penny stocks can serve as a powerful investment vehicle for expanding the efficient frontier of the conventional investment set and that including them in fund portfolios improves a fund's performance. Third, we find that penny stocks held more by funds provide excess returns even for a 5-factor model that includes a liquidity factor.

Keywords Penny stock; Fund performance; Fund manager; Security selection ability

JEL Classification: G11, G21

1. Introduction

The stock price effect is an anomaly related to penny stocks. First proposed by Blume and Husic (1973) and Bachrach and Galai (1979), this effect is characterized by a significantly negative relationship between abnormal returns and stock prices. Kross (1985) and Bhardwaj and Brooks (1992) empirically show that the stock price effect drives the firm size effect. Jaffe *et al.* (1989) find that stock price is a significant factor explaining the January effect even after controlling for the firm size effect.

Low-price stocks should have higher abnormal returns due to their higher default risk, lower liquidity, and less available information. Thus, penny stocks should show low-price effects. However, few studies have investigated penny stocks. Several studies examine penny stock-related IPOs (Beatty and Kadiyala, 2003;

*Corresponding author: Business School, Sungkyunkwan University Business School, 25-2, Sungkyunkwan-ro, Jongno-gu, Seoul, Republic of Korea 03063. Tel: +82-2-760-0418, Fax: +82-2-760-0145, email: ykpark@skku.edu.

Bradley *et al.*, 2006; Fernando et al., 2004), but Liu *et al.* (2012) are almost unique in examining the abnormal returns of penny stocks.[1] For the 2001–2010 period, they find that, compared to normal stocks, penny stocks have higher returns, higher systematic risk (beta), higher unsystematic risk, smaller size, a higher book-to-market ratio, and lower liquidity. Their findings suggest that the abnormal returns of penny stocks cannot be explained by traditional factor models. They suggest that only liquidity appears to have significant explanatory power for the abnormal performance of penny stocks. Jung (1997) examines penny stocks in the Korean market. He defines penny stocks as securities with prices below ₩15 000 (roughly US $15) and compares performance between penny stock portfolios and normal stock portfolios for the period between 1994 and 1995. His results suggest that penny stock portfolios do not show significantly positive abnormal returns relative to normal stock portfolios in either the statistical or economic sense.

The literature on the neglected firm effect and the abnormal returns of over-the-counter securities is worth consulting since penny stocks not only have lower trading volume and smaller size but also attract little interest from institutional investors. In the neglected firm effect, first reported by Arbel and Strebel (1983a,b), the stock returns and risk-adjusted performance of neglected firms are higher than those of normal stocks. The lack of information on neglected firms causes risk premiums to rise above the appropriate level. The literature on abnormal returns for over-the-counter securities includes Ang *et al.* (2013) and Eraker and Ready (2014). Ang *et al.* (2013) report that over-the-counter stocks have risk premiums similar to those of under-the-counter stocks in terms of size, value, and volatility but receive higher risk premiums for low liquidity. Eraker and Ready (2014) show that, while the average returns of over-the-counter stocks are negative, their distributions are positively skewed, implying that some securities have exceptionally high returns.

The research on low-priced stocks and neglected firms is related to penny stocks, but penny stocks have unique characteristics that are not explicable by conventional theories. The high information asymmetry in penny stocks often provides widely divergent investment outcomes. Many individual investors consider penny stocks as a subject of speculation due to their lottery-like disposition, while risk management and compliance codes often prevent institutional investors from investing in them. These unique characteristics motivated us to investigate penny stocks and the benefits of including them in fund portfolios. This study tests four hypotheses.

First, we test whether penny stocks exhibit abnormal returns (alpha) that are not explained by traditional performance evaluation models. Testing in the US market, Liu *et al.* (2012) find that penny stocks are high in returns, high in systematic and unsystematic risks, small in size, and low in liquidity. They also report that the

[1]They define penny stocks as securities on NYSE, AMEX, and NASDAQ with an average price less than or equal to five dollars in the previous 12 months.

performance of penny stocks cannot be sufficiently explained by conventional models (1-factor model; CAPM, 3-factor model; Fama and French, 1993, or 4-factor model; Carhart, 1997). However, they find that the explanatory power of the model greatly improves after the inclusion of the liquidity factor. Penny stocks traded in the Korean capital market are similar to those in the US market in that they are both extremely small in size and trading volume and high in volatility. Therefore, this study examines whether the excess returns found in Liu *et al.* (2012) that cannot be explained by conventional factor models also exist in the Korean market. If the excess returns exist, this study attempts to determine the factors that explain the abnormal performance. Second, where abnormal performance is observed, further tests are conducted to verify whether penny stocks can expand investors' opportunity set and ultimately lead to the expansion of an efficient frontier. Spanning tests can aid in verifying the value of penny stocks as an additional investment vehicle.

Third, if traditional models cannot account for the performance of penny stocks, we expect that fund performance will improve after the inclusion of penny stocks in fund portfolios. The rationale for this hypothesis is that funds with more penny stocks will have unexplained factors that contribute to positive excess returns. If the inclusion of penny stocks has a positive impact on the abnormal returns of a fund, this may be because penny stocks dominate other assets or because fund managers have the ability to select good penny stocks. Since it is unrealistic to assume that a particular group of securities always dominates other groups, the latter explanation is tested. We further investigate whether this ability differs across fund manager groups.

The rest of this paper is organized as follows. Section 2 defines penny stocks and describes the research data. Section 3 discusses the performance and performance factors of penny stocks as well as the spanning test conducted. Section 4 presents the test's empirical results regarding how the inclusion of penny stocks affects fund performance and compares stock-selection ability across fund manager groups. Section 5 summarizes the results, presents its key insights, and concludes the paper.

2. Definition of Penny Stocks and Data

2.1. Definition of Penny Stocks

Liu *et al.* (2012) define penny stocks as securities with an average previous 12-month price less than or equal to five dollars. This study follows the methodology used in Liu *et al.* (2012) and defines penny stocks as securities with a stock price ≤₩5000 (roughly US$5). The Korean stock exchange also categorizes stocks with prices ≤₩5000 as penny stocks. Once a stock is categorized as a penny stock, the position prevails for the next 12 months. In other words, a stock with an average price from month $(t-12)$ to month $(t-1)$ of ≤₩5000 is classified as a penny stock for the period of month (t) to month $(t+11)$. Thus, the period prior to the

classification at month (t) is the selection period for penny stocks, and the subsequent 12 months is the performance investigation period.

Penny stocks are further broken down into three subgroups by price range: (i) stocks with prices ≤₩1000, (ii) stocks with prices over ₩1000 and ≤₩3000, and (iii) stocks with prices over ₩3000 and ≤₩5000. Non-penny stocks are also categorized into four subgroups: (i) stocks with prices >₩5000 but ≤₩10 000, (ii) stocks with prices greater than ₩10 000 but ≤₩50 000, (iii) stocks with prices greater than ₩50 000 but ≤₩100 000, and (iv) stocks with prices greater than ₩100 000. These price subgroups are formed based on the average price of the previous 12 months.

2.2. Data

The research period for this study covers January 2004 to December 2013. We use monthly data because data on portfolio holdings for funds are available on a monthly basis. Our data actually begin in January 2003 because data for the previous 12 months must be used to calculate the average stock price and categorize a stock as a penny stock. This study has two parts: an examination of penny stocks and their impact on fund performance; thus, we use both stock price data and fund NAV (net asset value) data.

Stock price data for securities listed on KOSPI and KOSDAQ were obtained from WISEfn. Unlike normal stocks, penny stocks often face transaction abnormalities such as delisting or trade suspension. Transaction abnormalities are characteristic of penny stocks; therefore, they are not deleted. In this study, stock returns for trade suspension and delisting are treated as 0% and –100% respectively. Only common stock data are used; preferred stock, ETF, ELW, and DR data are excluded.

Our fund data covering Korean domestic active mutual funds are provided by KFR (Korea Fund Ratings). The data include fund type, fund price, NAV, and portfolio holdings. Korean public mutual fund data are collected daily by the KOFIA (Korea Financial Investment Association). Data quality is guaranteed by the KOFIA and by fund rating companies such as KFR and Morningstar Korea. Korea may be the only market where mutual fund data are provided cleanly, without selection bias. The data include monthly fund portfolio holdings, which are rare short-frequency relative to the normal quarterly frequency in the United States and other market fund data. Thus, the data are relatively free of window dressing. Korean fund data are valuable for a market study because of their unique characteristics.

3. Performance Analysis and Spanning Test

3.1. Methodology

3.1.1. Performance measurement.

In this section, we examine the factors related to the performance of penny stocks in order to determine whether penny stocks follow traditional performance evaluation models, including the 1-factor model (CAPM), 3-factor model (Fama and

French, 1993), and 4-factor model (Carhart, 1997) or whether other factors can explain the performance of penny stocks. We build a penny stock portfolio according to the penny stock selection criteria described in the previous section. Then, the performance of the penny stock portfolio is measured using conventional factor models.

The traditional 1-factor model is presented in equation 1:

$$r_{p,t} = \alpha_p + \beta_p r_{m,t} + \varepsilon_{p,t} \tag{1}$$

$r_{p,t}$ is a portfolio return exceeding the risk-free rate, calculated as the value-weighted average return of the penny stocks at time t minus the risk-free rate. $r_{m,t}$ is the excess return of the market relative to the risk-free rate at time t.[2] β_p is the systematic risk of portfolio p, and α_p is the excess performance of portfolio p relative to the market return. Similarly, we use the 3-factor and 4-factor models as in equations 2 and 3 to measure the risk-adjusted performance of a penny stock portfolio:

$$r_{p,t} = \alpha_p + \beta_p r_{m,t} + s_p SMB_t + h_p HML_t + \varepsilon_{p,t} \tag{2}$$

$$r_{p,t} = \alpha_p + \beta_p r_{m,t} + s_p SMB_t + h_p HML_t + p_p MOM_t + \varepsilon_{p,t} \tag{3}$$

SMB_t and HML_t each represent the size factor and the value factor at time t, while α_p is the risk-adjusted performance of portfolio p (after market, size, and value factors are all accounted for). MOM_t in the 4-factor model is the momentum factor. To compute the momentum factor, stocks are first ranked according to their returns over the 11 months in the previous year excluding the month immediately preceding. Firms in the highest 30% return group form portfolio W, and firms in the lowest 30% return group form portfolio L. Each portfolio's returns are calculated by averaging the individual stock returns within the portfolio using the equally weighted average method. Then, the momentum factor is computed by subtracting the return of portfolio L from the return of portfolio W.

3.1.2. Liquidity.

Amihud (2002) argues that the returns of individual securities are determined not only by their market risks but also by their liquidity levels. He finds evidence that stocks with lower liquidity provide investors with higher returns to compensate for the higher trading costs. Amihud also reports that this illiquidity effect is more pronounced for small firms. In line with this finding, Eleswarapu (1997) also shows that illiquidity has a greater impact on stock returns for securities traded on the NASDAQ market than those traded on the NYSE.

Penny stocks are generally small in size and trading volume. Therefore, it is expected that liquidity is critically important to the performance of penny stocks, as

[2]Market returns are KOSPI returns, and the risk-free rate is the return on 1-year government bonds.

the literature has reported. To test this hypothesis, the following 5-factor model, which includes the Amihud illiquidity measure in addition to the traditional performance evaluation model, is tested:

$$r_{p,t} = \alpha_p + \beta_p r_{m,t} + s_p SMB_t + h_p HML_t + p_p MOM_t + l_p LiQ_t + \varepsilon_{p,t} \quad (4)$$

Numerous studies propose various ways of measuring stock liquidity, including Amihud and Mendelson (1986), Glosten and Harris (1988), Foster and Viswanathan (1993), Datar *et al.* (1998), Amihud (2002), and Pastor and Stambaugh (2003). This study employs the methodology used in Amihud (2002).[3] Amihud (2002) measures stock illiquidity as the ratio of the absolute value of daily price changes to dollar trading volume. We first rank stocks according to the Amihud illiquidity measure and then form two portfolios: stocks in the highest 30% liquidity group (W) and stocks in the lowest 30% liquidity group (L). Each portfolio's returns are calculated by averaging the individual stock returns within the portfolio using the equally weighted average method. Subtracting the returns of portfolio L from that of portfolio W produces the liquidity factor.

3.1.3. Spanning test.

Huberman and Kandel (1987) were the first to examine whether a set of new assets can expand the efficient frontier of investors. Ferson *et al.* (1993), DeSantis (1993), Bekaert and Urias (1996), and De Roon *et al.* (2002) helped develop the research methodology and expand this analysis.

When K number of assets exists and if we add N number of assets, the minimum-variance frontier for (K+N) assets can be established. If we can make the minimum variance frontier equal to (K+N) assets by linearly combining K assets, the process is called "spanning." We employ the regression model used in Huberman and Kandel (1987) to test whether penny stock portfolios can be spanned with existing investment assets:

$$R_t = \alpha + \beta BM_t + \varepsilon_t \quad (5)$$

BM_t is the return vector (K-dimension vector) of K benchmark assets at time t, and R_t is the return vector (N-dimension vector) of N test assets (penny stock portfolio) at time t. The null hypothesis for the mean-variance spanning test is as follows:

$$\alpha = 0_N, \hat{\delta} = \tau_N - \hat{\beta}\tau_K = 0 \quad (6)$$

τ_N and τ_K refer to the N-dimension unit vector and the K-dimension unit vector, respectively. Were the null hypothesis not rejected, we would conclude that the mean-variance frontier composed of penny stocks is no better than the existing one.

[3]Another common method requires bid–ask price data, but these are not publicly available for the Korean stock market.

3.2. Performance Factors for Penny Stocks

Prior to conducting empirical analysis, the current status and characteristics of penny stocks are examined.

Table 1 shows the return, volatility, market capitalization, trading volume, PER, and book-to-market ratio of penny stocks and non-penny stocks. Compared to non-penny stocks, penny stocks have greater return and risk (volatility) but smaller market capitalization and trading volume. Penny stocks also have a higher book-to-market ratio and PER, and most penny stock firms are listed on KOSDAQ (472 firms versus 197 firms on KOSPI). From this observation, we can expect that the SMB and HML play important roles in explaining the performance of penny stocks. We should also not forget the liquidity factor, since penny stocks' trading volume is low.

Penny stocks exhibit performance that is much higher than that of non-penny stocks. This section analyzes whether the performance of penny stocks, with dispositions so different from those of other stocks, can be explained by traditional performance evaluation models.

Table 2 shows measures of the performance factors of penny stocks employing traditional performance evaluation models such as the 1-factor model (CAPM),

Table 1 Characteristics of penny stocks and non-penny stocks

The characteristics of penny stocks and non-penny stocks are presented. For each month, stocks with an average previous 12-month price of ≤₩5000 are defined as penny stocks, and stocks with prices of more than ₩5000 are defined as non-penny stocks. This classification prevailed for the following 12 months. The standard used to define the subgroups within the penny stock/non-penny stock category is the average price of the previous 12 months. For penny stocks, the subgroups are defined using the average prices throughout the following 12 months. For non-penny stocks, the subgroups are readjusted each month by using the average stock prices of the previous 12 months. The values shown in the table for the return (%), volatility (%), market cap (100 million), trading volume (100 million), BM, and PER are all characteristics reflective of penny stocks and are averaged by group according to the monthly values for each stock within the groups. Return refers to monthly returns. Volatility is calculated by converting for each year the monthly standard deviation of daily returns. The market cap and the trading volumes are the averages of daily market cap and trading volume for each month. The values for BM, PER, and the number of stocks are calculated as of each end-of-the-month.

Classification	Return	Volatility	Market cap	Trading volume	BM	PER	Number of stocks	
							KOSPI	KOSDAQ
Penny stocks (≤₩5000)	2.61	54.89	567	15	1.71	19.84	197	472
L1: ≤₩1000	4.27	64.25	375	20	1.88	19.16	35	81
L2: ≤₩3000	2.59	55.86	476	15	1.73	20.45	92	244
L3: ≤₩5000	1.98	49.70	776	13	1.62	19.24	72	166
Non-penny stocks (>₩5000)	1.39	42.75	12 120	69	1.49	16.97	398	245
H1: ≤₩10 000	1.68	45.00	1843	18	1.83	15.49	92	116
H2: ≤₩50 000	1.32	42.90	8190	59	1.44	17.45	216	117
H3: ≤₩100 000	0.90	37.80	24 596	147	1.05	19.69	54	8
H4: >₩100 000	1.10	37.01	77 122	300	0.86	16.94	46	2

3-factor model (Fama and French, 1993), 4-factor model (Carhart, 1997), and 5-factor model with the liquidity factor that is expected to reflect another important aspect of penny stocks.

The penny stock portfolio exhibits a positive and significant excess performance in the 1-factor model, while the explanatory power (R2) of 0.63 is markedly lower than the 0.92 result for non-penny stocks. The excess performance persists when measured with the 3-factor and 4-factor models, which seems to confirm the conjecture that traditional performance evaluation models cannot explain the excess return in penny stocks. The excess performance disappears in the 5-factor model, which includes the liquidity variable. This implies that the excess performance of penny stocks, which is not explicable using traditional models, is accounted for by the liquidity factor. The explanatory power of the model sharply increases to 0.90 in the 3-factor model, which adds the size factor. As stated in the preceding section, penny stocks are generally small-cap stocks; therefore, the models' explanatory power increases rapidly with the inclusion of the size factor.

By contrast, a recent study by Fama and French (2015) found that the 3-factor model can be improved by adding profitability (RMW) and investment (CMA) factors. They argue (Fama and French, 2016a) that the new model works not only for markets in North America but also for those in Europe and the Asia–Pacific region. They show that it is useful to dissolve the excess returns of micro-cap stocks, which share characteristics with penny stocks, and some anomalies (market β, share repurchase/issues, volatility). Therefore, we test the returns of penny stocks with the 5-factor model (Fama and French, 2015)) but find that neither RMW nor CMA explains the excess returns in penny stocks (see Appendix Table A1).[4] Although penny stocks belong to the micro-cap category, they have a unique low-price characteristic, making them different from general micro-cap stocks, and their excess returns do not disappear in the 5-factor model. Therefore, we do not consider RMW or CAM factors in the subsequent analysis of penny stocks.

3.3. Spanning Test

In this section, a mean-variance spanning test is employed to verify whether penny stocks expand the efficient frontier of investors. The benchmarks used to build the efficient frontier are market size indices of KOSPI and KOSDAQ. For KOSPI, large-cap, medium-cap, and small-cap indices are used. For KOSDAQ, KOSDQ100, mid-300, and small-cap indices are employed.[5]

[4]This is consistent with prior tests using the Fama and French 5-factor model for Korea. Kang and Jang (2016) run a test using RMW and CMA for the Korean market and find that these additional factors do not contribute to the existing 3-factor model.

[5]We also conducted an analysis using the asset class index for stocks (KOSPI, KOSDAQ), bonds (Gov. + Corporate composite index), and cash (Call yield). The result was consistent with those shown in Table 3 and was omitted to save space.

Table 2 Factor analysis of returns for penny stocks

This table presents the factor analysis of returns for penny stock portfolios. Penny stocks are classified according to the definition used in this study. Factor analyses of returns were conducted using the CAPM (1-factor model), Fama and French () model, Carhart () model, and the 5-factor model, which adds the liquidity premium:$r_{p,t} = \alpha_p + \beta_p r_{m,t} + s_p SMB_t + h_p HML_t + p_p MOM_t + l_p LiQ_t + \varepsilon_{p,t} r_{p,t}$ is the portfolio return in excess of the risk-free rate, computed by subtracting the risk-free rate (1-year Treasury bond) from the monthly returns of individual stocks in each price group. $r_{m,t}$ is calculated by subtracting the risk-free rate from the KOSPI returns. SMB_t and HML_t are calculated following Fama and French (), and MOM_t is computed following Carhart (). The liquidity factor (LiQ_t) is computed following Amihud () by first ranking the liquidity of the stock and then forming portfolios based on the top and bottom 30%, and finally subtracting the returns of the bottom 30% portfolio from the top 30% portfolio. The figures in parentheses are *t*-values, significant at the 1%, 5%, and 10% levels and denoted by ***, **, and *, respectively.

α_p	β_p	s_p	h_p	p_p	l_p	Adj R^2
2.04 (4.18)***	1.17 (14.08)***					0.63
2.01 (7.11)***	1.19 (27.00)***	0.97 (17.01)***	−0.01 (−0.07)			0.90
2.01 (7.07)***	1.19 (26.89)***	0.97 (16.89)***	0.00 (−0.05)	0.00 (−0.06)		0.90
0.52 (1.19)	1.09 (23.08)***	1.01 (18.62)***	0.18 (2.15)**	−0.04 (−0.73)	−40.37 (−4.33)***	0.91

Table 3 presents the results of the mean-variance spanning test. For penny stocks, the sum of the regression coefficients is 1.1522, and the intercept is 0.0175, which rejects the null hypothesis that the intercept is 0 and the sum of the coefficients is 1 at the 1% confidence level. In other words, the linear combination of benchmark assets cannot span the penny stock portfolio. These results suggest that, when we add penny stocks to the six benchmark stock indices, penny stocks are an additional investment class that expands the investment opportunity set. Conventional market indices do not sufficiently reflect the characteristics of penny stocks because they comprise an extremely small proportion of stock indices. Our spanning test results suggest that the inclusion of penny stocks in an investment set can expand the efficient frontier and improve portfolio performance.

4. Penny Stocks' Contribution to Fund Performance

4.1. Methodology

4.1.1. Performance of funds holding penny stocks.

The analysis in the previous section confirms that penny stocks can expand the efficient frontier of existing portfolios. This section examines whether penny stocks help improve fund performance. We also check whether fund managers have stock-selection ability for penny stocks. The effect of penny stocks on fund performance is examined using the following regression model:

$$\alpha_{i,t} = \beta_0 + \beta_1 \omega_{i,t}^{Penny} + \beta_2 \omega_{i,t}^{L1} + \beta_3 \omega_{i,t}^{L2} + \beta_4 \omega_{i,t}^{L3} + \sum_j \beta_j control_{j,i,t-1} + \varepsilon_{i,t} \quad (7)$$

$\alpha_{i,t}$ is the excess return of fund i in year t derived from various performance measurement models. It is computed through the 1-factor model (CAPM), 4-factor model (Carhart, 1997), and 5-factor model. As in Bär *et al.* (2011), which examines the US market, fund return is computed using the monthly returns of each year.

$\omega_{i,t}^{Penny}$, the main explanatory variable, is the average weight of penny stocks in fund i in year t. Variables $\omega_{i,t}^{L1}$, $\omega_{i,t}^{L2}$, and $\omega_{i,t}^{L3}$ are also calculated to examine the impact of subgroup weights on fund performance. $\omega_{i,t}^{L1}$, $\omega_{i,t}^{L2}$, $\omega_{i,t}^{L3}$ each refers to the weight of stocks belonging to the penny stock subgroups: L1 (stocks with prices ≤1000), L2 (stocks with prices ≤3000), and L3 (stocks with prices ≤5000). The control variables ($control_{i,t-1}$) used in the study include variables reflecting performance during the previous period, fund age, size, turnover ratio, and expenses. To alleviate potential endogeneity problems, explanatory variables from period $(t-1)$ are used in the analysis. Fund age ($Age_{i,t-1}$) is the log of the fund management period (in months) after the fund is established. Fund size ($Size_{i,t-1}$) is the log of the NAV of the fund. The fund turnover ratio ($Turnover_{i,t-1}$) is the portfolio turnover ratio of the fund in year $(t-1)$. Fund expenses ($Fee_{i,t-1}$) is the total fee for the fund (e.g. sales, management). The year fixed-effect model is used to account

Table 3 Mean-variance spanning test of penny stocks

This table presents the results of the mean-variance spanning test for the returns of price subgroups within the penny stocks. Penny stocks are classified according to the definition used in this study. The subgroups within the penny stock group are defined according to the average price of the immediately preceding 12 months. Intercepts, regression coefficients, and adj R^2 are computed by estimating the regression model $R_t = \alpha + \beta BM_t + \varepsilon_t$. In the regression model, BM_t refers to the return vector (K-dimension vector) of K benchmark assets at time t. R_t refers to the return vector (N-dimension vector) of N test assets at time t. The benchmarks used in the analysis are the market size indices of the KOSPI and KOSDAQ markets, including the large-cap, medium-cap, and small-cap indices of the KOSPI market and the KOSDQ100, mid300, and small-cap indices of the KOSDAQ market. The L.M. test refers to the test statistics of the joint hypotheses $\alpha = 0_N$ and $\hat{\delta} = \tau_N - \hat{\beta}\tau_K = 0$. The statistical significance levels of the regression coefficients are calculated based on the standard error of White (). The figures in parentheses are t-values, significant at the 1%, 5%, and 10% levels and denoted by ***, **, and *, respectively.

	Penny stock returns			
	Penny stock	L1: ≤₩1000	L2: ≤₩3000	L3: ≤₩5000
Intercept	0.0175 (10.92)***	0.0231 (4.81)***	0.0175 (8.53)***	0.0163 (7.24)***
KOSPI large-cap	0.0891 (1.89)*	0.1425 (1.04)	−0.0167 (−0.30)	0.1623 (2.32)**
KOSPI medium-cap	0.1643 (1.94)*	−0.1496 (−0.68)	0.3170 (2.23)**	0.0595 (0.60)
KOSPI small-cap	0.3949 (3.37)***	0.5330 (2.15)**	0.3222 (2.25)**	0.4519 (2.81)***
KOSDAQ 100	0.0609 (0.96)	−0.3662 (−2.08)**	−0.0439 (−0.39)	0.2218 (2.29)**
KOSDAQ mid300	0.4017 (4.99)***	0.3409 (1.67)*	0.4486 (4.18)***	0.3892 (3.47)***
KOSDAQ small	0.0412 (0.47)	0.6415 (3.42)***	0.1440 (1.40)	−0.1587 (−1.41)
$\Sigma\beta$	1.1522	1.1421	1.1713	1.1260
Adj R^2	0.9512	0.7555	0.9267	0.9089
L.M. test	183.32***	30.31***	93.69***	76.25***
Number of observations	132	132	132	132

for the proportion of penny stocks in the funds that may be affected by yearly changes in the number of samples, fund performance, size, and changes in the stock market situation.

4.1.2. Penny stock selection ability of fund managers.

If including penny stocks in a fund has a positive impact on fund performance, this may occur because (i) penny stocks always provide excess returns and including any penny stock in a fund thus improves performance or (ii) fund managers have the ability to select high-performing penny stocks. Since it is impossible for any penny stock to consistently yield returns superior to other stocks, it is more rational to test the second explanation—that fund managers have the ability to select better-performing penny stocks despite their high level of information asymmetry.

To verify this hypothesis, we divide penny stocks in each price group into stocks held more by funds (G1) and those held less by funds (G2). Then, we compare the two groups' performance levels with a *t*-test. The performance measures used in this analysis are raw return and the risk-adjusted alphas from the 3-factor and 4-factor models as well as the 5-factor model with the liquidity factor.

4.1.3. Penny stock selection ability across fund managers.

Finally, this study tests whether fund managers differ in their ability to select penny stocks. We propose that fund managers who frequently invest in penny stocks or who manage small- and medium-style funds are more likely to have better selection ability for penny stocks. This is based on the assumption that they invest more in penny stocks because they possess more knowledge about them. We also propose that fund managers with better fund performance (winner managers) are likely to have better penny stock-selection ability. The model used to analyze differences in fund managers' penny stock-selection ability is as follows.

$$\begin{aligned}\alpha_{i,t}^{Penny} = {} & \beta_0 + \beta_1 \omega_{i,t}^{Penny} + \beta_2 D_{i,t}^{Winner} + \beta_3 D_{i,t}^{Loser} \\ & + \beta_4 \left(D_{i,t}^{Winner} \times \omega_{i,t}^{Penny} \right) + \beta_5 \left(D_{i,t}^{Loser} \times \omega_{i,t}^{Penny} \right) \\ & + \beta_6 D_i^{Small} + \beta_7 \left(D_i^{Small} \times \omega_{i,t}^{Penny} \right) + \sum_j \beta_j control_{j,i,t-1} + \varepsilon_{i,t}\end{aligned} \tag{8}$$

$\alpha_{i,t}^{Penny}$ is the excess performance of the penny stock portfolio within fund i, calculated using the monthly returns ($r_{i,t}^{Penny} = \sum_j \omega_{i,j,t} stockret_{i,j,t}$)[6] of the penny stock

[6] $\omega_{i,j,t}$ is the weight of stock j in fund i, calculated by dividing the stock's value within the fund by the NAV of the fund. $stockret_{i,j,t}$ is the monthly returns of stock j in fund i. Portfolio holding data for public funds are provided by KOFIA at the end of each month. Fund trading history data, including on changes in holding assets or the original cost of stocks during the month, are not available. Therefore, we assume that, for each month, the trading history of the fund is consistent throughout the month to calculate the penny stock portfolio returns

portfolio for each fund by year. As mentioned, the dependent variable in the above model is the return of the penny stock portfolio within the fund, not the return of the fund itself. Using the return of the fund would not indicate whether the performance was achieved because the fund simply included a number of penny stocks or because high-performing penny stocks were selected in the first place. A previous analysis has shown that the weights of penny stocks can affect fund performance. Therefore, we isolate the return of penny stocks within the fund as a dependent variable to examine the effect of penny stock selection ability.

Equation 8 is used to test three hypotheses: (i) fund managers who frequently deal with penny stocks have superior penny stock-selection ability; (ii) fund managers who manage small- and medium-cap funds whose constituents share characteristics with penny stocks have better penny stock-selection ability; and (iii) fund managers with better performance have better penny stock-selection ability. In other words, the analysis seeks to examine whether the explanatory variable in each hypothesis is positively (+) related to the return of the penny stock portfolio, the dependent variable. Therefore, the explanatory variable $\omega_{i,t}^{Penny}$ is the average proportion of penny stocks (=the average of [monthly sum of appraised value of penny stock/NAV of fund]) in fund i in year t for (i) fund managers who frequently trade penny stocks. Then, to examine hypothesis (ii), the dummy variable of small- and medium-cap funds (D_i^{Small}) is used as the explanatory variable. A fund is defined as small- and medium-cap if its prospectus states that investing in small- and medium-cap stocks is a major management strategy. A value of 1 is given if the fund is a small- and medium-cap fund and 0 otherwise. Among small- and medium-cap funds, a fund that places more weight on penny stocks is expected to have higher penny stock-selection ability. Thus, an interaction variable (*small- and medium-cap fund dummy* × *penny stock weight* [$D_{i,t}^{Winner}$]) is added to examine this effect. Finally, the explanatory variable used to examine hypothesis (iii) is a winner dummy variable ($D_{i,t}^{Winner}$) that takes a value of 1 if the return of the fund in the month immediately preceding is in the top 20% return group. A loser dummy variable ($D_{i,t}^{Loser}$) is also created that takes a value of 1 if the return of the fund is in the bottom 20% group to allow for comparison with the winner dummy variable. As in the small- and medium-cap funds analysis, winner fund managers who deal more often with penny stocks are expected to have better penny stock-selection ability. Therefore, interaction variables (*winner dummy* × *penny stock weight* [$D_{i,t}^{Winner} \times \omega_{i,t}^{Penny}$], *loser dummy* × *penny stock weight* [$D_{i,t}^{Loser} \times \omega_{i,t}^{Penny}$]) are also added to test for this effect. The control variables ($control_{i,t-1}$) used in equation 7 are again applied. All analyses are conducted using the year fixed-effect model.

4.2. Penny Stocks in Funds

Table 4 presents the yearly proportion of penny stocks in funds. The proportion of listed penny stocks incorporated into funds is, on average, 23.24%, which means that one out of every four penny stocks is included in funds. This proportion is low compared to the rest of the stocks (77.13%) but is still relatively high

considering the common perception that institutional investors avoid investing in penny stocks. Nevertheless, penny stocks comprise only 2.63% of fund value, against the 84.42% proportion claimed by the rest of the stocks. These numbers imply that, although fund managers invest in many different penny stocks, the actual value weight of penny stocks in funds is very low. This may be because penny stocks have a number of characteristics that fund managers want to avoid (e.g. small cap, high volatility, low liquidity, transaction abnormalities). Therefore, we conjecture that fund managers invest in penny stocks not as a major investment tool but only to earn marginal extra return.

Descriptive statistics and correlation analysis results are presented in Tables 5 and 6. Table 5 shows the descriptive statistics of the variables used in the analysis.[7] The abnormal returns (alpha) from the 1-factor model, 4-factor model, and 5-factor model are the dependent variable,[8] whereas the proportion of penny stocks is the

Table 4 Yearly trends for inclusion of penny stocks and non-penny stocks in funds

This table presents the yearly trend of penny stock and non-penny stock inclusion in funds. Penny stocks and non-penny stocks are classified according to the definition used in this study. The subgroups within each group are defined according to the average price in the previous 12 months. For the domestic active equity-type public offering fund, Panel A shows the weights of stocks included in funds for each price subgroup. Panel B describes the yearly averaged weights calculated dividing stock value by fund NAV for each month.

Classification	2004	2005	2006	2007	2009	2010	2011	2012	2013	Avg
Panel A: Weights of stocks included in funds (%)										
Penny stocks (≤₩5000)	16.03	25.82	30.31	28.96	26.74	26.50	26.99	19.51	20.42	23.24
L1: ≤₩1000	4.30	7.91	11.13	9.66	13.72	5.62	6.63	3.49	3.83	3.02
L2: ≤₩3000	13.78	26.67	26.37	23.68	21.02	19.52	20.74	14.31	14.29	14.37
L3: ≤₩5000	28.29	43.14	45.77	40.29	35.17	41.71	46.63	31.80	33.61	37.51
Non-penny stocks (>₩5000)	61.52	72.42	72.37	73.51	77.73	78.52	77.88	74.68	74.78	77.13
Panel B: Weights of stocks included in funds, using NAV (%)										
Penny stocks (≤₩5000)	2.99	2.99	2.99	2.99	1.93	2.80	3.30	2.39	2.28	2.63
L1: ≤₩1000	1.46	1.46	1.46	1.46	2.31	2.01	0.94	0.73	0.80	1.21
L2: ≤₩3000	1.60	1.60	1.60	1.60	0.90	1.73	1.89	1.16	1.23	1.66
L3: ≤₩5000	2.51	2.51	2.51	2.51	1.82	2.16	2.46	2.25	2.09	2.08
Non-penny stocks (>₩5000)	74.52	74.52	74.52	74.52	72.59	75.72	83.46	84.96	86.27	84.42

[7]The descriptive statistics of the variables used in equations 1 and 5 are presented together.

[8]The results of using excess performance in the 3-factor model were similar to those generated in the 4-factor model and are therefore not presented.

main explanatory variable. As presented in Table 5, a fund on average invests 4.70% of its portfolio in penny stocks. The maximum weight is 36.67%. When divided into subgroups, the highest price group, L3 (prices over ₩3000 and ≤₩5000), shows the highest proportion (2.74%). The L1 group (prices ≤₩1000), the coin stock group, shows almost 0%, with the maximum reaching a mere 5.54%.

Table 6 presents a summary of the correlation analysis between the dependent and explanatory variables used in the regression model (to save space, correlations between the independent variables are not shown). The results show that excess performance, the major dependent variable in the 1-factor model and 4-factor model, has a significantly positive correlation with penny stock weights, the key explanatory variable. However, the statistical significance disappears for the excess performance in the 5-factor model. This again confirms that penny stock investment has a positive effect on fund performance in traditional performance evaluation models, while this positive excess return disappears when the liquidity factor is added.

Across subgroups, L3, the group with stock prices ≤₩5000, shows a correlation result similar to that of penny stocks as a whole. Nevertheless, for L1, the group with prices ≤₩1000, the proportion of penny stocks shows no positive effect in the 1-factor or 4-factor model, and even shows a negative effect in the 5-factor model. However, these results are only for univariate analysis. We will conduct a more thorough examination of whether the positive relationship between penny stock weights and fund performance persists after controlling for various factors that may affect fund performance.

4.3. Performance of Funds Holding Penny Stocks

Table 7 presents the regression analyses on how penny stocks' fund weights affect performance.[9] As in the correlation analysis results in Table 6, penny stock weights have statistically significant positive coefficients after other variables that affect fund performance are controlled for. For the 1-factor and 4-factor models, an increase in stock weight of 1% yields 0.020 and 0.010% increases in excess performance. Thus, we would argue that investing in penny stocks, which has largely been neglected, can improve fund performance.

In subgroup L3, weights have a statistically significant positive impact on excess performance in the traditional performance evaluation models (1-factor and 4-factor models). On the other hand, in L1, the coin-stock group has no significant relationship with the dependent variable in the 1-factor or 4-factor model. L1, as revealed in Table 1, has the highest raw return, but is also high in terms of risk. Therefore, the L1 group does not provide evidence that it contributes positively to fund performance.

[9]The results from the 3-factor model were similar to those from the 4-factor model and therefore are not presented.

Table 5 Descriptive statistics

The table shows the descriptive statistics of variables used in the regression model. The excess performance of funds is yearly and refers to the alphas from 1-factor, 4-factor (CAPM; Carhart,), and 5-factor (with liquidity premium) models using the 12-monthly returns for each year. The excess performance of penny stocks refers to the alphas from 1-factor (CAPM), 4-factor (Carhart,), and 5-factor (with the liquidity premium) models using the 12-monthly performance of penny stock portfolios within the funds. Penny stock weights represents the yearly average weights placed on penny stocks. L1, L2, and L3 weights are weights placed on penny stocks for the respective price subgroups. *Small and medium dummy* is a dummy variable with a value of 1 if a given fund's prospectus states that it mainly invests in small and medium stocks and 0 otherwise. *Winner dummy* is a dummy variable assuming a value of 1 if the return of the fund in the month immediately preceding belongs to the top 20% return group, and *Loser dummy* is given a value of 1 if the fund belongs to the bottom 20%. *Small and medium dummy* × *Penny stock weights*, *Winner dummy* × *Penny stock weights*, and *Loser dummy* × *Penny stock weights* are the interaction variables of the respective dummy variables with the penny stock weights. Fund age is the fund management period after the establishment date, as of each end of the year. Fund size is the NAV of the fund as of each end of the year. Fund turnover ratio is the turnover ratio of the fund for each year. Fund expenses refers to the total fee for the fund (= sales + management + other fees).

Classification	Average	SD	Min.	Median	Max.
Fund					
Alpha (1) (%)	0.10	0.63	−2.67	0.08	3.57
Alpha (4) (%)	0.10	0.69	−2.47	0.09	4.77
Alpha (5) (%)	−0.08	1.24	−7.82	0.08	6.16
Penny stocks					
Alpha (1) (%)	3.80	3.09	−6.55	4.09	21.70
Alpha (4) (%)	3.42	3.93	−7.55	3.30	25.10
Alpha (5) (%)	2.61	7.91	−37.77	3.00	29.23
Penny stock weights (%)	4.70	3.87	0.04	3.91	36.67
L1 weights (%)	0.00	0.14	0.00	0.00	5.54
L2 weights (%)	0.87	1.90	0.00	0.00	21.60
L3 weights (%)	2.74	2.67	0.00	2.31	20.77
Small and medium dummy	0.04				
Winner dummy	0.20				
Loser dummy	0.20				
Small and medium dummy × *Penny stock weight*	0.39	2.39	0.00	0.00	34.25
Winner dummy × *Penny stock weights*	0.90	2.28	0.00	0.00	21.41
Loser dummy × *Penny stock weights*	1.21	3.62	0.00	0.00	36.67
Fund age (months)	53.24	31.33	1.00	54.00	488.00
Fund size (₩100 million)	466.56	1332.48	0.02	57.12	15 762.23
Fund turnover ratio (%)	28.87	15.94	0.00	28.13	94.86
Fund expenses (%)	0.99	1.30	0.00	0.00	5.55

The significance of excess penny stock performance disappears in the 5-factor model, again indicating that the liquidity premium is the main driver of excess performance in penny stocks. Among the control variables, the performance of the previous period shows a significantly positive relationship with all of the excess performance variables. This result is consistent with the literature's findings on

Table 6 Correlation analysis

The following are the correlation analyses between the variables in the regression model. The excess performance of funds is a yearly figure and refers to the alphas from 1-factor (CAPM), 4-factor (Carhart,), and 5-factor (with the liquidity premium) models using the 12-monthly returns for each year. Penny stock weights refers to the yearly average weights placed on penny stocks. Fund age is the log of the fund management period after the establishment date, as of each end of the year. Fund size is the log of the NAV of the fund as of each end of the year. Fund turnover ratio is the turnover ratio of the fund for each year, and fund expenses is the total fee of the fund (= sales + management + other fees). The figures in parentheses are *t*-values, significant at the 1%, 5%, and 10% levels and denoted by ***, **, and *, respectively. To save space, correlations between the explanatory variables are not shown. There is no evidence of multicollinearity for the variables given the variance inflation factor (VIF).

Classification	1-factor alpha	4-factor alpha	5-factor alpha
Penny stock weights	0.135***	0.085***	−0.041
L1 weights	−0.017	−0.010	−0.059**
L2 weights	0.089***	−0.002	−0.023
L3 weights	0.190***	0.134***	−0.024
Fund age	−0.149***	−0.056**	0.024
Fund size	0.040	−0.055**	−0.048*
Fund turnover ratio	0.076***	0.017	−0.174***
Fund expenses	−0.013	−0.009	−0.023

performance persistence over a relatively short period.[10] Fund expenses and size are statistically insignificant, and turnover ratio exhibits a negative relationship only in the 5-factor model.[11]

4.4. Penny Stock-Selection Ability of Fund Managers

The preceding analysis suggests that the inclusion of penny stocks in funds has a positive impact on fund performance. This is likely because either penny stocks dominate non-penny stocks, or fund managers who invest in penny stocks have penny stock-selection ability. Since it is irrational to assume that one class of stocks dominates the rest of the stocks in the market, we would conjecture that fund managers who invest more in penny stocks have better penny stock-selection ability. In order to test this hypothesis, we first calculate the weight of penny stocks in funds dividing the value of individual penny stocks by the market capitalization of the stock. Stocks are classified into the G1 group if the stock's weight in the fund is

[10]Literature on the persistence of fund performance is broadly divided into two arguments, as follows: (i) persistence of fund performance does not exist (Carhart, 1997; Malkiel, 1995; and others); (ii) persistence of fund performance only exists in the short-term (<1 year) (Bollen and Busse, 2004; and others).

[11]We add volatility as a control variable and conducted regression analysis of Table 7 again and results remain the same. The results are not presented to save space, but are available upon request.

Table 7 Fund performance according to penny stock proportion

This table analyzes the effect of penny stock inclusion on fund performance with equation. $\alpha_{i,t} = \beta_0 + \beta_1\omega_{i,t}^{Penny} + \beta_2\omega_{i,t}^{L1} + \beta_3\omega_{i,t}^{L2} + \beta_4\omega_{i,t}^{L3} + \sum_j \beta_j control_{j,i,t-1} + \varepsilon_{i,t}\alpha_{i,t}$ is the excess performance of fund i in year t, and refers to the alpha from the 1-factor (CAPM), 4-factor (Carhart,), and 5-factor (with liquidity premium) models, calculated by using the 12-monthly returns of each year. $\omega_{i,t}^{Penny}$ is the average weight of penny stocks in fund i in year t. $\omega_{i,t}^{L1}$, $\omega_{i,t}^{L2}$, and $\omega_{i,t}^{L3}$ are the fund weights of penny stocks corresponding to the L1 (≤₩1000), L2 (≤₩3000), and L3 (≤₩5000) groups. Performance of the previous period, fund age, fund size, fund turnover, and fund expenses are used as control variables ($control_{i,t-1}$). To attenuate potential endogeneity issues that may arise, explanatory variables from period $t-1$ were applied. Fund age ($Age_{i,t-1}$) is the log of the fund management period (in months) after the establishment date, in year $t-1$. Fund size ($Size_{i,t-1}$) is the log of the NAV of the fund. Fund turnover ratio ($Turnover_{i,t-1}$) is the turnover ratio of the fund in year $t-1$, and fund expenses ($Fee_{i,t-1}$) refers to the total fee for the fund (= sales + management + other fees). The year fixed-effect model was used. The figures in parentheses are t-values, significant at the 1%, 5%, and 10% levels and denoted by ***, **, and *, respectively.

	1-factor alpha		4-factor alpha		5-factor alpha	
Penny stock weights	0.020 (5.49)***		0.010 (2.19)**		−0.013 (−1.52)	
L1 weights		−0.841 (−1.40)		−0.478 (−0.62)		−4.150 (−3.09)***
L2 weights		0.031 (4.51)***		−0.002 (−0.21)		0.005 (0.29)
L3 weights		0.018 (3.50)***		0.017 (2.45)**		−0.013 (−1.12)
Performance of the previous period	0.181 (7.26)***	0.180 (7.16)***	0.127 (4.74)***	0.127 (4.72)***	0.097 (3.72)***	0.100 (3.85)***
Fund age	−0.132 (−5.19)***	−0.133 (−5.24)***	−0.061 (−1.88)*	−0.062 (−1.93)*	0.031 (0.55)	0.028 (0.49)
Fund size	0.005 (0.76)	0.003 (0.46)	−0.004 (−0.44)	−0.005 (−0.64)	0.009 (0.61)	0.014 (0.92)
Fund turnover ratio	−0.001 (−1.53)	−0.001 (−0.98)	0.000 (0.21)	0.000 (0.28)	−0.011 (−5.29)***	−0.011 (−5.65)***
Fund expenses	−0.003 (−0.28)	−0.003 (−0.34)	−0.008 (−0.66)	−0.009 (−0.69)	−0.013 (−0.59)	−0.012 (−0.53)
Intercept	−0.243 (−1.22)	−0.183 (−0.93)	0.001 (0.01)	0.058 (0.23)	−0.246 (−0.55)	−0.357 (−0.81)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.434	0.438	0.256	0.255	0.253	0.257
Number of observations	1474	1474	1474	1474	1474	1474

above the median and are classified into the G2 group if the stock's weight in the fund is below the median.

Before we compare the performance of the two groups, Table 8 compares the characteristics of the two groups. The results imply that, among penny stocks, those held more by fund managers (G1 group) have high return, low risk (volatility), relatively small size, small trading volume, low book-to-market ratio, and high PER. The same results hold for all groups when broken down into detailed price ranges (excluding PER of the L2 group). The most important lesson from this table is that funds mainly hold those stocks with high return and low risk, which directly implies that fund managers have superior ability to select good stocks within the penny stock pool. In contrast, the fact that funds prefer to hold small-sized and less-liquid penny stocks indicates that the higher return is mainly due to the small firm effect and liquidity premium.

Table 9 presents the main results of this section and compares returns between groups divided by their weights in funds. For both penny and non-penny stocks, the return of the group with the greater holding proportion (G1) is higher than that of its counterpart (G2). The returns of G1 are 3.67%, compared to G2 at 2.35%, for a 1.32% p difference. Even when divided into subgroups, the G1 group as a whole has higher returns than the G2 group does.

Table 10 conducts a similar test but uses excess performance instead of raw returns. Regardless of how excess performance is measured, the results are exactly the same as those shown in Table 9. The performance of G1, which is held more by fund managers, is better than that of G2 in all groups. Therefore, we would argue that fund managers have stock-selection ability and that penny stocks held in greater quantities by fund managers outperform those that are held in fewer quantities. Interestingly, G1 shows excess performance even for the 5-factor model, which means that the penny stocks preferred by fund managers earn excess returns even after the liquidity premium involved in penny stocks is accounted for. Thus, we would argue that fund managers who take advantage of the information asymmetry in penny stocks can benefit from it.

Figure 1 compares the cumulative returns of portfolios formed according to the holding weights of penny stocks versus non-penny stocks in funds. For both penny and non-penny stocks, the stocks held more by fund managers display higher performance than those that are held less. However, the stock performance difference depending on the proportion held by fund managers is more pronounced for penny stocks than for non-penny stocks. Thus, we conclude that fund managers have better stock-selection ability where greater information asymmetry exists, such as in penny stocks.

4.5. Differences in Stock-Selection Ability Across Fund Managers

The analysis in the preceding section seems to suggest that fund managers in general have better stock-selection ability for penny stocks. However, fund managers seldom employ penny stocks as a major investment strategy, and the proportion of

Table 8 Characteristics of penny stocks according to weights held in funds

This table describes the characteristics of penny stocks according to their weights in funds. Penny stock is classified according to the definition used in this study. The subgroups within the penny stock group are defined according to the average price of the immediately preceding 12 months. Only the domestic active equity-type public funds were examined. Weights were calculated by dividing the value of individual stocks in a given fund by the market capitalization of the stock. Stocks are classified into the G1 (G2) group if the stock's weight in the fund is above (below) the median for each price subgroup. The number of stocks was counted for stocks that correspond to either the price subgroup or the G1/G2 groups, so double-counting may have occurred. The values shown in the table for the return (%), volatility (%), market cap (100 million), trading volume (100 million), BM, and PER are all characteristics reflective of penny stocks and were averaged by subgroups according to the monthly values for each stock within the groups. Return refers to monthly returns. Volatility was calculated by converting for each year the monthly standard deviation of daily returns. The market cap and the trading volumes are the averages of the daily market cap and trading volume for each month. The values for BM, PER, and the number of stocks were calculated as of each end-of-the-month.

Classification	Group	Number of stocks	Return	Volatility	Market cap	Trading volume	BM	PER
Penny stocks total	G1	601	3.22	43.44	1113	15	1.20	19.50
(≤₩5000)	G2	827	2.26	48.78	1298	26	1.46	16.86
L1 (≤₩1000)	G1	63	4.48	57.14	1028	26	1.39	42.48
	G2	83	2.87	57.18	1221	49	1.71	23.65
L2 (≤₩3000)	G1	336	3.50	45.07	897	16	1.28	9.57
	G2	439	2.53	49.93	1076	26	1.53	13.89
L3 (≤₩5000)	G1	387	2.98	41.72	1260	15	1.17	23.22
	G2	569	1.96	46.94	1481	23	1.35	20.61

penny stocks in funds is, on average, extremely low. Thus, it would be illogical to propose that all fund managers have good penny stock-selection ability. Rather, it would be more reasonable to state that fund managers who have better access to information on penny stocks perform better in penny stock investments. Thus, this section tests whether selection ability for penny stocks differs across fund managers.

The descriptive statistics presented in Table 5 suggest[12] that the excess return of the penny stock portfolio within a fund is, on average, 3.80% in the 1-factor model, with a maximum return of 21.70%. The small- and medium-stock fund dummy variable, set to 1 if the fund's prospectus states that it will invest mainly in small and medium stocks, has an average score of 0.04. In other words, only 4% of the total sample represents funds that strategically invest in small and medium stocks. The interaction term for the small- and medium-stock funds dummy and penny stock weights (*small- and medium-stock fund dummy* × *penny stock weight*) has an average score of 0.39, implying that the average penny stock weight in small- and

[12]Correlation analysis for the regression model is also conducted. The results are not presented due to space constraints. No evidence of multicollinearity is found in the calculation of the variance inflation factor (VIF) for the model.

Table 9 Performance analysis of stock groups according to weights in funds

Return analysis in this table was conducted using the interactions of stock prices and their weights in funds. Penny stocks are classified according to the definition used in this study. The subgroups within the penny stock group are defined according to the average price of the immediately preceding 12 months. Only the domestic active equity-type public offering funds are examined. Weights are calculated by dividing the appraised value of individual stocks in a given fund by the market capitalization of the stock. Stocks are placed into the G1 (G2) group if the stocks' weight in the fund is above (below) the median for each price subgroup. Return is measured using the monthly raw return (raw return, %). Portfolio returns are weighted by the average monthly market capitalizations of the stocks in the portfolio. The figures in parentheses are *t*-values, significant at the 1%, 5%, and 10% levels and denoted by ***, **, and *, respectively.

	Group	Total	L1	L2	L3
Raw return	G1	3.67 (4.68)***	3.61 (2.25)**	3.80 (4.33)***	3.70 (4.91)***
	G2	2.35 (2.67)***	2.88 (1.78)*	2.24 (2.24)**	2.41 (2.81)***
	Diff	1.32 (2.68)***	0.73 (0.39)	1.56 (2.43)**	1.29 (2.53)**

medium-stock funds is 9.75% (0.39/0.04). This number is higher than the average penny stock weight of 4.70% for the total sample. Thus, it can be inferred that small- and medium-stock funds hold a relatively high proportion of penny stocks. The other dummy variables that distinguish between the top and bottom 20% performance funds are the winner and loser dummy variables. When interacted with penny stock weight, the winner fund interaction term (*winner dummy* × *penny stock weights*) has an average of 0.90, meaning that the proportion of penny stocks in the winner fund is 4.50% (0.90/0.2). By contrast, the loser fund interaction term (*loser dummy* × *penny stock weight*) has an average of 1.21, meaning that the proportion of penny stocks in the loser fund is 6.05% (1.21/0.2). This indicates that fund managers with better performance do not hold more penny stocks in their portfolio.

Table 11 presents the results from the regression model analyzing whether fund managers differ in their ability to select penny stocks. Model (1) analyzes the influence of penny stock weights on the excess performance of penny stock portfolios. Models (2-1) and (2-2) perform the same analysis for small- and medium-stock funds. Models (3-1) and (3-2) perform the same analysis for winner and loser funds. In Panel A, examining excess performance in the 1-factor model, the proportion-of-penny-stock variable in model (1) has a statistically significant and positive coefficient of 0.042, meaning that a 1% increase in the fund's penny stock proportion leads to a 0.042% increase in excess performance for penny stock portfolios within the fund. In model (2-1), the small- and medium-stock fund dummy shows a statistically significant and positive coefficient on penny stock portfolio returns. However, when the interaction variable (*small- and medium-stock fund dummy* × *penny stock weight*) is added, only the interaction variable shows a significantly positive relationship (0.180) with the dependent variable, meaning that small- and medium-stock funds with increased penny stock weights have penny

Table 10 Analysis of excess performance across groups according to weights in funds

Analyses of excess performance in this table are conducted by using the interactions of stock price and their weights in funds. Penny stocks are classified according to the definition used in this study. Only the domestic active equity-type public funds are examined. Weights are calculated by dividing the value of individual stocks in a given fund by the market capitalization of the stock. Stocks are defined into the G1 (G2) group if the stocks' weight in the fund is above (below) the median for each price subgroup. Excess performance is measured using the alpha (α_p) from the 1-factor (CAPM), 4-factor (Carhart,), and 5-factor (with the liquidity premium) models and Sharpe's ratio:.$r_{p,t} = \alpha_p + \beta_p r_{m,t} + s_p SMB_t + h_p HML_t + p_s MOM_t + l_p LiQ_t + \varepsilon_{p,t} r_{p,t}$ is the portfolio return in excess of the risk-free rate, computed by subtracting the risk-free rate (1-year Treasury bond) from the monthly returns of individual stocks in each price group. $r_{m,t}$ is calculated by subtracting the risk-free rate from the KOSPI returns. SMB_t and HML_t are calculated following Fama and French (), and MOM_t is computed following Carhart (). The liquidity factor (LiQ_t) is computed following Amihud (). Panel A presents the excess performance (alpha, α_p, %) from the 1-factor model and Panels B and C present the alpha (α_p, %) from the 4-factor and 5-factor models, respectively. Portfolio returns are weighted by the average monthly market capitalizations of the stocks in the portfolio. The figures in parentheses are *t*-values, significant at the 1%, 5%, and 10% levels and denoted by ***, **, and *, respectively.

	Group	Total	L1	L2	L3
Panel A: 1-factor alpha	G1	2.644 (5.38)**	2.589 (1.78)*	2.733 (4.61)***	2.745 (5.30)***
	G2	1.228 (2.26)**	1.768 (1.24)	1.081 (1.57)	1.323 (2.45)**
	Diff	1.416 (2.76)***	0.821 (0.88)	1.652 (3.32)***	1.422 (1.95)*
Panel B: 4-factor alpha	G1	2.389 (5.80)***	2.102 (1.37)	2.541 (4.55)***	2.403 (5.39)***
	G2	0.948 (1.93)*	1.851 (1.27)	0.605 (0.96)	1.177 (2.30)**
	Diff	1.441 (2.32)**	0.251 (0.39)	1.936 (3.08)***	1.226 (1.39)
Panel C: 5-factor alpha	G1	1.469 (2.19)**	0.445 (0.18)	1.812 (1.98)*	1.321 (1.83)*
	G2	−1.300 (−1.70)*	−0.767 (−0.33)	−1.059 (−1.04)	−1.108 (−1.39)
	Diff	2.769 (1.54)	1.212 (−0.95)	2.871 (1.44)	2.429 (0.93)
Panel D: Sharpe's ratio	G1	0.469 (15.43)***	0.191 (7.16)***	0.428 (15.17)***	0.459 (14.51)***
	G2	0.248 (9.30)***	0.144 (4.54)***	0.188 (6.44)***	0.267 (10.21)***
	Diff	0.221 (10.57)***	0.047 (1.81)*	0.240 (11.22)***	0.192 (7.51)***

Table 11 Analysis of factors affecting excess performance of penny stock portfolios within funds

This table analyzes the factors affecting the excess performance of penny stock portfolios within the funds: $\alpha_{i,t}^{Penny} = \beta_0 + \beta_1 \omega_{i,t}^{Penny} + \beta_2 D_{i,t}^{Winner} + \beta_3 D_{i,t}^{Loser} + \beta_4 \left(D_{i,t}^{Winner} \times \omega_{i,t}^{Penny} \right) + \beta_5 \left(D_{i,t}^{Loser} \times \omega_{i,t}^{Penny} \right) + \beta_6 D_i^{Small} + \beta_7 \left(D_i^{Small} \times \omega_{i,t}^{Penny} \right) + \sum_j \beta_j control_{j,i,t-1} + \varepsilon_{i,t} \alpha_{i,t}^{Penny}$ is the excess performance of a penny stock portfolio within fund i in year t, calculated by using the 12-monthly returns of the funds' penny stock portfolio ($r_{i,t}^{Penny} = \sum_j \omega_{i,j,t} stockret_{i,j,t}$). It is also the alpha from the 1-factor (CAPM), 4-factor (Carhart,), and 5-factor (with liquidity premium) models. The small and medium dummy (D_i^{Small}) is a dummy variable set to 1 if the prospectus of the fund states that investment in small- and medium-cap stocks is a major management strategy and 0 otherwise. The winner dummy ($D_{i,t}^{Winner}$) is a dummy variable set to 1 if the return of the fund in the month immediately preceding belongs to the top 20% return group. The loser dummy ($D_{i,t}^{Loser}$) is a dummy variable set to 1 if the return of the fund in the month immediately preceding belongs to the bottom 20% return group. *Small and medium dummy* × *Penny stock weights* ($D_i^{Small} \times \omega_{i,t}^{Penny}$), *Winner dummy* × *Penny stock weights* ($D_{i,t}^{Winner} \times \omega_{i,t}^{Penny}$), and *Loser dummy* × *Penny stock weights* ($D_{i,t}^{Loser} \times \omega_{i,t}^{Penny}$) are interaction variables for each dummy variable with penny stock weights. The performance of the previous period, fund age, fund size, fund turnover, and fund expenses were used as control variables ($control_{i,t-1}$). To attenuate potential endogeneity issues, explanatory variables from period $t-1$ were applied. Fund age ($Age_{i,t-1}$) is the log of the fund management period (in months) after the establishment date in year $t-1$. Fund size ($Size_{i,t-1}$) is the log of the NAV of the fund. Fund turnover ratio ($Turnover_{i,t-1}$) is the turnover ratio of the fund in year $t-1$, and fund expenses ($Fee_{i,t-1}$) refers to the total fee for the fund (= sales + management + other fees). The year fixed-effect model was used. The figures in parentheses are t-values, significant at the 1%, 5%, and 10% levels and denoted by ***, **, and *, respectively.

	(1)	(2-1)	(2-2)	(3-1)	(3-2)
Panel A: 1-factor alpha					
Penny stock weights	0.042 (1.66)*				
Small and medium dummy		0.696 (1.67)*	−0.655 (−0.89)		
Winner dummy				−0.035 (−0.17)	−0.616 (−1.82)*
Loser dummy				0.212 (0.74)	0.420 (1.08)
Interaction (Small and medium × Weights)			0.180 (2.23)**		
Interaction (Winner × Weights)					0.114 (2.22)**
Interaction (Loser × Weights)					−0.032 (−0.76)
Performance of the previous period	0.130 (3.96)***	0.129 (3.92)***	0.122 (3.70)***	0.140 (4.17)***	0.136 (4.04)***
Fund age	0.241 (1.41)	0.236 (1.38)	0.262 (1.53)	0.200 (1.14)	0.181 (1.03)

Table 11 (*Continued*)

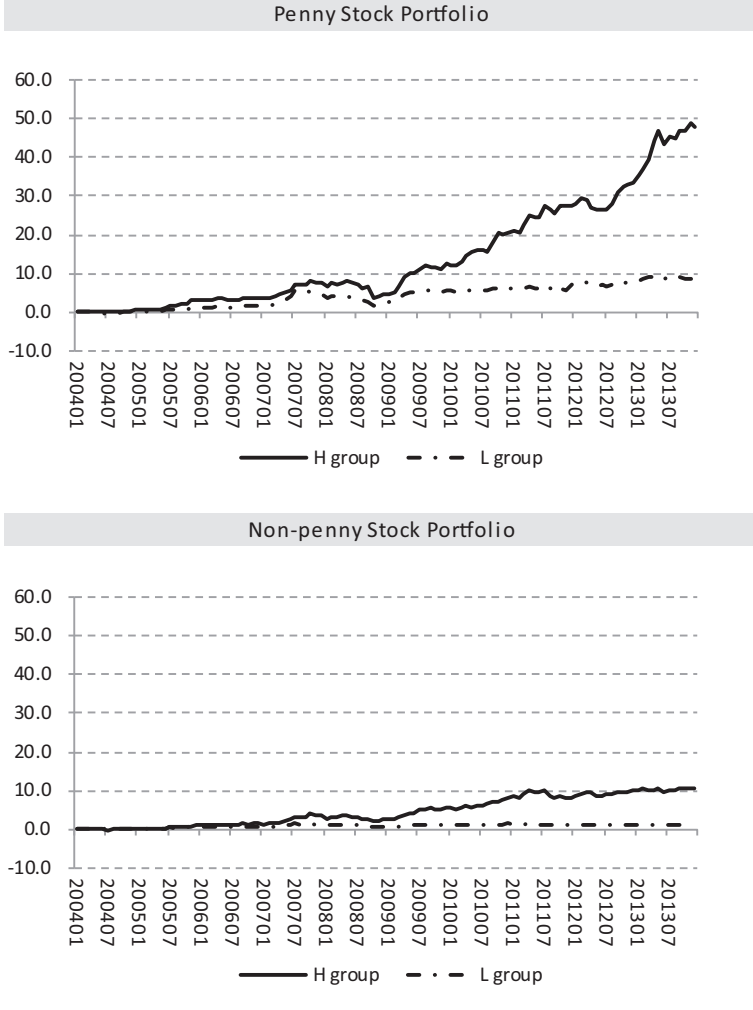
	(1)	(2-1)	(2-2)	(3-1)	(3-2)
Fund size	−0.203 (−4.70)***	−0.217 (−5.07)***	−0.216 (−5.06)***	−0.209 (−4.82)***	−0.206 (−4.76)***
Fund turnover ratio	0.017 (2.78)***	0.018 (3.01)***	0.018 (3.04)***	0.019 (3.16)***	0.019 (3.11)***
Fund expenses	−0.099 (−1.42)	−0.079 (−1.13)	−0.081 (−1.16)	−0.095 (−1.36)	−0.101 (−1.45)
Intercept	6.431 (4.82)***	6.886 (5.29)***	6.782 (5.22)***	6.809 (5.14)***	6.848 (5.18)***
Fixed effect	Yes	Yes	Yes		
Adj R^2	0.393	0.396	0.393		
Number of observations	783	783	783		
Panel B: 4-factor alpha					
Penny stock weights	−0.028 (−0.77)				
Small and medium dummy		0.366 (0.62)	−0.976 (−0.94)		
Winner dummy				0.642 (2.14)**	0.221 (0.46)
Loser dummy				−0.580 (−1.45)	0.389 (0.71)
Interaction (Small and medium × Weights)			0.178 (1.56)		
Interaction (Winner × Weights)					0.086 (1.19)
Interaction (Loser × Weights)					−0.154(−2.56)**
Performance of the previous period	0.218 (5.25)***	0.217 (5.23)***	0.216 (5.20)***	0.198 (4.72)***	0.185 (4.39)***
Fund age	0.313 (1.29)	0.355 (1.47)	0.382 (1.58)	0.469 (1.89)*	0.428 (1.73)*
Fund size	−0.180 (−2.94)***	−0.175 (−2.89)***	−0.174 (−2.87)***	−0.198 (−3.24)***	−0.201 (−3.31)***
Fund turnover ratio	0.029 (3.36)***	0.027 (3.15)***	0.027 (3.17)***	0.029 (3.50)***	0.033 (3.83)***
Fund expenses	0.008 (0.08)	0.015 (0.15)	0.013 (0.13)	−0.006 (−0.06)	−0.009 (−0.09)
Intercept	4.876 (2.59)***	4.513 (2.46)**	4.379 (2.39)**	4.500 (2.44)**	4.692 (2.55)**
Fixed effect	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.313	0.312	0.314	0.318	0.324

Table 11 (*Continued*)

	(1)	(2-1)	(2-2)	(3-1)	(3-2)
Number of observations	783	783	783	783	783
Panel C: 5-factor alpha					
Penny stock weights	0.047 (0.65)				
Small and medium dummy		0.154 (0.13)	−1.472 (−0.70)		
Winner dummy				0.333 (0.55)	−0.445 (−0.46)
Loser dummy				−1.384 (−1.72)*	−1.939 (−1.75)*
Interaction (Small and medium × Weights)			0.216 (0.94)		
Interaction (Winner × Weights)					0.152 (1.04)
Interaction (Loser × Weights)					0.091 (0.75)
Performance of the previous period	0.143 (3.72)***	0.143 (3.72)***	0.142 (3.69)***	0.137 (3.54)***	0.138 (3.55)***
Fund age	0.391 (0.80)	0.356 (0.73)	0.389 (0.80)	0.407 (0.81)	0.411 (0.82)
Fund size	−0.194 (−1.58)	−0.207 (−1.69)*	−0.205 (−1.68)*	−0.232 (−1.90)*	−0.224 (−1.82)*
Fund turnover ratio	0.004 (0.25)	0.007 (0.40)	0.007 (0.41)	0.010 (0.60)	0.007 (0.40)
Fund expenses	−0.123 (−0.62)	−0.116 (−0.58)	−0.118 (−0.59)	−0.128 (−0.65)	−0.136 (−0.68)
Intercept	4.720 (1.25)	5.278 (1.43)	5.100 (1.38)	5.661 (1.52)	5.561 (1.49)
Fixed effect	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.353	0.353	0.353	0.355	0.355
Number of observations	783	783	783	783	783

Figure 1 Cumulative return trends of stock groups according to weights in funds.

This figure presents the trend of the cumulative return of penny stock and non-penny stock portfolios according to their different weights held in funds. Penny stocks and non-penny stocks are classified according to the definition used in this study. Only the domestic active equity-type public funds are examined. The weights of individual stocks in the fund are calculated by dividing the value of the stock in the fund by the stocks' market cap. Stocks whose weights exceed the median weight in their price group are placed in the G1 (High) group, and the rest are placed in the G2 (Low) group. To allow for comparability, identical Y-axes are used for each group. Cumulative returns are calculated by first value-weighting the individual stocks' monthly returns and then cumulating the portfolio returns.



stock-selection ability. The coefficient of the interaction variable is 0.180, suggesting that an increase of 1% for penny stocks in small- and medium-stock funds leads to a 0.180% increase in excess performance for the penny stock portfolio within a fund. This figure is much higher than the average excess return of 0.042% for all

funds that invest in penny stocks. Therefore, we can argue that managers of small- and medium-stock funds who invest more in penny stocks have superior selection ability for penny stocks.

Finally, the winner and loser funds are compared in model (3-1). The results show that whether the fund is a winner or loser has no impact on penny stock performance. Interestingly, model (3-2) presents a negative coefficient for the winner dummy but a positive coefficient for the interaction variable (*winner dummy* × *penny stock weights*). These results suggest that not all winner funds have better penny stock-selection ability but that only the winner managers who hold more penny stocks have such ability.

Among the control variables, fund size exhibits a negative correlation with the dependent variable, while the fund turnover ratio has a positive correlation. In other words, funds that are smaller and that participate in rigorous trading see greater improvements in the performance of their penny stocks.

In Panels B and C, the 4-factor and 5-factor model alphas are used as the dependent variables. The results show that the significance of the explanatory variable largely disappears. In Panel B, the significance of the major explanatory variables is almost nonexistent, while the significance of the control variables remains largely similar to that shown in Panel A. By contrast, as shown in Panel C, even the control variables lose significance in the model with a liquidity factor. Thus, we conclude that the difference in the levels of stock-selection ability between fund managers is mostly a premium rewarded for taking additional liquidity risks in penny stocks.

5. Conclusion

Penny stocks are generally described as securities with high risk, low liquidity, and high information asymmetry. These characteristics make their nature and mechanisms hard to reconcile with general financial theory. For individual investors, penny stocks are the subject of speculation due to their lottery-like disposition, and risk management and compliance codes often prevent institutional investors from investing in them. Nevertheless, their past performance can make penny stocks seem an attractive investment medium. This study analyzes the characteristics of penny stocks and the benefits of including them in fund portfolios. The main findings of the study are as follows.

First, this study examines the performance factors of penny stocks and conducts spanning tests. The results reveal that penny stocks exhibit excess performance that is not explicable by traditional performance factors (e.g. market, size, value, momentum). Instead, the liquidity factor accounts for the excess performance of penny stocks. This indicates that market participants require a risk premium for taking on penny stocks, which have low liquidity and high information asymmetry. Second, penny stocks serve as a meaningful investment medium that expands the efficient frontier of investment sets, which are composed of market indices. Since the proportion of penny stocks in stock indices is extremely low, the indices do not

reflect the characteristics of penny stocks sufficiently to build an efficient frontier. Therefore, we argue that including penny stocks as a new investment class in existing investment sets can improve portfolio performance.

Third, we find that the inclusion of penny stocks in a fund portfolio improves fund performance. In particular, penny stocks with relatively high price ranges of ₩3000–₩5000 contribute to the excess performance of funds. This result implies that fund performance can benefit from investments in penny stocks, which are often neglected by institutional investors. However, the excess performance of the funds disappears in the 5-factor model, which takes the liquidity factor into account. Finally, this study finds that penny stocks held more by funds provide excess returns not only for traditional factor models but also for the 5-factor model with the liquidity factor. We also find that the more fund managers include penny stocks in their portfolios, the better their selection ability for penny stocks becomes. However, the difference across fund managers' stock-selection ability again disappears with the inclusion of explanatory variables, especially the liquidity factor. These results suggest that the excess performance of penny stocks is mostly due to the risk premium rewarded for taking additional risks, although some penny stocks deliver alphas even after liquidity risk is taken into account.

The development of the financial market has reduced the number of management strategies and investment opportunities for generating excess performance (alpha). Some investors are considering penny stocks as an alternative investment medium for creating alpha. Reflecting this trend, the NAV of Fidelity's Low-Priced Stock Fund exceeded $30bn in March 2015. However, very few studies have been conducted on penny stocks. This study contributes to the literature by directly examining penny stocks as an investment vehicle. Nevertheless, this study leaves much room for further analysis. For instance, future research should further divide penny stocks' price ranges into more detailed classes and thoroughly examine the many unique characteristics and risks of penny stocks, such as transaction abnormalities and sudden price peaks among many others.

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Appendix

Table A1 Factor analysis of returns for penny stock

This table presents the factor analysis of returns for penny stock portfolios. Penny stocks are classified according to the definition used in this study. Factor analyses of returns were conducted using the CAPM (1-factor model), Fama and French () model, Carhart () model, Fama and French () model, and the 5-factor model that adds a liquidity premium.$r_{p,t} = \alpha_p + \beta_p r_{m,t} + s_p SMB_t + h_p HML_t + p_p MOM_t + r_p RMW_t + c_p CMA_t + l_p LiQ_t + \varepsilon_{p,t} r_{p,t}$ is the portfolio return in excess of the risk-free rate, computed by subtracting the risk-free rate (1-year Treasury bond) from the monthly returns of individual stocks in each price group. $r_{m,t}$ is calculated by subtracting the risk-free rate from the KOSPI returns. SMB_t and HML_t are calculated following Fama and French (), $RMW_t$and CMA_t are calculated following Fama and French (), and MOM_t is computed following Carhart (). The liquidity factor (LiQ_t) is computed following Amihud () by first ranking the liquidity of the stock and then forming portfolios based on the top and bottom 30%, and finally subtracting the returns of the bottom 30% portfolio from the top 30% portfolio. The figures in parentheses are *t*-values, significant at the 1%, 5%, and 10% levels and denoted by ***, **, and *, respectively.

α_p	β_p	s_p	h_p	p_p	r_p	c_p	l_p	$Adj\ R^2$
2.05 (7.21)***	1.17 (23.01)***	0.97 (16.96)***	−0.02 (−0.26)	0.03 (0.45)	−0.23 (−1.94)	−0.01 (−0.02)		0.90
0.59 (1.35)	1.06 (20.11)***	1.01 (18.68)***	0.16 (1.95)	−0.01 (−0.17)	−0.21 (−1.89)	−0.04 (−0.38)	−39.84(−4.30)***	0.91