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The Performance Analysis of Trading Strategies Based on Insider Silence

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Abstract

Seyhun (1986) argues that insider buying predicts positive future returns, while insider selling reveals only a slight signal to predict negative future returns, possibly to satisfy liquidity needs. Gao et al. (2021) find that insiders are afraid of exposure to litigation risk, they neither sell their stocks on bad news nor buy, so insiders keep silent. Based on Gao et al. (2021), we construct the portfolio, which is to buy the "insider sell" group and to sell the "insider silence" group. According to Johnson and So (2012), the O/S portfolio is constructed based on the ratio of individual stock options to the trading volume of the underlying stock. F/S portfolio is constructed by the ratio of individual stock futures to the trading volume of the underlying stock. We find that under the holding period of more than one year, the performance of insider trading strategy is better than other strategies. Specifically, "buying insider purchases and selling insider sales" strategies are more profitable with longer holding periods. Moreover, the longer the holding period of OS and FS strategies, the greater the negative return effect.

JEL classification numbers: G11, G12, G14.
Keywords: Insider trading, Insider silence, OS strategy, FS strategy, and one-dimensional strategy.

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1. Introduction

Insider trading has received considerable academic attention in recent years. Due to the positions within a company, Insiders possess more undisclosed private information than investors, which gives them an advantage in engaging in trading activities. Jaffe (1974), Finnerty (1976), and Lakonishok and Lee (2001) use insider purchases and sales to construct investment portfolios to get profits. Seyhun (1986) demonstrate that insiders can predict abnormal changes in future stock prices. Insider purchases predict positive future returns, while insider sales only reveal slight signals to predict negative future returns, which may meet liquidity needs. King and Roell (1988) find that insider purchases had significant positive abnormal returns on company stocks, while insider sales had negative abnormal returns on company stocks. Pope et al. (1990) find that after insider sales, the abnormal returns of company stocks is significantly negative within six months, while after insider purchases, the abnormal returns is insignificantly positive within six months. Cohen et al. (2012) classify insider trading into "routine" and "opportunistic" insider trading, and show that an investment portfolio strategy that focuses only on opportunistic insider trading generates 82 basis points of abnormal returns per month.

Hong and Li (2019) find that when insiders suddenly became silent after selling trades in the same month for consecutive years, it indicate positive abnormal returns, and when insiders suddenly became silent after buying trades, it predicts negative returns. This suggests that the silence of routine insiders trading can provide valuable information. Gao et al. (2021) demonstrate that in a sample of US common stocks, 66% of companies have no insider trading activities within a month, and 12% have no insider trading activities within a year, suggesting that insiders refrain from trading and remain silent when there is no positive or negative information available for trading. They find that insider silence is negatively correlated with litigation risk and future stock returns and construct portfolios of stocks by buying insider sales and selling insider silence, and find that the abnormal returns of the companies with insider silence is lower than those with insider sales.

Derivative financial markets contribute to price discovery. Compared to trading in the underlying assets, trading in derivative financial markets can provide more detailed and accurate information about the value of the underlying assets. Johnson and So (2012) use the option-to-stock volume ratio, known as the "O/S ratio," to present the imbalances in order flow. They find that the companies with low O/S ratios outperform the market and the negative correlation between O/S ratio and future returns is driven by short-selling costs in the stock market.

The Taiwan Futures Exchange (TFE) introduce individual stock options in January 2003 and individual stock futures in January 2010. However, the trading volume of individual stock options in Taiwan is very low, with low liquidity and a small number of issuing companies. The number of companies issuing individual stock options (40) is only 17% of the number of companies issuing individual stock futures (227). From 2012 to 2021, the average annual trading volume of individual

stock options is only 0.79% of the trading volume of individual stock futures (16.2 thousand contracts for options vs. 20.378 million contracts for futures). This indicates that investors use individual stock futures trading more frequently. Based on Johnson and So (2012) O/S ratio, we construct a ratio of futures to stock trading volume, "F/S ratio," and applies it to the Taiwan market. We create an investment strategy, which is to buy stocks with low F/S ratios and to sell stocks with high F/S ratios, to investigate whether the FS strategy can provide better investment performance than OS strategy.

Traditionally, many investors rely on historical stock prices to assess future stock performance and trends. This investment strategy is widely applied in the stock market. For example, "price momentum strategy" provided by Jegadeesh and Titman (1993) differentiates winners and losers based on past stock returns, implementing a trading strategy of buying past winners and selling past losers, which results in significant abnormal returns. It is found that holding stocks for 3 to 12 months yields positive significant returns, but half of the excess returns in the year following portfolio formation dissipates within the next two years. Nonetheless, De Bondt and Thaler (1985) argue that there is an irrational overreaction phenomenon in the market, and discover that portfolios of previous "losers" outperform portfolios of previous "winners," suggesting that investors can obtain excess returns using this contrarian strategy. Moreover, Lee and Swaminathan (2000) incorporate trading volume momentum alongside price momentum, constructing a trading strategy to explore the investment portfolios based on high and low turnover rates. Li et al. (2009) demonstrate that high trading volume winners and losers outperformed low trading volume winners and losers. Naughton et al. (2008) focus on trading volume momentum in the Chinese stock market and find a high correlation between stock returns and past trading volume.

Apart from using past stock returns and trading volume to form investment strategies, George and Hwang (2004) introduce the "52-week high" strategy, which utilizes the highest price of individual stocks in the past 52 weeks as an indicator and compares it with the price momentum strategy and past industry returns. They find that the 52-week high strategy yields twice the returns of the other two strategies, indicating that regardless of whether individual stocks had extreme returns in the past, the 52-week measurement had predictive power. Subsequently, Sapp (2011) applies "52-week high" strategy to mutual funds, discovering that the 52-week high also has significant and independent predictive power for fund returns.

Based on Gao et al. (2021), we categorizes stocks that have had no insider trading activities in the past twelve months as the "silent" group, while stocks with positive and negative net insider trading activities constitute the "buying" and "selling" groups, respectively. Then, we construct the "buying insiders sale and the selling insider silence" portfolio, "buying insiders purchase and selling insider silence" portfolio, and "buying insiders purchase and selling insiders sale" portfolio to compares the performance of trading strategies formed by insider silence with OS, FS, price momentum, trading volume momentum, and the 52-week high strategy.

The remainders of this paper are organized as follows. Section 2 reviews the

literature. Section 3 describes the data and methodology. In Section 4, we present the empirical results. Section 5 provides the conclusion.

2. Literature Review

2.1 Insider Silence

Insiders possess privileged information about the insider affairs and expected profitability of a company, enabling them to engage in stock trading before the information becomes public and generate abnormal returns. Due to their superior profit-generating ability compared to regular investors, previous literature has primarily focused on insider trading rather than insider silence. For instance, Gao et al. (2021) demonstrated that insider silence strongly predicts cumulative excess returns for the following year, but its predictability weakens significantly for the subsequent two years. Insiders refrain from selling their company's stock when anticipating negative news, and they also avoid buying it, indicating their preference to remain silent.

Based on the analysis of insider trading data in the U.S. securities market, Gao et al. (2021) categorized stocks into different groups based on insider trading activities over the past twelve months. Stocks with no insider trading activity during the past twelve months constituted the "silence" group, while stocks with positive and negative insider trading activities formed the "buy" and "sell" groups, respectively. Drawing mainly from Gao et al. (2021), the research portfolio consists of buying the "insider sell" group and selling the "insider silence" group to examine the impact of silence on future stock returns. Additionally, a secondary investigation examines the magnitude of the silence effect by buying the "insider buy" group and selling the "insider silence" group.

2.2 Option-to-Stock Volume Ratio (O/S)

Roll et al. (2010) initially introduced the concept of O/S, indicating that the cross-sectional and time-series variations in O/S are driven by informed trading. Additionally, Johnson and So (2012) found that comparing publicly available company-specific options and stock volume predictors with the directional changes in prices, especially for low O/S companies, their performance outperformed the market, while high O/S companies underperformed. As shorting costs increase, informed traders are more likely to shift from stock trading to options trading on negative information, indicating that high O/S implies bad news for investors. Investors with negative information are more willing to trade options during times of bad news, thus increasing the availability of O/S through informed trading.

Based on the research by Johnson and So (2012), private information of informed traders is reflected in O/S. At the end of each week, companies are ranked based on O/S, and the average returns of portfolios are calculated. The portfolio is formed by buying stocks with low O/S and selling stocks with high O/S, suggesting that O/S enables investors to profit from this strategy. Huang and Wu (2020) applied the O/S strategy to the U.S. NASDAQ100 and found that the profitability becomes more evident over a holding period of one year or longer, particularly with the P/S (put-to-stock volume ratio) strategy, which is more pronounced and superior to the O/S strategy.

2.3 Futures-to-Stock Volume Ratio (F/S)

Johnson and So (2012) utilized the O/S ratio created by Roll et al. (2010) and found that it provides a clearer signal of private information in the U.S. market compared to the ratio of buying volume to selling volume. Buying volume can represent either positive news (if informed traders are buying) or negative news (if informed traders are selling). Martins et al. (2012) conducted research in the Indian market and demonstrated a significant relationship between stock trading volume and stock futures trading volume. In this study, we explore the Taiwan market, where the number of stock options issued by the Taiwan Futures Exchange is relatively limited. Therefore, we apply the O/S method from Johnson and So (2012) to measure the Taiwan market using the futures-to-stock volume ratio (F/S). By buying stocks with low F/S and selling stocks with high F/S, we form an investment portfolio. The aim is to investigate whether the F/S trading strategy can serve as a reference for countries with active stock futures trading.

2.4 Traditional Investment Portfolio Strategies

In this study, we adopt the "52-Week High" strategy proposed by Huang and Wu (2020) based on the concept introduced by George and Hwang (2004). This strategy uses the past 52-week high price of individual stocks as an indicator and evaluates the investment direction based on the distance between the current stock price and its highest price.

We also combine the "Trading Volume Momentum" strategy and the "Price Momentum" strategy introduced by Lee and Swaminathan (2000) to construct a two-dimensional strategy. Additionally, we examine the performance of the "Price Momentum" strategy by Jegadeesh and Titman (1993) in conjunction with the "Insider Silence" strategy, "O/S" strategy, and "F/S" strategy used in this study.

By analyzing the performance of these strategies, we aim to evaluate the effectiveness of the "Insider Silence" strategy, "O/S" strategy, and "F/S" strategy in comparison to the three traditional strategies mentioned above.

This study is based on the "Price Momentum" strategy by Jegadeesh and Titman (1993), which divides stocks into winners and losers based on past returns and constructs long positions in past losers and short positions in past winners. Building on this, Lee and Swaminathan (2000) combined the concepts of stock price momentum and trading volume momentum to observe the momentum and reversal phenomena in the long-term holdings of various investment portfolios. Based on past returns and trading volume rankings, this study constructs investment portfolios. The traditional investment portfolios based on price momentum and trading volume momentum are used as benchmarks to investigate whether the profitability of the "Insider Silence," "O/S," and "F/S" strategies surpasses that of traditional investment portfolio strategies.

3. Data and Methodology

3.1 Data

Stock returns are obtained from the Taiwan Economic Journal (TEJ) price database, using unadjusted monthly stock prices. The TEJ database provides data on company information and insider trading activities. Insiders are defined as directors, supervisors, managers, and shareholders holding more than 10% of the total shares of a company. Individual stock futures and options data are obtained from the TEJ database on derivative financial products. The sample period covers from January 2010 to December 2021, comprising a total of 144 months. Companies with missing data are excluded from the sample, resulting in a final sample size of 5,328 observations. The data that satisfy any of the following criteria are included by: First, listed companies with individual stock futures and options; second, companies with stock futures and options trading available from January 1, 2010, to December 31, 2021; third, incomplete data during the study period were excluded from the sample; fourth, stock prices greater than $1.

3.2 Methodology

3.2.1 Formation Period and Holding Period

Following Huang and Wu (2020) and Lee and Swaminathan (2000), we adopt the formation periods of 1, 3, 6, and 12 months. The holding periods consist of 1, 3, 6, 12, and 24 months, forming a combination of cross-sectional portfolios.

For each strategy under investigation, the variables are examined over the formation period of J months. The sample is divided into three groups of investment portfolios. The returns of the portfolios are calculated using the product method by buying and holding (selling) the portfolios for K months.

$$CAR_{i,t}^{J,K} = \prod_{j=t+1}^{t+K} \left(1 + R_{i,j}\right) - 1, \ K = 1, \ 3, \ 6, \ 12, \ 24 \tag{1}$$

where K represents the number of holding months, $CAR_{i,t}^{J,K}$ represents the cumulative return of the i-th stock during the (J, K) formation and holding period in the t-th period, $R_{i,j}$ represents the monthly return of the i-th stock in the j-th period.

To increase the statistical power and draw upon the research methods of George and Hwang (2004), we employ an overlapping sample design. By using overlapping periods, we enrich the sample, enhance the explanatory power and minimize errors in order to test the effectiveness of momentum strategies. Figure 1 illustrates the concept of overlapping periods. For example, when the formation period and the holding period are 6 months, the first portfolio group spans from January 2010 to January 2011, the second portfolio group from February 2010 to February 2011, and so forth.

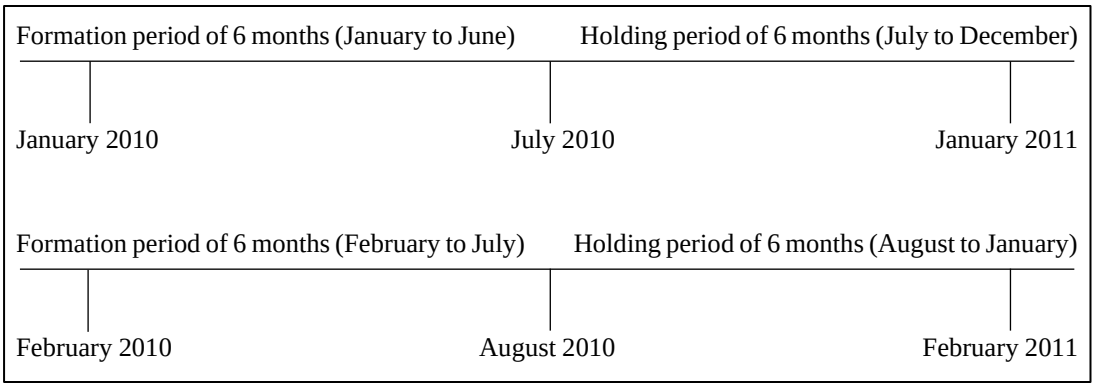

Figure 1: Illustration of Overlapping Periods

3.2.2 Silent Insider Strategy

According to Gao et al. (2021), the net insider demand $(NID_{j,m})$ for the j-th month during the past m months is defined as the total number of stocks purchased by insider traders minus the total number of stocks sold by insiders within the past m months. It is then normalized by the outstanding shares at month j-1

$$NID_{j,m} = \frac{number\ of\ shares\ insiders\ buy_{j-m,j-1} - number\ of\ shares\ insiders\ sell_{j-m,j-1}}{number\ of shares\ outstanding_{j-1}} \quad (2)$$

where $NID_{j,m}$ represents the net insider demand for the jth month within the past m months, $number\ of\ shares\ insiders\ buy_{j-m,j-1}$ refers to the total number of shares insiders purchased during the past m months, $number\ of\ shares\ insiders\ sell_{j-m,j-1}$ refers to the total number of shares insiders sold during the past m months, $number\ of\ shares\ outstanding_{j-1}$ refers to the standardized total number of outstanding shares in the j-1 month (total shares available for trading).

Following Gao et al. (2021), we group stocks based on the insider trading activities over the past twelve months. Stocks that have not experienced any insider trading activities during the past twelve months are classified into the "Insider Silence" (IS) group. Stocks with positive or zero net insider demand (NID) are classified into the "Net Buy" (NB) group, while stocks with negative NID are classified into the "Net Sell" (NS) group. Then, we construct investment portfolios, which buy the NS group and sell the IS group. Additionally, another investment portfolio is constructed by buying the NB group and selling the IS group. The performance of these portfolios is then compared to the traditional insider trading portfolio, which involves buying the NB group and selling the NS group.

3.2.3 Option-Stock Trading Volume Ratio (O/S) strategy

Based on Johnson and So (2012), where low option-to-stock trading volume ratio (OS) companies outperform the market while high O/S companies perform poorly, we established long positions for the bottom 33% of companies (R_{OSL}) and short positions for the top 33% of companies (R_{OSL}) to investigate the profitability of O/S strategy. We calculate the option-to-stock trading volume ratio for company i in month t as follow:

$$O/S_{i,t} = \frac{OPVOL_{i,t}}{STVOL_{i,t}} \tag{3}$$

where $OPVOL_{i,t}$ represents the total trading volume of option contracts for company i in month t, $STVOL_{i,t}$ represents the total trading volume of stocks for company i in month t.

3.2.4 The Futures-to-Stock Volume Ratio (F/S) strategy

Based on the concept of "O/S", the Futures-to-Stock Volume Ratio (F/S) is defined as the ratio of futures trading volume to stock trading volume for company i in month t ($FS_{i,t}$). Johnson and So (2012) argue that companies with low O/S outperform the market, while those with high O/S underperform. Therefore, in this study, the lowest 33% of companies (R_{FSL}) are selected for long positions, and the highest 33% of companies(R_{FSH}) are selected for short positions to examine the profitability of the F/S strategy.

The calculation of $F/S_{i,t}$ involves the ratio of trading volume between futures and stocks in month t:

$$F/S_{i,t} = \frac{FUVOL_{i,t}}{STVOL_{i,t}} \tag{4}$$

where $FUVOL_{i,t}$ represents the total trading volume of futures contracts for company i in month t, $STVOL_{i,t}$ represents the total trading volume of stocks for company i in month t.

3.2.5 Price Momentum Strategy

Momentum strategy is based on the methodology proposed by Jegadeesh and Titman (1993). The top 33% of stocks with the highest returns are defined as the winner portfolio (R_{RW}), while the bottom 33% of stocks with the lowest returns are defined as the loser portfolio (R_{RL}). The investment portfolio is constructed by buying the winner portfolio and selling the loser portfolio to examine its profitability.

$$R_{i,t} = \ln\left(P_{i,t}/P_{i,t-1}\right) \tag{5}$$

where $P_{i,t}$ represents the closing price of stock i at time point t, $P_{i,t-1}$ represents the closing price of stock i in the previous period, $R_{i,t}$ represents the return of stock i at time point t.

In the constrain strategy, the loser portfolio (R_{RL}) is bought while the winner portfolio(R_{RW})is sold.

3.2.6 Trading Volume Momentum Strategy

The trading volume momentum strategy involves classifying stocks based on their cumulative trading volume from highest to lowest. The top 33% of stocks with the highest trading volume are classified as high-volume stocks(R_{Sh}), while the bottom 33% of stocks with the lowest trading volume are classified as low-volume stocks (R_{SL}) The strategy compares the monthly trading volume of individual stocks with their total trading volume over the past year.

$$TOR_{i,t}^{stock} = \frac{V_{i,t}^{stock}}{O_{i,t}^{stock}} \tag{6}$$

Where $V_{i,t}^{stock}$stock represents the trading volume of i-th stock in the t-th month, $O_{i,t}^{stock}$stock represents the total trading volume of i-th stock over the past year, $TOR_{i,t}^{stock}$stock represents the trading volume momentum of i-th stock in the t-th month.

3.2.7 52-week high strategy

The 52-week high strategy, based on the methodology proposed by George and Hwang (2004), involves evaluating the proximity of the current stock price to its highest price in the past 52 weeks. Stocks that are closest to their 52-week high, representing the top 33%, are selected for long positions (R_{Hh}), while stocks that are relatively far from their 52-week high, representing the bottom 33%, are selected for short positions (R_{HL}). The proximity is measured by comparing each stock's closing price in period t-1 to its highest price in the previous 52 weeks.

$$\frac{P_{i,t-1}}{high_{i,t-1}} \tag{7}$$

Where $P_{i,t-1}$ is the closing price of stock i in period t-1, $high_{i,t-1}$ is the 52-week high price of stock i in period t-1.

4. Empirical Results

Table 1 presents descriptive statistics for net insider demand. Following Gao et al. (2021), we categorize the stocks that have not undergone insider trading activities in the past twelve months as the "Insider Silence" (IS) group. Stocks with positive net insider demand (NID) form the "Net Buy" (NB) group, while those with negative NID constitute the "Net Sell" (NS) group. Average values of NID in 2011, 2013, and 2018 are negative, while during other periods, they are positive. This suggests that insiders may have sold their stocks, possibly influenced by events such as the 2011 Eurozone crisis, the 2013 Abenomics "three arrows" plan, and the 2018 U.S.-China trade war.

Table 1: Descriptive statistics

Year	Sample	Average	Median	P25	P75	SD
2010	444	2.34E-04	0	-6.88E-05	2.02E-07	95.176
2011	444	-6.55E-05	0	-3.13E-05	5.24E-06	95.2234
2012	444	5.63E-05	0	-7.46E-06	0	95.2707
2013	444	-2.25E-05	0	-1.50E-05	0	95.3181
2014	444	1.50E-06	0	-1.95E-05	0	95.3654
2015	444	2.78E-05	0	-1.72E-05	5.79E-08	95.4128
2016	444	1.68E-05	0	-3.16E-06	0	95.4601
2017	444	4.73E-06	0	-4.59E-07	0	95.5075
2018	444	-7.50E-06	0	-1.66E-06	0	95.5548
2019	444	4.50E-05	0	0	0	95.6022
2020	444	1.60E-05	0	0	0	95.6495
2021	444	8.83E-06	0	0	0	95.6969
Average	444	2.63E-05	0	-1.37E-05	4.58E-07	95.4364

Table 2 displays the average net insider demand (NID) and the proportion of companies in the "Silence" (SIL), "Buy," and "Sell" groups under different definition of insider silence. If a company's insiders have not traded in the past m months, the company is classified into the "Silence" group. If there is a net insider buying activity in the past m months (1, 3, 6, 12), the company belongs to the "Buy" group, whereas if there is a net insider selling activity in the past m months, it falls into the "Sell" group. The sample period spans from January 2010 to December 2021, totaling 144 months. We exclude companies with missing individual stock data, resulting in a final sample of 5,328 observations. In Table 2, insider silences average around 50%. Specifically, in the past one month insider trading, the proportion of companies in the "Silent" group is 52.75%, indicating infrequent insider trading. 15.35% of companies have a net buying activity, and 31.90% of companies have a net selling activity. The proportion of silent companies decreases to 52.10% over time. This trend is somewhat similar to the empirical analysis of the U.S. stock market conducted by Gao et al. (2021), where the percentage of insider silence gradually decreases over time.

Table 2: Insider silence frequency

	NID	SIL	Buy	Sell
1	6.08E-06	52.75%	15.35%	31.90%
3	5.25E-06	52.60%	15.35%	32.05%
6	4.66E-06	52.54%	15.26%	32.20%
12	8.12E-06	52.10%	15.42%	32.47%

Table 3 shows the holding returns for the three insider trading strategies. First strategy, based on the method explored by Gao et al. (2021), involves buying the “insider sale” group and selling the “insider silence” group. Second strategy is to buy the “insider purchase” group and to sell the “insider silence” group. Third strategy involves buying the “insider purchase” group and selling the “insider sale” group. Panel A presents the returns of “buying insider sales and selling insider silence” for different holding periods under various formation periods. Empirical results demonstrate that the investment portfolios based on insider silence outperform the portfolios based on insider selling across various formation periods. However, the strategy’s performance is significantly lower with lower statistical significance for formation periods of 1, 3, and 6 months. For a formation period of 12 months and a holding period of 12 months, the strategy exhibits a significant positive return at a 10% significance level, with a profit of 1.58%. Comparing the results between formation periods with K=12 and K=3, the strategy shows a return difference of 1.589%. Therefore, we can infer that the strategy based on insider silence is more suitable for longer formation and holding periods (longer-term investments). According to Gao et al. (2021), litigation risk and insider silence are negatively correlated with future stock returns, and companies with insider silence exhibit lower abnormal returns than companies with insider selling. Nevertheless, we find that in Taiwan stock market, companies with insider silence have higher abnormal returns than companies with insider selling. This indicates that Taiwanese companies face lower litigation risk and have less stringent regulations on insider trading compared to the United States, leading to the different results. Panel B presents the returns of "buying insider purchases and selling insider silence" strategy for different formation periods and holding periods. Empirical results show that regardless of the formation period, the investment portfolios of the "insider purchases" strategy consistently outperform the portfolios of the "insider silence" group. As the holding period extends, the profitability gradually increases. For example, with a formation period of 3 months and a holding period of 24 months, the strategy's profitability exceeds zero at a significance level of 5% and reaches 3.15%. When comparing the strategy's returns between K=24 and the shorter K=1, there is a difference of 2.72% in strategy returns. Thus, it can be inferred that the "buying purchases and selling silence" strategy is more suitable for long-term investments. Panel C presents the returns of the "buying insider purchases and selling insider sales" strategy for different formation periods and holding periods.

Empirical results show that for all formation periods and holding periods, the investment portfolios of the "insider purchases" group consistently outperform the portfolios of the "insider sales" group. Moreover, as the holding period extends, the profitability gradually increases. For example, with a formation period of 1 month and a holding period of 24 months, the strategy's profitability exceeds zero at a significance level of 10% and reaches 3.25%. When comparing the strategy's returns between K=24 and the shortest K=1, there is a difference of 2.7% in strategy returns. Therefore, "buying purchases and selling sales" strategy is more effective for long-term investments.

Table 3: The performance of Insider silence strategy

Panel A							
			Average monthly returns for holding K months				
			K=1	**K=3**	**K=6**	**K=12**	**K=24**
J=1	R_{NS}	μ	0.0027	0.0090	0.0169*	0.0212*	0.0256
		p	0.2680	0.1389	0.0866	0.0995	0.1185
	R_{IS}	μ	0.0033	0.0088*	0.0182**	0.0317**	0.0301**
		p	0.1898	0.0832	0.0248	0.0123	0.0206
	$R_{NS} - R_{IS}$	μ	-0.0006	0.0001	-0.0013	-0.0104	-0.0045
		p	0.4061	0.4877	0.4306	0.1554	0.3818
J=3	R_{NS}	μ	0.0022	0.0059	0.0153	0.0138	0.0290
		p	0.3188	0.2375	0.1139	0.2075	0.1005
	R_{IS}	μ	0.0036	0.0092*	0.0185**	0.0307**	0.0280**
		p	0.1664	0.0805	0.0286	0.0145	0.0272
	$R_{NS} - R_{IS}$	μ	-0.0015	-0.0033	-0.0031	-0.0169*	0.0010
		p	0.2946	0.2374	0.3206	0.0604	0.4751
J=6	R_{NS}	μ	0.0029	0.0073	0.0141	0.0179	0.0386*
		p	0.2537	0.1960	0.1127	0.1474	0.0546
	R_{IS}	μ	0.0039	0.0107*	0.0187**	0.0262**	0.0278**
		p	0.1522	0.0559	0.0318	0.0290	0.0274
	$R_{NS} - R_{IS}$	μ	-0.0010	-0.0034	-0.0046	-0.0083	0.0108
		p	0.3434	0.2267	0.2462	0.2198	0.2571
J=12	R_{NS}	μ	-0.0001	-0.0027	0.0078	0.0338**	0.0556***
		p	0.4908	0.3685	0.2626	0.0350	0.0067
	R_{IS}	μ	0.0032	0.0062	0.0096	0.0180*	0.0343**
		p	0.2180	0.1813	0.1498	0.0873	0.0145
	$R_{NS} - R_{IS}$	μ	-0.0033	-0.0090**	-0.0018	0.0158*	0.0213*
		p	0.1147	0.0430	0.4009	0.0717	0.0690

Panel B							
			Average monthly returns for holding K months				
			K=1	**K=3**	**K=6**	**K=12**	**K=24**
J=1	R_{NB}	μ	0.0080**	0.0201***	0.0314***	0.0495***	0.0581***
		p	0.0334	0.0034	0.0049	0.0016	0.0014
	R_{IS}	μ	0.0033	0.0088*	0.0182*	0.0317**	0.0301**
		p	0.1898	0.0832	0.0959	0.0123	0.0206
	$R_{NB} - R_{IS}$	μ	0.0047*	0.0112**	0.0132**	0.0178*	0.0280*
		p	0.0767	0.0194	0.0393	0.0783	0.0509
J=3	R_{NB}	μ	0.0079**	0.0172***	0.0227**	0.0401***	0.0596***
		p	0.0277	0.0057	0.0103	0.0059	0.0017
	R_{IS}	μ	0.0036	0.0092*	0.0185**	0.0307**	0.0280**
		p	0.1664	0.0805	0.0286	0.0145	0.0272
	$R_{NB} - R_{IS}$	μ	0.0043*	0.0080**	0.0042	0.0094	0.0315**
		p	0.0713	0.0270	0.2741	0.2202	0.0329
J=6	R_{NB}	μ	0.0047	0.0097*	0.0165*	0.0310**	0.0554***
		p	0.1220	0.0790	0.0511	0.0282	0.0030
	R_{IS}	μ	0.0039	0.0107*	0.0187**	0.0262**	0.0278**
		p	0.1522	0.0559	0.0318	0.0290	0.0274
	$R_{NB} - R_{IS}$	μ	0.0009	-0.0011	-0.0022	0.0049	0.0275*
		p	0.3681	0.4855	0.3827	0.3484	0.0526
J=12	R_{NB}	μ	0.0028	0.0085	0.0134	0.0320**	0.0502***
		p	0.2691	0.1432	0.1201	0.0162	0.0042
	R_{IS}	μ	0.0032	0.0062	0.0096	0.0180*	0.0343**
		p	0.2180	0.1813	0.1498	0.0873	0.0145
	$R_{NB} - R_{IS}$	μ	-0.0004	0.0022	0.0039	0.0140*	0.0159
		p	0.4540	0.3418	0.3164	0.0939	0.1659
Panel C							
			Average monthly returns for holding K months				
			K=1	**K=3**	**K=6**	**K=12**	**K=24**
J=1	R_{NB}	μ	0.0080**	0.0201***	0.0314***	0.0495***	0.0581***
		p	0.0334	0.0034	0.0011	0.0014	0.0014
	R_{NS}	μ	0.0027	0.0090	0.0169*	0.0212*	0.0256
		p	0.2680	0.1389	0.0866	0.0995	0.1185
	$R_{NB} - R_{NS}$	μ	0.0053*	0.0111*	0.0145*	0.0282**	0.0325*
		p	0.0807	0.0502	0.0664	0.0308	0.0566
J=3	R_{NB}	μ	0.0079**	0.0172***	0.0227**	0.0401***	0.0596***
		p	0.0277	0.0057	0.0103	0.0059	0.0017
	R_{NS}	μ	0.0022	0.0059	0.0153	0.0138	0.0290
		p	0.3188	0.2375	0.1139	0.2075	0.1005
	$R_{NB} - R_{NS}$	μ	0.0057*	0.0113**	0.0074	0.0263**	0.0306*
		p	0.0613	0.0328	0.2279	0.0460	0.0717
J=6	R_{NB}	μ	0.0047	0.0097*	0.0165*	0.0310**	0.0554***
		p	0.1220	0.0790	0.0511	0.0282	0.0030
	R_{NS}	μ	0.0029	0.0073	0.0141	0.0179	0.0386*

		p	0.2537	0.1960	0.1127	0.1474	0.0546
	$R_{NB} - R_{NS}$	μ	0.0019	0.0024	0.0024	0.0132	0.0167
		p	0.2884	0.3484	0.4004	0.1874	0.2279
J=12	R_{NB}	μ	0.0028	0.0085	0.0134	0.0320**	0.0502***
		p	0.2691	0.1432	0.1201	0.0162	0.0042
	R_{NS}	μ	-0.0001	-0.0027	0.0078	0.0338**	0.0556***
		p	0.4908	0.3685	0.2626	0.0350	0.0067
	$R_{NB} - R_{NS}$	μ	0.0029	0.0112*	0.0057	-0.0018	-0.0054
		p	0.2235	0.0564	0.2895	0.4479	0.3984

Note: P-value is reported in parentheses. ***, **, and * denote significant at 1%, 5%, and 10% level.

We analyze the investment performance of the OS (Option-to-Stock) strategy in the Taiwan stock market. The OS strategy is based on the monthly ratio of option trading volume to stock trading volume. We construct an investment portfolio strategy by buying stocks with the lowest O/S ratio group and selling stocks with the highest O/S ratio group. In recent years, the proportion of retail investors trading options in the US options market has reached one-fourth. The popularity of options trading is due to its lower costs compared to traditional brokerage services, as it does not require direct contact with brokers and has lower transaction fees. Although the options market in the US is highly active, Huang and Wu (2020) show that in the highly liquid NASDAQ100 market, the OS strategy may not be as profitable in the short term but can generate profits for investors with a holding period of one year or more. In comparison, Taiwanese investors tend to trade stocks more frequently and may be less familiar with the futures and options. The liquidity of the stock options market in Taiwan is relatively lower and we examine the OS strategy's performance in the Taiwanese market. Table 4 presents the holding returns of the OS strategy under various formation periods and different holding periods. We find that the investment portfolio with the highest O/S ratio consistently outperforms the portfolio with the lowest O/S ratio across different formation periods. For example, with a formation period of 12 months and a holding period of 12 months, the strategy of buying the portfolio with the lowest O/S ratio and selling the portfolio with the highest O/S ratio generates a negative return of -2.06% at the 5% significance level. The negative effect is more pronounced when the holding period is greater.

Table 4: The performance of OS strategy

			Average monthly returns for holding K months				
			K=1	**K=3**	**K=6**	**K=12**	**K=24**
J=1	R_{OSL}	μ	0.0079**	0.0156**	0.0265***	0.0447***	0.0473***
		p	0.0281	0.0212	0.0062	0.0010	0.0006
	R_{OSH}	μ	0.0000	0.0048	0.0108	0.0290**	0.0364**
		p	0.4971	0.2353	0.1339	0.0251	0.0298
	$R_{OSL} - R_{OSH}$	μ	0.0079***	0.0108***	0.0158***	0.0156**	0.0109
		p	0.0015	0.0043	0.0023	0.0367	0.2216
J=3	R_{OSL}	μ	0.0388	0.0104*	0.0239**	0.0383***	0.0431***
		p	0.2009	0.0845	0.0108	0.0021	0.0015
	R_{OSH}	μ	-0.0032	0.0068	0.0136*	0.0333**	0.0364**
		p	0.2161	0.1619	0.0855	0.0189	0.0291
	$R_{OSL} - R_{OSH}$	μ	0.0420	0.0036	0.0103**	0.0049	0.0067
		p	0.4288	0.1732	0.0375	0.2979	0.3210
J=6	R_{OSL}	μ	0.0038	0.0130**	0.0241***	0.0318***	0.0428***
		p	0.1729	0.0427	0.0072	0.0067	0.0020
	R_{OSH}	μ	0.0025	0.0072	0.0154*	0.0374**	0.0375**
		p	0.2522	0.1405	0.0679	0.0130	0.0257
	$R_{OSL} - R_{OSH}$	μ	0.0013	0.0058*	0.0087*	-0.0056	0.0053
		p	0.3157	0.0871	0.0747	0.2805	0.3599
J=12	R_{OSL}	μ	0.0031	0.0071	0.0099	0.0204*	0.0388***
		p	0.2295	0.1587	0.1466	0.0584	0.0040
	R_{OSH}	μ	0.0044	0.0105*	0.0219**	0.0411***	0.0518***
		p	0.1327	0.0718	0.0272	0.0095	0.0047
	$R_{OSL} - R_{OSH}$	μ	-0.0013	-0.0034	-0.0119**	-0.0206**	-0.0129
		p	0.3105	0.2199	0.0471	0.0248	0.2055

Note: P-value is reported in parentheses. ***, **, and * denote significant at 1%, 5%, and 10% level.

According to Johnson and So (2012), in the U.S. market, the companies with low O/S ratios outperform the market, while those with high O/S ratios underperform. They construct a portfolio strategy of buying low O/S ratio stocks and selling high O/S ratio stocks. In this study, we find that individual stock futures in Taiwan are more commonly used as tools for hedging against spot positions. The low liquidity and high leverage of futures make investors prefer trading stocks rather than futures and options. Therefore, we extend the O/S ratio concept to construct a portfolio strategy defined as buying low F/S ratio stocks and selling high F/S ratio stocks to investigate the differences of performance between the strategies based on FS and OS. Table 5 displays the holding returns of the FS strategy under various formation periods and holding periods. Empirical results present that the holding returns of the highest F/S portfolio are significantly superior to those of the lowest F/S portfolio across different formation periods. Taking the example of a 12-month formation period and holding period, at a 1% significance level, the holding return is significantly negative (-4.55%). When the holding period is greater, the negative effect becomes more pronounced. In other words, the longer holding period is associated with the greater loss.

Table 5: The performance of FS strategy

			Average monthly returns for holding K months				
			K=1	**K=3**	**K=6**	**K=12**	**K=24**
J=1	R_{FSL}	μ	0.0025	0.0071	0.0132*	0.0137	0.0044
		p	0.2401	0.1191	0.0615	0.1044	0.3525
	R_{FSH}	μ	0.0030	0.0105*	0.0197*	0.0356**	0.0344*
		p	0.2456	0.0986	0.0559	0.0334	0.0619
	$R_{FSL} - R_{FSH}$	μ	-0.0005	-0.0034	-0.0066	-0.0219*	-0.0300*
		p	0.4346	0.2855	0.2474	0.0721	0.0571
J=3	R_{FSL}	μ	0.0022	0.0059	0.0106	0.0081	0.0000
		p	0.2660	0.1679	0.1180	0.2240	0.4992
	R_{FSH}	μ	0.0045	0.0108*	0.0178*	0.0357**	0.0359 *
		p	0.1515	0.0944	0.0732	0.0346	0.0518
	$R_{FSL} - R_{FSH}$	μ	-0.0024	0.0049	-0.0072	-0.0275**	-0.0360**
		p	0.2299	0.2140	0.2184	0.0309	0.0253
J=6	R_{FSL}	μ	0.0020	0.0047	0.0070	0.0011	-0.0007
		p	0.2850	0.2231	0.2126	0.4601	0.4761
	R_{FSH}	μ	0.0044	0.0093	0.0165*	0.0370**	0.0387**
		p	0.1570	0.1232	0.0876	0.0288	0.0383
	$R_{FSL} - R_{FSH}$	μ	-0.0024	-0.0046	-0.0095	-0.0359***	-0.0395**
		p	0.2285	0.2065	0.1372	0.0057	0.0156
J=12	R_{FSL}	μ	0.0000	-0.0005	-0.0036	-0.0028	0.0136
		p	0.4991	0.4701	0.3407	0.4045	0.1460
	R_{FSH}	μ	0.0055	0.0108	0.0235**	0.0427**	0.0515**
		p	0.1111	0.1019	0.0273	0.0114	0.0116
	$R_{FSL} - R_{FSH}$	μ	-0.0055**	-0.0112**	-0.0272***	-0.0455***	-0.0378**
		p	0.0451	0.0242	0.0008	0.0005	0.0232

Note: P-value is reported in parentheses. ***, **, and * denote significant at 1%, 5%, and 10% level.

Based on the price momentum strategy, the companies with the highest 33% returns are defined as the winner portfolio, while those with the lowest 33% returns are defined as the loser portfolio. The price momentum strategy is constructed by buying the winner portfolio and selling the loser portfolio. Table 6 shows that in all the formation period, the performance of this strategy is not good. Taking the example of a 6-month formation period and holding for 1 month, the return is significantly negative (-0.51%) at the 5% significance level. Huang and Wu (2020) use the constituents of the US NASDAQ100 and find that the effectiveness of the price momentum strategy increases with the holding period. Nonetheless, we use the sample of Taiwan stock market and find that the loser portfolio exhibits a more significant and pronounced positive return compared to the winner portfolio. Specifically, with a formation period of 12 months and holding for 24 months, the loser portfolio achieves a significantly positive return (3.48%) at the 1% significance level. This is consistent with De Bondt and Thaler (1985), which argue that markets exhibit irrational overreaction, suggesting that the "loser" portfolio outperforms the "winner" portfolio. Investors can, therefore, utilize a contrarian strategy to gain excess returns.

Table 6: The performance of price momentum strategy

			Average monthly returns for holding K months				
			K=1	**K=3**	**K=6**	**K=12**	**K=24**
J=1	R_{RW}	μ	0.0039	0.0092	0.0177*	0.0289**	0.0258*
		p	0.1794	0.1034	0.0527	0.0373	0.0779
	R_{RL}	μ	0.0019	0.0077	0.0156*	0.0240*	0.0226
		p	0.3255	0.1535	0.0643	0.0560	0.1046
	$R_{RW} - R_{RL}$	μ	0.0019	0.0015	0.0021	0.0049	0.0032
		p	0.2738	0.3812	0.3921	0.3402	0.4202
J=3	R_{RW}	μ	0.0029	0.0056	0.0159*	0.0218*	0.0264*
		p	0.2375	0.2324	0.0962	0.0803	0.0748
	R_{RL}	μ	0.0035	0.0111*	0.0182**	0.0201	0.0239
		p	0.2103	0.0637	0.0339	0.1016	0.1033
	$R_{RW} - R_{RL}$	μ	-0.0006	-0.0550	-0.0023	0.0017	0.0025
		p	0.4219	0.1465	0.3906	0.4444	0.4375
J=6	R_{RW}	μ	0.0011	0.0102	0.0158*	0.0174	0.0266*
		p	0.3961	0.1059	0.0881	0.1313	0.0773
	R_{RL}	μ	0.0062*	0.0094	0.0163*	0.0205*	0.0263*
		p	0.0684	0.1015	0.0592	0.0967	0.0900
	$R_{RW} - R_{RL}$	μ	-0.0051**	0.0009	-0.0005	-0.0031	0.0003
		p	0.0488	0.4399	0.4756	0.3972	0.4920
J=12	R_{RW}	μ	0.0019	0.0014	0.0031	0.0186	0.0380**
		p	0.3190	0.4240	0.3864	0.1122	0.0184
	R_{RL}	μ	0.0014	0.0024	0.0058	0.0169	0.0348**
		p	0.3696	0.3848	0.3054	0.1460	0.0435
	$R_{RW} - R_{RL}$	μ	0.0004	-0.0010	-0.0027	0.0017	0.0033
		p	0.4377	0.4294	0.3619	0.4385	0.4213

Note: P-value is reported in parentheses. ***, **, and * denote significant at 1%, 5%, and 10% level.

We also formulate an investment strategy based on the historical trading volumes of individual stocks. This strategy compares the monthly and annual total trading volumes to construct a portfolio and evaluate its profitability. We define high and low trading volumes as the top 33% and bottom 33%, respectively. The strategy includes buying stocks with the highest 33% trading volume and selling stocks with the lowest 33% trading volume. Table 7 reveals that, under a 1-month formation period and a holding period of 1 month, the strategy's effect is significantly positive (0.36%) at a 10% significance level. Nevertheless, as the holding period increases, the profitability gradually decreases. If we adjust the portfolio to be a 1-month formation period and a 24-month holding period, the strategy's effect is significantly negative (-5.2%) at a 1% significance level. These results suggest that the trading volume momentum strategy can be applied to the Taiwan stock market in short-term holding period. This is similar with Huang and Wu (2020), who examine the US NASDAQ100 component stocks and observe that the strategy could not generate significant profits with an increase in the formation and holding periods.

Table 7: The performance of volume momentum strategy

			Average monthly returns for holding K months				
			K=1	**K=3**	**K=6**	**K=12**	**K=24**
J=1	R_{SH}	μ	0.0047	0.0135**	0.0246**	0.0209**	-0.0022
		p	0.1402	0.0394	0.0375	0.0441	0.4480
	R_{SL}	μ	0.0011	0.0033	0.0103	0.0344***	0.0498***
		p	0.3815	0.3187	0.3107	0.0043	0.0019
	$R_{SH} - R_{SL}$	μ	0.0036*	0.0102**	0.0143**	-0.0135*	-0.0520***
		p	0.0897	0.0168	0.0354	0.0939	0.0000
J=3	R_{SH}	μ	0.0040	0.0102	0.0194*	0.0090	-0.0032
		p	0.1803	0.1098	0.0559	0.2944	0.4254
	R_{SL}	μ	0.0008	0.0055	0.0150**	0.0381***	0.0488***
		p	0.4227	0.2090	0.0457	0.0012	0.0029
	$R_{SH} - R_{SL}$	μ	0.0032	0.0047	0.0044	-0.0291***	-0.0520***
		p	0.1161	0.1846	0.2890	0.0038	0.0000
J=6	R_{SH}	μ	0.0033	0.0103	0.0097	0.0028	0.0034
		p	0.2290	0.1097	0.1963	0.4331	0.4242
	R_{SL}	μ	0.0024	0.0064	0.0204**	0.0358***	0.0506***
		p	0.2611	0.1572	0.0117	0.0023	0.0036
	$R_{SH} - R_{SL}$	μ	0.0009	0.0039	-0.0106*	-0.0330***	-0.0472***
		p	0.3741	0.2336	0.0651	0.0005	0.0004
J=12	R_{SH}	μ	-0.0010	-0.0053	-0.0045	0.0043	0.0290*
		p	0.4000	0.2511	0.3489	0.3933	0.0588
	R_{SL}	μ	-0.0053	0.0123**	0.0178**	0.0323**	0.0416**
		p	0.1055	0.0319	0.0313	0.0197	0.0183
	$R_{SH} - R_{SL}$	μ	-0.0063**	-0.0176***	-0.0223***	-0.0280***	-0.0126
		p	0.0133	0.0002	0.0009	0.0028	0.2054

Note: P-value is reported in parentheses. ***, **, and * denote significant at 1%, 5%, and 10% level.

We utilize monthly data on individual stock price 52-week highs to examine their proximity to the past highest prices and form investment portfolios. The strategy defines the top 33% of stocks closest to their 52-week highs as the buy-in portfolio and the bottom 33% as the sell-out portfolio. Table 8 indicates that with a formation period of 1 month and a holding period of 3 months, returns are significantly positive (0.89%) at the 10% significance level. As the holding period extends, the profits gradually disappear. For a formation period of 6 months and a holding period of 12 months, returns are significantly negative (-3.91%) at the 1% significance level. Therefore, the 52-week high strategy is more suitable for short-term investments. Huang and Wu (2020), based on the U.S. stock market, argue that as the holding period lengthens, profits gradually diminish, which is consistent with our findings in Taiwan stock market.

Table 8: The performance of 52-week high strategy

			Average monthly returns for holding K months				
			K=1	**K=3**	**K=6**	**K=12**	**K=24**
J=1	R_{HH}	μ	0.0067**	0.0143**	0.0231***	0.0215**	0.0206*
		p	0.0321	0.0123	0.0090	0.0318	0.0530
	R_{HL}	μ	0.0013	0.0054	0.0134	0.0359**	0.0371*
		p	0.3944	0.2569	0.1260	0.0242	0.0558
	$R_{HH} - R_{HL}$	μ	0.0054*	0.0089*	0.0097	-0.0144	-0.0165
		p	0.0687	0.0890	0.1573	0.1487	0.1923
J=3	R_{HH}	μ	0.0029	0.0098*	0.0141*	0.0069	0.0179*
		p	0.2099	0.0806	0.0596	0.2707	0.0905
	R_{HL}	μ	0.0033	0.0086	0.0195*	0.0402**	0.0321*
		p	0.2516	0.1520	0.0578	0.0157	0.0866
	$R_{HH} - R_{HL}$	μ	-0.0003	0.0012	-0.0054	-0.0333***	-0.0142
		p	0.4651	0.4274	0.2842	0.0090	0.2308
J=6	R_{HH}	μ	0.0042	0.0068	0.0087	0.0013	0.0218*
		p	0.1334	0.1398	0.1456	0.4553	0.0518
	R_{HL}	μ	0.0039	0.0101	0.0240**	0.0404**	0.0300
		p	0.2107	0.1225	0.0318	0.0183	0.1069
	$R_{HH} - R_{HL}$	μ	0.0003	-0.0033	-0.0153**	-0.0391***	-0.0082
		p	0.4661	0.2955	0.0481	0.0027	0.3394
J=12	R_{HH}	μ	-0.0005	-0.0035	-0.0061	0.0068	0.0408***
		p	0.4443	0.2902	0.2472	0.2841	0.0008
	R_{HL}	μ	0.0040	0.0081	0.0164	0.0302*	0.0238
		p	0.2070	0.1837	0.1181	0.0755	0.1613
	$R_{HH} - R_{HL}$	μ	-0.0045*	-0.0116**	-0.0225**	-0.0234*	0.0170
		p	0.0928	0.0335	0.0116	0.0665	0.1888

Note: P-value is reported in parentheses. ***, **, and * denote significant at 1%, 5%, and 10% level.

Table 9 compares the investment performance of "buying insider sales and selling insider silence" strategy with those on OS, FS, price momentum, volume momentum, and 52-week high strategies. Panel A presents the comparison between the performance of this insider strategy and OS strategy. Taking the example of a 12-month formation period and holding for 12 months, the return difference between two strategies is significantly positive (3.64%) at a 5% significance level. Comparing the shortest holding periods of K=1 and J=12, the strategy return difference is 3.84%. Therefore, we infer that the "buying insider sales and selling insider silence" strategy is superior to the OS strategy in long-term investment. Panel B shows the comparison between the performance of this insider strategy and FS strategy. Using a 12-month formation period and holding for 12 months as an example, the return difference between two strategies is significantly positive (6.13%) at a 1% significance level. Thus, "buying insider sales and selling insider silence" strategy is better than the FS strategy in long-term investment. Panel C shows that, compared with the price momentum strategy, this insider strategy is

unable to profit. Specifically, the longer the holding period, the greater the loss. In Panel D, we compare this insider strategy with the trading volume momentum strategy. Taking the example of a 6-month formation period and holding for 24 months, the return difference between two strategies is significantly positive (5.8%) at a 1% significance level. As the formation period and holding period lengthen, the profits are significantly positive only after one year. Panel E shows the comparison between this insider strategy and the 52-week high point strategy. Using a 12-month formation period and holding for 12 months as an example, the return difference between two strategies is significantly positive (3.92%) at a 5% significance level.

Table 9: The performance of buying sale and selling silent strategies

Panel A							
		Average monthly returns for holding K months					
			K=1	**K=3**	**K=6**	**K=12**	**K=24**
J=1	$(R_{NS} - R_{IS})$ −OS	μ	-0.0085***	-0.0107**	-0.0171**	-0.0261**	-0.0154**
		p	0.0068	0.0349	0.0280	0.0341	0.0266
J=3	$(R_{NS} - R_{IS})$ −OS	μ	-0.0019	-0.0069	-0.0138*	-0.0218*	-0.0057
		p	0.2910	0.1117	0.0602	0.0765	0.4104
J=6	$(R_{NS} - R_{IS})$ −OS	μ	-0.0023	-0.0092**	-0.0133*	-0.0027	0.0055
		p	0.2348	0.0420	0.0705	0.4332	0.4187
J=12	$(R_{NS} - R_{IS})$ −OS	μ	-0.0020	-0.0055	0.0101	0.0364**	0.0343*
		p	0.2921	0.2179	0.1754	0.0199	0.0890
Panel B							
		Average monthly returns for holding K months					
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NS} - R_{IS})$ −FS	μ	-0.0001	0.0036	0.0053	0.0114	0.0254
		p	0.4916	0.3490	0.3601	0.2932	0.1976
J=3	$(R_{NS} - R_{IS})$ −FS	μ	0.0009	0.0016	0.0037	0.0106	0.0369
		p	0.4250	0.4299	0.3397	0.3048	0.1068
J=6	$(R_{NS} - R_{IS})$ −FS	μ	0.0014	0.0012	0.0049	0.0275*	0.0503*
		p	0.3779	0.4467	0.3492	0.0906	0.0533
J=12	$(R_{NS} - R_{IS})$ −FS	μ	0.0022	0.0023	0.0254	0.0613***	0.0592**
		p	0.3025	0.3977	0.2710	0.0020	0.0227
Panel C							
		Average monthly returns for holding K months					
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NS} - R_{IS}) - PM$	μ	-0.0025	-0.0014	-0.0034	-0.0153	-0.0077
		p	0.2467	0.4178	0.3567	0.1670	0.3671
J=3	$(R_{NS} - R_{IS}) - PM$	μ	-0.0008	0.0022	-0.0012	-0.0186	-0.0015
		p	0.4222	0.3752	0.4517	0.1425	0.4750
J=6	$(R_{NS} - R_{IS}) - PM$	μ	0.0041	-0.0043	-0.0041	-0.0052	0.0105
		p	0.1252	0.2601	0.3506	0.3780	0.3400
J=12	$(R_{NS} - R_{IS}) - PM$	μ	-0.0037	-0.0080	-0.0041	-0.0052	0.0105
		p	0.1513	0.1396	0.4661	0.1905	0.2215

Panel D							
			Average monthly returns for holding K months				
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NS} - R_{IS}) - VM$	μ	-0.0041*	-0.0101**	-0.0156**	0.0031	0.0475***
		p	0.0907	0.0361	0.0218	0.3873	0.0096
J=3	$(R_{NS} - R_{IS}) - VM$	μ	-0.0046*	-0.0080*	-0.0079	0.0122	0.0530***
		p	0.0819	0.0943	0.1674	0.1636	0.0073
J=6	$(R_{NS} - R_{IS}) - VM$	μ	-0.0019	-0.0074*	0.0060	0.0247**	0.0580***
		p	0.2751	0.0800	0.1996	0.0273	0.0097
J=12	$(R_{NS} - R_{IS}) - VM$	μ	0.0030	0.0087*	0.0205**	0.0438***	0.0339*
		p	0.1752	0.0802	0.0154	0.0042	0.0657
Panel E							
			Average monthly returns for holding K months				
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NS} - R_{IS}) - 52W$	μ	-0.0060*	-0.0087	-0.0109	0.0040	0.0120
		p	0.0750	0.1587	0.1854	0.4060	0.3452
J=3	$(R_{NS} - R_{IS}) - 52W$	μ	-0.0011	-0.0045	0.0019	0.0164	0.0152
		p	0.4132	0.2932	0.4426	0.1808	0.3104
J=6	$(R_{NS} - R_{IS}) - 52W$	μ	-0.0013	-0.0002	0.0108	0.0307*	0.0189
		p	0.3912	0.4919	0.1924	0.0607	0.2825
J=12	$(R_{NS} - R_{IS}) - 52W$	μ	0.0012	0.0026	0.0207*	0.0392**	0.0043
		p	0.3868	0.3827	0.0792	0.0493	0.4430

Note: P-value is reported in parentheses. ***, **, and * denote significant at 1%, 5%, and 10% level.

In Table 10, we compare the performance of "buying insider purchases and selling insider silence" strategy with those of OS, FS, price momentum, trading volume momentum, and 52-week high point strategies. In Panel A, using a 12-month formation period and holding for 12 months as an example, the performance of insider strategy is significantly higher than OS strategy at a 10% significance level, reaching 3.46%. Comparing this return with the return in shortest holding periods (K=1), the difference between these two strategies' returns is 3.37%. Thus, the longer holding period is associated with the greater difference between the performance of insider strategy and OS strategy. Panel B shows the comparison between this insider strategy and FS. Using a 6-month formation period and holding for 24 months as an example, the performance of insider strategy is significantly higher than FS strategy at a 1% significance level, reaching 6.7%. With the extension of the holding period, the difference between these two strategies' returns gradually increases. Therefore, we infer that the performance of this insider strategy is better than the FS strategy. In Panel C, we compare this insider strategy with price momentum strategy. Using a 3-month formation period and holding for 3 months as an example, the performance of insider strategy is significantly higher than price momentum strategy at a 5% significance level, reaching 1.35%. It is noticeably unprofitable in other periods. Panel D compares this insider strategy with trading volume momentum strategy. Using a 3-month formation period and holding for 24

months as an example, the performance of insider strategy is significantly higher than volume momentum strategy at a 1% significance level, reaching 8.36%. Comparing this return with the return in other strategies, it has a 4% higher return, and the average profit effect for holding periods of one year or more reaches over 3%. Therefore, for long-term investment, the insider strategy performs better. In Panel E, we compare this insider strategy with the 52-week high point strategy. Using a 3-month formation period and holding for 24 months as an example, the performance of insider strategy is significantly higher than 52-week high point strategy at a 5% significance level, reaching 4.58%. With the increase in the holding period, the average profit effect can reach a 4% return.

Table 10: The comparison between the performance of buying sale and selling silent strategy with other strategies

Panel A							
			Average monthly returns for holding K months				
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NB} - R_{IS})$ −OS	μ	-0.0032	0.0004	-0.0026	0.0022	0.0171
		p	0.1961	0.4752	0.3924	0.4463	0.2333
J=3	$(R_{NB} - R_{IS})$ −OS	μ	0.0038	0.0044	-0.0060	0.0045	0.0249
		p	0.1508	0.2270	0.2513	0.3877	0.1459
J=6	$(R_{NB} - R_{IS})$ −OS	μ	-0.0004	-0.0056	-0.0109	0.0104	0.0223
		p	0.4578	0.2007	0.1342	0.2538	0.1735
J=12	$(R_{NB} - R_{IS})$ −OS	μ	0.0009	0.0057	0.0158*	0.0346**	0.0288
		p	0.4136	0.2058	0.0811	0.0135	0.1219
Panel B							
			Average monthly returns for holding K months				
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NB} - R_{IS})$ −FS	μ	0.0052	0.0147**	0.0197*	0.0397**	0.0580***
		p	0.1153	0.0453	0.0602	0.0223	0.0090
J=3	$(R_{NB} - R_{IS})$ −FS	μ	0.0066*	0.0128**	0.0115	0.0369**	0.0675***
		p	0.0649	0.0465	0.1620	0.0178	0.0025
J=6	$(R_{NB} - R_{IS})$ −FS	μ	0.0033	0.0048	0.0073	0.0407***	0.0670***
		p	0.2031	0.2595	0.2479	0.0073	0.0017
J=12	$(R_{NB} - R_{IS})$ −FS	μ	0.0051	0.0135**	0.0310***	0.0595***	0.0537**
		p	0.1211	0.0428	0.0032	0.0001	0.0135
Panel C							
			Average monthly returns for holding K months				
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NB} - R_{IS})$ −PM	μ	0.0028	0.0097	0.0111	0.0129	0.0249
		p	0.2906	0.1210	0.1604	0.2438	0.1612
J=3	$(R_{NB} - R_{IS})$ −PM	μ	0.0049	0.0135**	0.0066	0.0077	0.0291
		p	0.1363	0.0228	0.2828	0.3386	0.1252
J=6	$(R_{NB} - R_{IS})$ −PM	μ	0.0059*	-0.0007	-0.0017	0.0080	0.0272
		p	0.0651	0.4646	0.4405	0.3318	0.1357
J=12	$(R_{NB} - R_{IS})$ −PM	μ	-0.0008	0.0032	0.0066	0.0123	0.0126
		p	0.4322	0.3535	0.2929	0.2250	0.2927

Panel D							
		Average monthly returns for holding K months					
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NB} - R_{IS})$ −VM	μ	0.0012	0.0010	-0.0011	0.0313**	0.0800***
		p	0.3858	0.4382	0.4551	0.0181	0.0001
J=3	$(R_{NB} - R_{IS})$ −VM	μ	0.0011	0.0033	-0.0001	0.0385***	0.0836***
		p	0.3827	0.2940	0.4956	0.0067	0.0001
J=6	$(R_{NB} - R_{IS})$ −VM	μ	0.0000	-0.0038	0.0084	0.0378***	0.0748***
		p	0.4946	0.3073	0.1950	0.0089	0.0003
J=12	$(R_{NB} - R_{IS})$ −VM	μ	0.0059*	0.0199***	0.0262***	0.0420***	0.0285
		p	0.0827	0.0029	0.0077	0.0034	0.1107
Panel E							
		Average monthly returns for holding K months					
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NB} - R_{IS})$ −52W	μ	-0.0007	0.0023	0.0035	0.0320*	0.0445*
		p	0.4462	0.3950	0.3880	0.0507	0.0524
J=3	$(R_{NB} - R_{IS})$ −52W	μ	0.0046	0.0068	0.0096	0.0427**	0.0458**
		p	0.1615	0.1884	0.2061	0.0112	0.0496
J=6	$(R_{NB} - R_{IS})$ −52W	μ	0.0005	0.0035	0.0131	0.0439	0.0357*
		p	0.4528	0.3263	0.1430	0.1290	0.0948
J=12	$(R_{NB} - R_{IS})$ −52W	μ	0.0041	0.0138*	0.0264**	0.0374**	-0.0011
		p	0.1977	0.0554	0.0300	0.0267	0.4824

Note: P-value is reported in parentheses. ***, **, and * denote significant at 1%, 5%, and 10% level.

Table 11 compares the performance of "buying insider purchases and selling insider sales" strategy with OS, FS, price momentum, trading volume momentum, and 52-week high point strategies. In Panel A, we compare the insider strategy with OS. Using a 12-month formation period and holding for 6 months as an example, the performance of insider strategy is significantly higher than OS strategy at a 10% significance level, reaching 1.76%. Comparing this return with the return in the shortest holding periods of K=12 and K=1, the difference between these two strategies' returns is 1.34%. With the extension of the formation period, the difference between these two strategies' returns gradually becomes insignificant or negatively significant. Therefore, we infer that this insider strategy can be more profitable in shorter formation periods. Panel B shows the comparison between this insider strategy and FS. Using a 3-month formation period and holding for 24 months as an example, the performance of insider strategy is significantly higher than FS strategy at a 1% significance level, reaching 6.65%. With the extension of the holding period, the difference between these two strategies' returns gradually increases. Therefore, we infer that the investment performance of this insider strategy is better than the FS strategy. In Panel C, we compare this insider strategy with price momentum strategy. Using a 3-month formation period and holding for 6 months as an example, the performance of insider strategy is significantly higher than price momentum strategy at a 5% significance level, reaching 1.68%. Therefore, we infer that this insider strategy is more advantageous in short-term

investments. Panel D compares this insider strategy with trading volume momentum. With the increase in the formation period and holding period, using a 1-month formation period and holding for 24 months as an example, the performance of insider strategy is significantly higher than volume momentum strategy at a 1% significance level, reaching 8.45% return. Compared this return with the return in other strategies, it has a 5% higher return, indicating that this insider strategy is superior to trading volume momentum strategy. In Panel E, it is evident that compared with the 52-week high point strategy, the buying and selling strategy is more pronounced in the medium to long term. Using a 6-month formation period and holding for 12 months as an example, at a 1% significance level, the performance of insider strategy is significantly higher than 52-week high point strategy, reaching 5.22%. This indicates that this insider strategy is superior to the 52-week high point strategy.

Table 11: The comparison between the performance of buying purchases and selling silencestrategy with other strategies

Panel A							
		Average monthly returns for holding K months					
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NB} - R_{NS})$ −OS	μ	-0.0026	0.0003	-0.0013	0.0126	0.0216
		p	0.2750	0.4868	0.4541	0.2374	0.1661
J=3	$(R_{NB} - R_{NS})$ −OS	μ	0.0052	0.0077	-0.0029	0.0214	0.0239
		p	0.1228	0.1575	0.4024	0.1135	0.1432
J=6	$(R_{NB} - R_{NS})$ −OS	μ	0.0006	-0.0034	-0.0063	0.0188	0.0115
		p	0.4484	0.3432	0.2882	0.1206	0.3103
J=12	$(R_{NB} - R_{NS})$ −OS	μ	0.0042	0.0146**	0.0176*	0.0189	0.0075
		p	0.1895	0.0334	0.0767	0.1068	0.3784
Panel B							
		Average monthly returns for holding K months					
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NB} - R_{NS})$ −FS	μ	0.0058*	0.0145**	0.0210**	0.0501***	0.0625***
		p	0.0886	0.0366	0.0307	0.0037	0.0012
J=3	$(R_{NB} - R_{NS})$ −FS	μ	0.0081**	0.0161**	0.0146*	0.0538***	0.0665***
		p	0.0310	0.0172	0.0945	0.0010	0.0005
J=6	$(R_{NB} - R_{NS})$ −FS	μ	0.0043	0.0070	0.0119	0.0490***	0.0562***
		p	0.1428	0.1496	0.1226	0.0007	0.0019
J=12	$(R_{NB} - R_{NS})$ −FS	μ	0.0084**	0.0224***	0.0328***	0.0437***	0.0324*
		p	0.0377	0.0025	0.0015	0.0006	0.0646

Panel C							
		Average monthly returns for holding K months					
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NB} - R_{NS})$ −PM	μ	0.0034	0.0096	0.0124	0.0234	0.0294
		p	0.2749	0.1564	0.1839	0.1248	0.1366
J=3	$(R_{NB} - R_{NS})$ −PM	μ	0.0063*	0.0168**	0.0097	0.0246	0.0281
		p	0.0960	0.0197	0.2489	0.1097	0.1387
J=6	$(R_{NB} - R_{NS})$ −PM	μ	0.0069*	0.0015	0.0029	0.0163	0.0164
		p	0.0738	0.4342	0.4118	0.2034	0.2715
J=12	$(R_{NB} - R_{NS})$ −PM	μ	0.0025	0.0122	0.0084	-0.0035	-0.0087
		p	0.3208	0.1111	0.2666	0.4223	0.3651
Panel D							
		Average monthly returns for holding K months					
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NB} - R_{NS})$ −VM	μ	0.0018	0.0009	0.0002	0.0418**	0.0845***
		p	0.3574	0.4600	0.4955	0.0172	0.0002
J=3	$(R_{NB} - R_{NS})$ −VM	μ	0.0025	0.0066	0.0030	0.0554***	0.0826***
		p	0.2924	0.2137	0.4163	0.0034	0.0002
J=6	$(R_{NB} - R_{NS})$ −VM	μ	0.0010	-0.0016	0.0130	0.0462***	0.0640***
		p	0.4160	0.4346	0.1593	0.0083	0.0030
J=12	$(R_{NB} - R_{NS})$ −VM	μ	0.0092**	0.0288***	0.0280**	0.0262*	0.0072
		p	0.0386	0.0010	0.0156	0.0506	0.3890
Panel E							
		Average monthly returns for holding K months					
			K=1	K=3	K=6	K=12	K=24
J=1	$(R_{NB} - R_{NS})$ −52W	μ	-0.0001	0.0022	0.0048	0.0426**	0.0490**
		p	0.4924	0.4052	0.3625	0.0255	0.0197
J=3	$(R_{NB} - R_{NS})$ −52W	μ	0.0060	0.0100	0.0128	0.0596***	0.0448**
		p	0.1064	0.1240	0.1588	0.0022	0.0314
J=6	$(R_{NB} - R_{NS})$ −52W	μ	0.0015	0.0057	0.0177*	0.0522***	0.0249
		p	0.3734	0.2448	0.0803	0.0033	0.1403
J=12	$(R_{NB} - R_{NS})$ −52W	μ	0.0074*	0.0228***	0.0282**	0.0216*	-0.0224
		p	0.0812	0.0067	0.0155	0.0827	0.1535

Note: P-value is reported in parentheses. ***, **, and * denote significant at 1%, 5%, and 10% level.

5. Conclusion

This study applies the concept of insider silence based on Gao et al. (2021) to observe the performance of strategies in the Taiwan stock market. We focus on 37 companies, which issue stocks, stock futures, and stock options. The study utilizes insider trading data from January 2010 to December 2021, categorizing companies into silent, buying, and selling portfolios to explore their return differences. The study also constructs one-dimensional portfolios using insider trading strategies and OS and FS strategies to assess their applicability in the market and provide investors with better choices in strategy selection. Here are the summarized conclusions. The “buying insider sales and selling insider silence” strategy shows more significant profits for holding periods longer than a year, with a notable return of 2.13% for a 12-month formation period and 24-month holding period. This suggests that the strategy is more suitable for long-term investment. The "buying insider purchases and selling insider silence" strategy also demonstrates significant profits for holding periods longer than a year, reaching a return of 3.15% for a 3-month formation period and 24-month holding period. It is inferred that this strategy is more suitable for long-term investment. The "buying insider purchases and selling insider sales" strategy shows more significant profits with longer investment periods, particularly for holding periods longer than a year, indicating its suitability for long-term buy-and-hold investment. The “buying insider sales and selling insider silence” strategy outperforms OS, FS, trading volume momentum, and 52-week high point strategies. It is more suitable for long-term investment. The "buying insider purchases and selling insider silence" strategy outperforms OS, FS, price momentum, trading volume momentum, and 52-week high point strategies, particularly for long-term investment. The "buying insider purchases and selling insider sales" strategy outperforms OS, FS, price momentum, trading volume momentum, and 52-week high point strategies, especially for holding periods longer than 12 months.

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