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Market impact cost asymmetry of the National Pension Service and its determinant analysis

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Abstract
As of March 2021, the National Pension Service (NPS) is the world's 3rd largest pension fund with 872.5tn won (KRW) in management. Recently, the NPS proposed a policy to gradually reduce the proportion of domestic stocks in the portfolio in the future. This change in the asset allocation strategy is related to the NPS's exit strategy for domestic stocks. This study aims to examine the market impact cost asymmetry between buys and sells of the NPS and suggest a trading strategy for mitigating the market impact cost. The results are as follows. First, there is an asymmetry between buys and sells in the market impact cost of the NPS. The market impact cost of the NPS is gradually increasing over time. In particular, the market impact cost from selling has increased significantly in recent years. Second, past returns, volatility, liquidity and trading intensity can be found as external factors affecting the asymmetric market impact cost of the NPS. Although there is no difference between the buying and selling ratios of the NPS, the market impact cost from sells is relatively higher than that from buys. Third, after controlling for the order execution size of the NPS, the longer the trade execution period, the lower the market impact cost. This result implies that the strategy of splitting orders as a way to reduce the market impact cost is effective. The trading behavior of the NPS directly or indirectly affects other investors. If the sell of the NPS incurs excessive market impact cost, the negative impact on the stock price will be further exacerbated. Therefore, it is necessary for the NPS to reduce the market impact cost through split trading in executing orders in the domestic stock market. Findings of this study provide implications for countermeasures and long-term management strategies that can minimize the market impact cost of the NPS in the process of reducing the proportion of domestic stocks in the future.

Keywords National Pension Service, Market impact cost, Price impact asymmetry, Pension funds, Split trading

Paper type Research paper

1. Introduction
The National Pension Service (hereafter NPS) of Korea, the institutional investor who manages the largest amount of funds in the domestic stock market, uses a contrarian strategy and is known to act as a market stabilizer and liquidity provider in the stock market (Kho *et al.*, 2008; Nahm *et al.*, 2015; Woo and Kim, 2018, 2019) and in the futures market (Woo and Kim, 2021). In particular, there is a study showing that the NPS causes a relatively small market impact cost compared to other investors (Eom and Woo, 2021).

According to previous studies, there is no evidence to judge that the trading behavior of the NPS negatively affects stock volatility or market stability. However, some studies have

JEL Classification — G11, G12, G23

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limitations in that they estimate the market impact cost using daily data rather than intraday data. Keim and Madhavan (1997) show that there exist significant differences between the temporary and permanent impacts of buyer-initiated and seller-initiated trades in the US markets. Since information is reflected in the price in real time, it is not easy to distinguish information effect from the market impact cost using daily transaction data. Our study is different from previous studies in that it estimates the market impact cost using high-frequency intraday data and analyzes the existence and causes of the asymmetry in the market impact cost between buys versus sells.

As of March 2021, the NPS is the world's 3rd largest pension fund with 872.5tn won (KRW) in management. While domestic stock management grew 74.5% from 102.4tn won in 2016 to 178.7tn won (20% proportion) as of March 2021, overseas stocks grew by 150.6% from 85.7tn won in 2016 to 214.8tn won (25% proportion) as of March 2021. Recently, the NPS proposed a policy to gradually reduce the proportion of domestic stocks in the portfolio to 15% by 2023. Since the NPS is planning a strategy to reduce the proportion of domestic stock investment in the future, it is considering market impacts due to an exit strategy and a stock price decline due to investors' follow-up trading. Therefore, this study seeks to answer the following questions.

First, this study investigates whether there is an asymmetry in the market impact cost between the NPS's buys and sells. The NPS is known to use a contrarian strategy, to hedge through shorting futures and not to use a short selling strategy. Futures trading is used as a complementary trading strategy for spot trading rather than arbitrage. Due to the NPS's spot and futures trading strategy, an asymmetry in the market impact cost between buys and sells may appear. Chiyachantana *et al.* (2004) show that market impact costs are observed asymmetrically according to the market conditions. During the market uptrend, the market impact cost of buys is relatively larger, and during the market downturn, the market impact cost of sells is observed to be relatively larger. This suggests implications for strategies that can minimize the market impact cost in implementing the plan to reduce the proportion of domestic stock investment.

Second, if the market impact cost of the NPS is asymmetric, this study looks for the cause in external factors such as the market conditions, information asymmetry, trading intensity and volatility. Chiyachantana *et al.* (2017), who first empirically analyzes Saar (2001) theoretical model on the asymmetry in the market impact cost between buys and sells, generally observe that the market impact cost of buys is larger than that of sells. However, when the stock price rises, the asymmetry of the market impact cost decreases or a reverse situation occurs in which the market impact cost of sells is greater than that of buys. In addition, as information asymmetry, intrinsic volatility, analyst forecast dispersion, trading intensity and price volatility increase, the reversal of the asymmetry of the market impact cost is further expanded.

Third, if the market impact cost of the NPS is asymmetric, this study looks for the cause in internal factors such as the frequency, the size and the timing of trades. In addition, depending on the execution of orders by securities companies following the execution of funds by the NPS, an asymmetry in the market impact cost between buys and sells may appear.

We calculate the market impact cost of buys and sells based on the history of the NPS's transactions in the domestic stock market from 2010 to 2018 and analyze the asymmetry. The main results are as follows. First, there is an asymmetry between buys and sells in the market impact cost of the NPS. The market impact cost of the NPS is gradually increasing over time, and the market impact cost from selling has increased significantly in recent years. Second, past returns, volatility, liquidity and trading intensity can be found as external factors affecting the asymmetric market impact cost of the NPS. Although there is no difference between the buying and selling ratios of the NPS, the market impact cost from sells is relatively higher than that from buys. After controlling for stock characteristics and past returns, the market impact cost of sells is still relatively larger than that of buys. Third, as an internal factor affecting the asymmetric market impact cost of the NPS, the differential order strategy between the sell order and the buy order of the NPS may be a factor. After controlling for the order execution size of the NPS, the longer the trade execution period, the lower the market impact cost. This result implies that the strategy of splitting orders as a way to reduce the market impact cost is effective. However, even considering the trade execution period, the market impact cost of sells is still higher than that of buys. This result is attributable to the NPS's more aggressive order submission on sell orders.

This study on the asymmetry of the market impact cost of the NPS can predict the market impact and the possibility of stock price fluctuations according to the exit strategy of the NPS in the future. This study also provides a basis for estimating whether other market participants use contrarian trading or positive feedback trading in response to the market impact caused by the NPS. In addition, our findings are expected to provide implications for countermeasures and long-term management strategies that can minimize the market impact cost of the NPS in the process of reducing the proportion of domestic stocks in the future.

The rest of this paper is organized as follows. Section 2 summarizes literature review, Section 3 describes research data and methodologies, Section 4 presents the research results and Section 5 discusses the conclusions and implications.

2. Literature review

There are not many studies on the market impact cost in the domestic stock market due to the limitations of intraday quotation and transaction data. Representative studies analyzing the market impact cost of the domestic stock market include Lee and Choe (1997), Kang (1999) and Eom and Woo (2021).

Lee and Choe (1997) analyze the market impact cost using quotation and transaction data of KOSPI 200 stocks for three months from April to June 1995. As a result of the analysis, there is no significant difference between the market impact cost from buys and the market impact cost from sells, and the market impact cost increases in proportion to the size of the order. Kang (1999) analyzes the market impact cost using stock index data from June 1987 to June 1999. According to the analysis result, the market impact cost is lower than the results of previous studies, but relatively high compared to non-Asian countries.

The study of Eom and Woo (2021) is interesting in that it analyzes the market impact cost of the NPS rather than market impact costs as a whole. They analyze the market impact cost of the stocks traded by the NPS for 10 years from July 2008 to June 2018. As a result of the analysis, the NPS shows relatively large market impact costs compared to individual investors, but relatively small market impact costs compared to investment trusts, pension funds and foreign investors. They also argue that the NPS adopts a trading strategy that reduces market impacts through relatively efficient order submission compared to other market participants.

Chan and Lakonishok (1993, 1997) and Keim and Madhavan (1997) analyze market impact costs in the US stock market. Chan and Lakonishok (1993) show that the market impact cost of buys is higher than that of sells. They argue that the asymmetry of the market impact cost is observed because sell transactions are often due to liquidity, whereas buy transactions are mainly due to good news for the stock. Chan and Lakonishok (1997) show that the market impact cost differs depending on the trading venue. They show that market impact costs for large stocks are lower on the NYSE, while market impact costs for smaller stocks are lower on the NASDAQ. Keim and Madhavan (1997) analyze the explicit and implicit transaction costs by market and show that transaction costs in NASDAQ are larger than those in NYSE or AMEX.

They also find that buys, especially in small stocks, are generally more costly than equivalent sells.

A comparative analysis of market impact costs by country is also being actively conducted. Domowitz and Madhavan (2001) study the explicit and implicit transaction costs of each country using transaction data for 42 countries from September 1996 to December 1998. As a result of the analysis, the country with the lowest transaction cost is about 30 basis points, and the country with the highest transaction cost is about 198 basis points, indicating that the market impact cost of developed countries is lower than that of developing countries.

Chiyachantana *et al.* (2004) provide important insights on the impact of the market condition on the price impact asymmetry by analyzing market impact costs across 37 countries. As a result of the analysis, market conditions can affect the market impact cost, and the average market impact cost is observed to be in the range of 31–45 basis points. In addition, the market impact cost for buys is relatively large in bullish markets, and the market impact cost for sells is relatively large in bearish markets. This finding suggests that the liquidity available to buy (sell) orders is higher in bearish (bullish) markets. It is interpreted that this is because it is relatively easy for sellers to find buyers during a market upturn, and buyers to find sellers during a market downturn.

Recently, Chiyachantana *et al.* (2017) empirically analyze Saar (2001)'s theoretical model on the asymmetry of the market impact cost between sells and buys. They show that the sign of the permanent price impact asymmetry between institutional buys versus sells is positive at the initial stage of a price run-up and decreases and becomes negative as the stock price rises, resulting in a reverse situation in which the market impact cost of sells is greater than that of buys. In addition, they show that idiosyncratic volatility, analyst forecast dispersion, trading intensity, price dispersion and bullish market conditions further sharpen the initial asymmetry, as well as its reversal after a price run-up.

3. Data and methodology

3.1 Data

The purpose of this study is to analyze the asymmetry of the market impact cost of the NPS and to find its determinants. Since it is not easy to directly use the stock trading data of the NPS, which is the subject of our study, we reconstruct the trading data through an indirect method. The process is as follows. First, disclosures reported in the name of the NPS are collected from the ownership status report of the Korea Exchange Disclosure System (KIND.KRX.CO.KR) from July 2008 to June 2018. We reconstruct a database of stocks, date, volume and average price that the NPS bought or sold. Second, we find an account with the same trading details as those reported by the NPS in the trading book of the Korea Exchange. Through this process, the transaction details of the NPS, which traded 1,211 stocks through 5,620 accounts, are confirmed. The NPS accounts for 0.07% of the total 7,953,518 market participants' accounts and trades 44.9% of listed stocks. Third, we complete a database in which the trading details of other stocks not reported in the ownership status report are added to the accounts owned by the NPS. From January 2010 to December 2018, there was 4,814,081 stock-date, and the NPS traded 2,827 times per stock, 513,594 shares and 4.06bn won. Finally, the market impact cost of buys and sells is calculated based on the submitted quotes and trades of the NPS.

3.2 Methodology

Market impact cost is to calculate how much the current market price has been changed by a quote submitted by a specific investor. The market impact cost of buys raises the current market price, while the market impact cost of sells causes the current market price to fall. The trade of buys is executed higher than the reference price, and the trade of sells is executed lower than the reference price, resulting in market impact costs and implicit transaction costs for investors. In order not to incur market impact costs, non-initiated trading should be executed by submitting a liquidity supply quote, but this has the disadvantage of not guaranteeing the immediacy of execution.

We calculate the market impact cost in the following way. First, among the bid price submitted by the NPS that is higher than the reference price and the ask price submitted lower than the reference price, the transaction details are selected. The average price of the best bid and best ask price at the time of execution is used as the reference price. Second, the transaction amount-weighted market impact cost is calculated when the order quantity exceeds the remaining depth of the best bid or ask price and is executed with a second-best bid or ask price. Third, the transaction amount-weighted market impact cost of a specific stock on a specific day is calculated using the transaction records that caused a market impact and did not have a market impact. Finally, by taking into account external factors such as stock characteristics, trading venue, market conditions and internal factors such as the size and time of fund execution, the market impact cost is analyzed.

Table 1 shows summary statistics of the market impact cost of the NPS calculated by date (Panel A) and by stock (Panel B) during the sample period. In Panel A, the market impact cost of buys (BMIC) is 0.3492%, raising the current market price by 34 basis points on average, and the market impact cost of sells (SMIC) is −0.4283%, lowering the current market price by 42 basis points on average. Our results are inconsistent with Chan and Lakonishok (1993) show that the market impact cost of buys is higher than that of sells. On the other hand, as for the proportion of the NPS's transaction amount in the total transaction amount of the stock, there is no significant difference between the ratio of buy volume (B Ratio) on average, 6.74%, and the ratio of sell volume (S Ratio) on average, 6.33%. The absolute value of the market impact cost between buys and sells shows a statistically significant difference at the 1% level (*t*-value is −7.85), while the trading ratio between buys and sells does not show a statistically significant difference (*t*-value is 0.04). Specifically, when calculated by each stock in Panel B, the average market impact cost of buys is 27 basis points, while the market impact cost of sells is −32 basis points on average. The absolute value of the market impact cost between buys and sells shows a statistically significant difference at the 1% level (*t*-value is −5.64). However, there is no statistically significant difference between the ratio of buy volume, 8.66%, and the ratio of sell volume, 8.02% (*t*-value is 0.06).

Figure 1 presents the time-series trend of market impact costs of the NPS's buys and sells. From 2010 to 2018, the market impact cost is showing a slight increase. In particular, the market impact cost of sells has been increasing in recent years, and it is showing a relatively larger absolute value than the market impact cost of buys.

3.3 Determinants of market impact cost

3.3.1 Market conditions. Woo and Kim (2018, 2019) find that the NPS follows a contrarian strategy in the KSE and KOSDAQ market. Since the market impact cost of a specific stock is affected by the stock price movement in the past, Equation (1) is a regression analysis model for the market impact cost that reflects the cumulative abnormal return for a certain period in the past as a control variable. A dummy variable is added for the market impact cost of buys in Equation (2); and a dummy variable is added for the market impact cost of sells in Equation (3); and dummy variables are added for the market impact cost of buys and sells in Equation (4) to test the difference between buys and sells. We also adopt a model using the net market impact cost (NET MIC), which is the sum of the market impact cost of buys and sells, as a dependent variable, and a model using the market impact cost as a dependent variable by changing it to an absolute value (ABS MIC). We also divide our sample into quintiles based on the cumulative abnormal returns for a certain period in the past and run a regression analysis

	BMIC	SMIC	*B* ratio	*S* ratio
Panel A: by date				
Nobs		2,220		
Mean	0.3492	−0.4283	0.0674	0.0633
St. dev	0.1061	0.1640	0.0190	0.0203
T value	155.07	−123.03	167.20	146.72
Max	0.8923	−0.0896	0.1526	0.1896
99%	0.5923	−0.1385	0.1162	0.1149
95%	0.5222	−0.1919	0.1003	0.0958
90%	0.4845	−0.2282	0.0913	0.0886
Q3	0.4221	−0.3033	0.0790	0.0771
Median	0.3505	−0.4139	0.0674	0.0631
Q1	0.2665	−0.5329	0.0547	0.0487
10%	0.2139	−0.6455	0.0421	0.0363
5%	0.1858	−0.7199	0.0365	0.0302
1%	0.1407	−0.8852	0.0273	0.0231
Min	0.0973	−1.2667	0.0189	0.0157
Panel B: by stock				
Nobs		1,033		
Mean	0.2753	−0.3210	0.0866	0.0802
St. dev	0.1581	0.2725	0.0675	0.0625
T value	55.96	−37.85	41.27	41.26
Max	1.1399	0.0000	0.7854	0.5705
99%	0.7694	−0.0030	0.3500	0.3085
95%	0.5436	−0.0617	0.2020	0.1853
90%	0.4748	−0.0977	0.1630	0.1493
Q3	0.3631	−0.1760	0.1118	0.1016
Median	0.2610	−0.2782	0.0709	0.0670
Q1	0.1633	−0.4154	0.0442	0.0413
10%	0.0945	−0.5547	0.0269	0.0240
5%	0.0513	−0.6812	0.0168	0.0130
1%	0.0031	−1.0140	0.0037	0.0020
Min	0.0000	−5.2810	0.0000	0.0000

Note(s): This table presents summary statistics of the market impact cost of the NPS calculated by date (Panel A) and by stock (Panel B) from January 2010 to December 2018. BMIC is the market impact cost from buys of the NPS, and SMIC is the market impact cost from sells of the NPS. The proportion of the NPS's transaction amount in the total transaction amount of the stock are B Ratio (the ratio of buy volume) and S Ratio (the ratio of sell volume), respectively

Table 1. Summary statistics (unit: %)

using Equations (2)–(4) for groups belonging to the high returns (highest 20% group), middle returns (middle 20% group) and low returns (lowest 20% group).

$$\mathrm{MIC}_{i,t} = \alpha_0 + \beta_1 * \mathrm{CAR}_{i,t-\tau,t-1} + \sum_{n=1}^{m} \beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t} \tag{1}$$

$$\mathrm{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Buy})_{i,t} + \beta_1 * \mathrm{CAR}_{i,t-\tau,t-1} + \sum_{n=2}^{m} \beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t} \tag{2}$$

$$\mathrm{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Sell})_{i,t} + \beta_1 * \mathrm{CAR}_{i,t-\tau,t-1} + \sum_{n=2}^{m} \beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t} \tag{3}$$

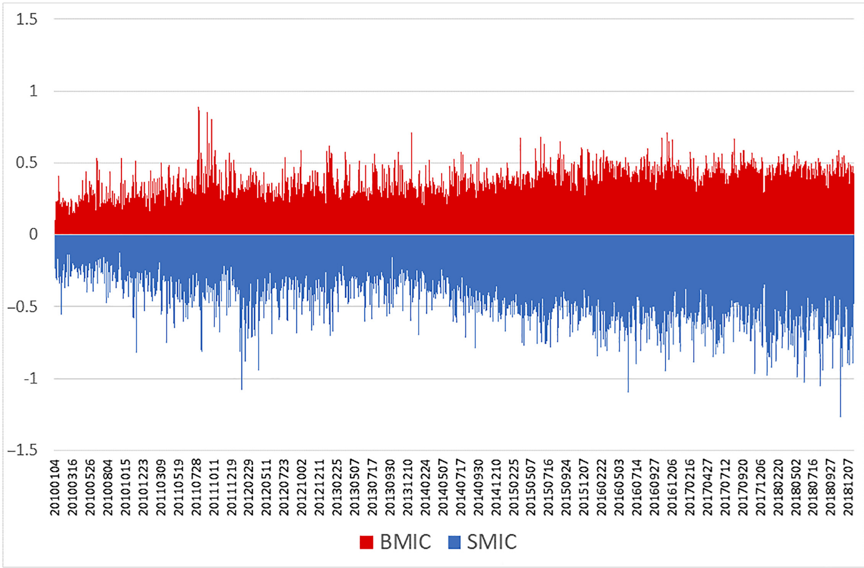


Figure 1.
Daily trends in market impact costs

Note(s): This figure presents the time-series trend of market impact costs of the NPS from January 2010 to December 2018. BMIC is the market impact cost from buys of the NPS and SMIC is the market impact cost from sells of the NPS

$$\mathrm{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Buy})_{i,t} + \beta_1 * D(\mathrm{Sell})_{i,t} + \beta_2 * \mathrm{CAR}_{i,t-\tau,t-1} + \sum_{n=3}^{m} \beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t} \tag{4}$$

MIC: Market impact cost

or, NET MIC: Net market impact cost

or, ABS MIC: Absolute value of the market impact cost

CAR: Cumulative abnormal return

D(Buy): Dummy variable of buys of the NPS

D(Sell): Dummy variable of sells of the NPS

ControlVariables: Control variables

3.3.2 Internal factors and external factors. If there is a difference in the market impact cost between buys and sells of the NPS, we first analyze whether the market impact cost is affected by external factors. Equation (5) is a regression analysis on whether the market impact cost of the NPS is affected by the bid-ask spread, an indicator of information asymmetry. Equation (6) is a regression analysis on whether the market impact cost of the NPS is affected by Amihud's illiquidity measure, an indicator of illiquidity. Equation (7) is a regression analysis on whether the market impact of the NPS is affected by intraday volatility, which is the difference between intraday high and low prices divided by the average of the two values. Equation (8) is a regression analysis on whether the market impact cost of the NPS is affected by trading intensity, which represents the proportion of the transaction value of the NPS to the total transaction value of the day. Equation (9) is a regression analysis on whether the market impact cost of the NPS is affected by the internal factors of the NPS, such as the frequency and size of fund execution. The amount of fund execution is estimated by summing up the transaction values based on the continuity of trading details.

$$\mathrm{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Buy})_{i,t} + \beta_1 * \mathrm{Spread}_{i,t} + \sum_{n=1}^{m} \beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t} \tag{5}$$

$$\mathrm{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Buy})_{i,t} + \beta_1 * \mathrm{Amihud}_{i,t} + \sum_{n=1}^{m} \beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t} \tag{6}$$

$$\mathrm{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Buy})_{i,t} + \beta_1 * \mathrm{Volatility}_{i,t} + \sum_{n=1}^{m} \beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t} \tag{7}$$

$$\mathrm{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Buy})_{i,t} + \beta_1 * \mathrm{TradeRatio}_{i,t} + \sum_{n=1}^{m} \beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t} \tag{8}$$

$$\mathrm{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Buy})_{i,t} + \sum_{n=1}^{10} \gamma_t * \mathrm{Trade}_t + \sum_{n=1}^{m} \beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t} \tag{9}$$

MIC: Market impact cost

or, NET MIC: Net market impact cost

or, ABS MIC: Absolute value of the market impact cost

D(Buy): Dummy variable of buys of the NPS

or, *D*(Sell): Dummy variable of sells of the NPS

Spread: Intraday spread

Amihud: Amihud's illiquidity measure

Volatility: Intraday volatility

TradeRatio: Trading ratio of the NPS

Trade: Trading amount of the NPS

ControlVariables: All control variables (A variable to be further analyzed is excluded from control variables)

We divide our sample into quintiles based on the bid-ask spread in Equation (5), Amihud's illiquidity measure in Equation (6), intraday volatility in Equation (7), trading intensity in Equation (8) and the amount of fund execution in Equation (9). We run a regression analysis using Equations (5)–(9) for groups belonging to the low group (lowest 20% group), middle group (middle 20% group) and high group (highest 20% group).

In the regression model, intraday volatility, spread, turnover ratio, Amihud measure, short selling ratio, daily rate of return, short selling amount, stock price, trading amount and market capitalization on the day, trading ratio are used as control variables. The intraday volatility is the difference between the intraday high and low prices divided by the average of the two values. The spread is the average value of the intraday spread, which is calculated by dividing the difference between the best bid quote and the best ask quote by the average of the two values. The turnover ratio is the daily trading volume divided by the number of outstandings. The Amihud's illiquidity measure is the absolute value of the daily return to trading amount ratio. The short selling ratio represents the proportion of the short selling volume to the trading volume of the day. The daily rate of return is the return on the closing price of the day compared to the closing price of the previous day. The trading ratio is the proportion of the NPS's transaction amount in the total transaction amount of the stock. The short selling amount is the natural logarithm of the short selling amount on the day. Stock prices, transaction amount and market capitalization are natural logarithms.

4. Main results

4.1 Trading intensity and market impact cost

This section calculates the market impact cost that affects the stock price in the process of the NPS's buying and selling in the domestic stock market and compares the difference of the market impact cost between buys and sells. Since the NPS is the world's third-largest public pension and the largest institutional investor in Korea, the trading behavior of the NPS is subject to follow-up trading by other investors. Not only the buys by the NPS but also the stock price increase due to the market impact cost of buys can act as good news for the market. A decline in stock prices due to market impact cost of sells as well as the selling by the NPS can act as bad news for the market.

Figure 2 shows the relationship between the trading intensity of the NPS and the market impact cost. There is a positive relationship between the trading intensity of the NPS and the market impact cost. As the trading intensity, which is measured by the volume ratio of the NPS, increases, the market impact cost rises regardless of whether it is buy-trade or sell-trade. While the distribution of the trading volume ratio between buying (B Ratio) and selling (S Ratio) does not appear to have much difference, the market impact cost of sells shows a relatively large dispersion compared to the market impact cost of buys. This result suggests that reducing the trading volume ratio of the NPS for individual stocks can be one candidate measure to reduce the market impact cost. For example, the NPS can break the orders up into successive trades that may run over several days.

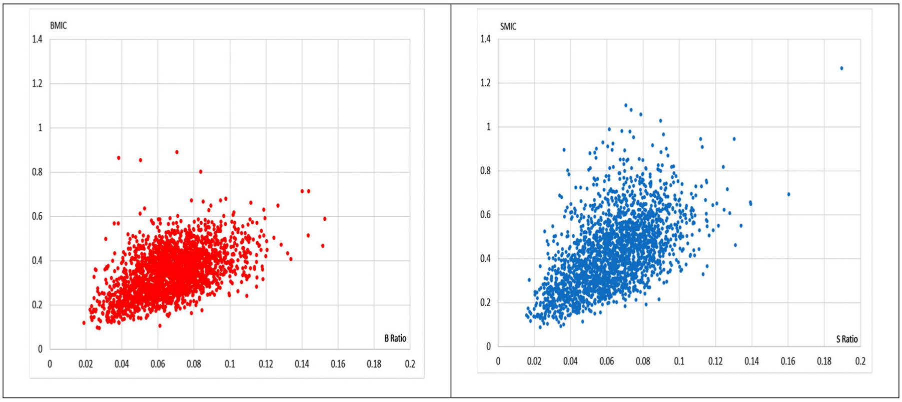


Figure 2.
Trading intensity and market impact cost

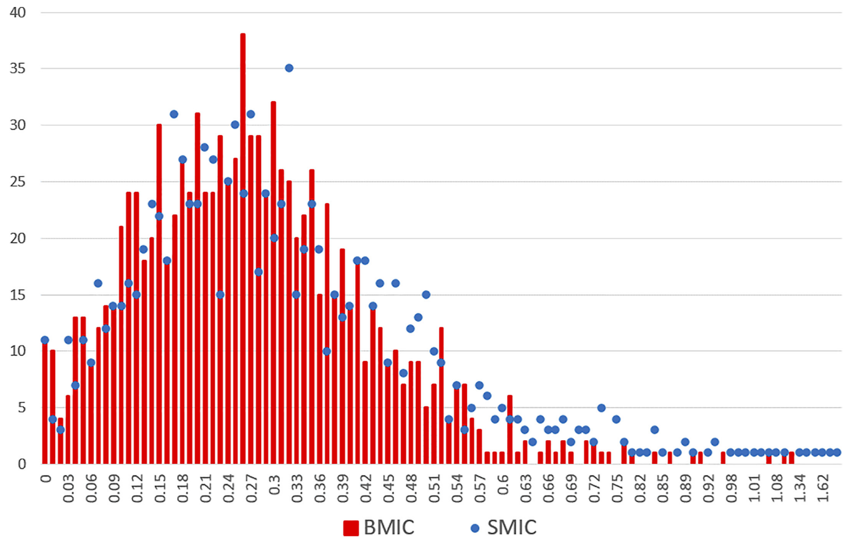
Note(s): This figure shows the relationship between the trading intensity of the NPS and the market impact cost from January 2010 to December 2018. BMIC is the market impact cost from buys of the NPS, and SMIC is the market impact cost from sells of the NPS. The proportion of the NPS's transaction amount in the total transaction amount of the stock are B Ratio (the ratio of buy volume) and S Ratio (the ratio of sell volume), respectively

Figure 3 shows the frequency according to the magnitude of the absolute value of the market impact cost of buys (bar graph) and sells (dot graph). For example, the number of stocks with the market impact cost of 30 basis points is 32 stocks in the case of buying and 20 stocks in the case of selling. However, the number of stocks that causes the market impact cost of 50 basis points is 5 stocks in the case of buying, whereas 15 stocks in the case of selling. As the market impact cost increases, in particular, when the market impact cost exceeds a certain level, the number of stocks sold is relatively higher than that of stocks bought.

4.2 Comparison of market impact costs

Woo and Kim (2018, 2019) show that the NPS follows a contrarian strategy, and they explain that the NPS plays the role of the market stabilizer based on this strategy. Table 2 shows the result of a regression analysis on how the market impact cost of the NPS is affected by firm characteristics. After controlling for all variables, the market impact cost of buys increases statistically significantly as the CAR increases from −3 to −1, from −5 to −1 and from −10 to −1. On the other hand, as the CAR increases from −30 to −1, the market impact cost of buys decreases statistically significantly. The market impact cost of sells increases consistently with the increase of the past CAR. However, as the CAR calculation period increases, the sensitivity to market impact costs gradually decreases.

Table 3 shows the results of regression analysis after controlling for various variables to see if there is a difference in the market impact cost of the NPS between buys and sells. Panel A shows the result of regression on the net market impact cost (NET MIC), which is the sum of the market impact cost of buys and sells. As independent variables, we use a dummy variable of buys that takes a value of one if there is a market impact cost of buys, and a dummy variable of sells takes a value of one if there is a market impact cost of sells. The dummy variable of buys has a positive effect on the market impact cost, and the dummy variable of sells has a negative



Note(s): This figure shows the frequency according to the magnitude of the absolute value of the market impact cost of buys (bar graph) and sells (dot graph) from January 2010 to December 2018. BMIC is the market impact cost from buys of the NPS, and SMIC is the market impact cost from sells of the NPS

Figure 3. Frequency of market impact cost of buys and sells by magnitude

Nobs	[t−3, t−1] Coeff. t-value	[t−5, t−1] Coeff. t-value	[t−10, t−1] Coeff. t-value	[t−20, t−1] Coeff. t-value	[t−30, t−1] Coeff. t-value
BMIC					
CAR[$t-\tau$, t−1]	0.2897**	0.1791**	0.0563**	−0.0058	−0.0001**
	5.07	2.99	5.96	−0.89	−3.85
Volatility	1.5487**	1.5383**	1.5284**	1.5325**	1.5302**
	3.97	3.74	3.50	3.58	3.54
Spread	19.9477**	19.9363**	19.9243**	19.9039**	19.9056**
	6.34	6.29	6.23	6.15	6.16
Turnover	−2.9400**	−2.9328**	−2.9003**	−2.8648**	−2.8696**
	−3.67	−3.57	−3.17	−3.73	−3.87
Amihud	−0.0046**	−0.0046**	−0.0047**	−0.0049**	−0.0048**
	−4.97	−4.89	−5.00	−5.20	−5.16
ShortRate	−0.0096	−0.0094	−0.0115	−0.0160	−0.0152
	−0.63	−0.62	−0.75	−1.05	−0.99
Return	0.8065**	0.8122**	0.8093**	0.8074**	0.8080**
	3.88	3.09	3.97	3.89	3.92
ShortAmt	0.0159**	0.0160**	0.0162**	0.0164**	0.0164**
	7.96	8.14	8.54	8.85	8.80
Price	−0.0420**	−0.0420**	−0.0420**	−0.0419**	−0.0419**
	−6.55	−6.59	−6.48	−6.25	−6.30
TrdAmt	0.1179**	0.1178**	0.1177**	0.1178**	0.1179**
	8.36	8.28	8.22	8.26	8.29
MktCap	−0.0015	−0.0015	−0.0017	−0.0019	−0.0019
	−1.16	−1.18	−1.32	−1.49	−1.47
Buy ratio	2.8429**	2.8431**	2.8472**	2.8513**	2.8506**
	5.51	5.38	5.68	6.10	6.53
Adj R-sq	0.3381	0.3380	0.3375	0.3374	0.3375
SMIC					
CAR[$t-\tau$, t−1]	1.0535**	0.7435**	0.4494**	0.2727**	0.0001*
	5.25	4.77	3.25	2.60	2.33
Volatility	−3.4284**	−3.4628**	−3.5153**	−3.5423**	−3.4877**
	−4.75	−4.19	−4.82	−4.12	−4.41
Spread	−30.2855**	−30.3100**	−30.2907**	−30.3485**	−30.4508**
	−5.30	−5.34	−5.28	−5.36	−5.49
Turnover	2.1629**	2.1565**	2.1760**	2.1721**	2.4165**
	4.08	4.04	4.16	4.12	5.72
Amihud	−0.0090**	−0.0087**	−0.0085**	−0.0085**	−0.0096**
	−5.35	−5.13	−5.02	−5.01	−5.69
ShortRate	0.0223	0.0261	0.0318	0.0361	−0.0013
	0.81	0.94	1.15	1.30	−0.05
Return	3.3097**	3.3327**	3.3268**	3.3288**	3.3109**
	6.78	7.25	7.10	7.11	6.65
ShortAmt	−0.0262**	−0.0261**	−0.0257**	−0.0255**	−0.0244**
	−5.50	−5.34	−4.99	−4.80	−3.72
Price	0.0727**	0.0725**	0.0723**	0.0721**	0.0734**
	5.91	5.71	5.52	5.29	5.36

(*continued*)

Table 2.
Market impact cost by past returns

Nobs	[t−3, t−1] Coeff. t-value	[t−5, t−1] Coeff. t-value	[t−10, t−1] Coeff. t-value	[t−20, t−1] Coeff. t-value	[t−30, t−1] Coeff. t-value
TrdAmt	−0.1804**	−0.1806**	−0.1812**	−0.1817**	−0.1823**
	−7.54	−7.63	−7.83	−7.04	−7.17
MktCap	−0.0138**	−0.0137**	−0.0137**	−0.0136**	−0.0148**
	−5.85	−5.83	−5.82	−5.76	−6.29
Sell ratio	−4.7766**	−4.7746**	−4.7769**	−4.7824**	−4.8094**
	−6.15	−6.95	−6.88	−6.15	−6.85
Adj R-sq	0.3301	0.3300	0.3294	0.3289	0.3272

Note(s): This table reports the estimates and t-value from the regression in Equation (1) where the dependent variable is MIC defined as the Market Impact Cost of the NPS

$MIC_{i,t} = \alpha_0 + \beta_1 * CAR_{i,t-\tau,t-1} + \sum_{n=1}^{m}\beta_{i,n} * ControlVariables_{i,n} + \varepsilon_{i,t}$ (1)

The main independent variable is CAR estimated using the KOSPI returns. Intraday volatility, spread, turnover ratio, Amihud measure, short selling ratio, daily rate of return, short selling amount, stock price, trading amount and market capitalization on the day, trading ratio are used as control variables. The intraday volatility is the difference between the intraday high and low prices divided by the average of the two values. The spread is the average value of the intraday spread, which is calculated by dividing the difference between the best bid quote and the best ask quote by the average of the two values. The turnover ratio is the daily trading volume divided by the number of outstandings. The Amihud measure is the absolute value of the daily return to trading amount ratio. The short selling ratio represents the proportion of the short selling volume to the trading volume of the day. The daily rate of return is the return on the closing price of the day compared to the closing price of the previous day. The trading ratio is the proportion of the NPS's transaction amount in the total transaction amount of the stock. The short selling amount is the natural logarithm of the short selling amount on the day. Stock prices, transaction amount and market capitalization are natural logarithms. The sample period runs from January 2010 to December 2018. * and ** indicate statistically significant levels at the 5% and 1% levels, respectively

Table 2.

effect on the market impact cost. In particular, when both dummy variables of buys and sells are used, the effect of the market impact cost from selling is higher than that of the market impact cost from buying. Panel B shows the results of the regression analysis in which all variables including the past CAR are additionally used as control variables. Even considering the investment strategy according to the NPS's past CAR, the effect of the market impact from selling is consistently greater than the effect of the market impact from buying.

Panel C and Panel D show the results of regression analysis using the absolute values of the market impact cost (ABS MIC) by the NPS as a dependent variable. The market impact cost from buying shows a negative influence, while the market impact cost from selling shows a positive effect. In particular, in the case of a regression analysis using both dummy variables, the effect of the market impact cost from selling is higher than the effect of the market impact cost from buying. The regression analysis, which uses the characteristics of stocks and the influence of the NPS on the stocks as control variables, also consistently shows that the effect of the market impact cost from selling is greater than the effect of the market impact cost from buying.

4.3 Comparison of market impact cost considering specific characteristics: CAR, liquidity, volatility, trading intensity

This section shows the results of a regression analysis of whether there is a difference in the market impact cost of the NPS between buys and sells, divided into several groups based on specific variables, such as past CAR, liquidity, volatility and trading intensity. We run a regression analysis using Equations (5)–(9) for groups belonging to the low group (lowest 20% group), middle group (middle 20% group) and high group (highest 20% group). For the sake of brevity, the regression coefficients and t-values for specific variables are reported.

Table 3.
Comparison of market impact cost between buys and sells

Panel A: NET MIC	Coeff. t-value	Coeff. t-value	Coeff. t-value
Dummy [BMIC]	0.3437**		0.3528**
	4.80		4.16
Dummy [SMIC]		−0.4221**	−0.4283**
		−5.11	−5.12
Adj R-sq	0.0073	0.0132	0.0209

Panel B: NET MIC	[$t-3$, $t-1$] Coeff. t-value	[$t-5$, $t-1$] Coeff. t-value	[$t-10$, $t-1$] Coeff. t-value	[$t-20$, $t-1$] Coeff. t-value	[$t-30$, $t-1$] Coeff. t-value
Dummy [BMIC]	0.1090**	0.1102**	0.1101**	0.1101**	0.1108**
	4.24	4.40	4.38	4.37	4.44
Dummy [SMIC]	−0.1710**	−0.1718**	−0.1730**	−0.1742**	−0.1754**
	−4.64	−4.75	−4.90	−5.05	−5.20
CAR [$t-\tau$,_$t-1$]	1.3271**	0.9108**	0.5001**	0.2628**	0.0000
	3.08	3.57	2.87	3.44	0.67
Volatility	−1.9642**	−2.0084**	−2.0701**	−2.0927**	−2.0428**
	−3.57	−3.08	−3.77	−4.00	−3.42
Spread	−10.0635**	−10.1010**	−10.0945**	−10.1728**	−10.2638**
	−7.55	−7.61	−7.59	−7.71	−17.85
Turnover	−0.7608**	−0.7594**	−0.7088**	−0.6767**	−0.4409**
	−4.57	−4.56	−4.25	−4.05	−2.64
Amihud	−0.0174**	−0.0170**	−0.0169**	−0.0171**	−0.0183**
	−9.49	−9.25	−9.20	−9.29	−9.94
ShortRate	0.1006**	0.1045**	0.1078**	0.1071**	0.0714*
	3.35	3.48	3.59	3.56	2.37
Return	4.0980**	4.1268**	4.1156**	4.1127**	4.0886**
	7.21	7.73	7.44	7.32	7.80
ShortAmt	−0.0106**	−0.0104**	−0.0098**	−0.0094**	−0.0084**
	−9.52	−9.28	−8.75	−8.42	−7.48
Price	0.0224	0.0221**	0.0220**	0.0219**	0.0231**
	6.74	6.55	6.43	6.34	7.22
TrdAmt	−0.0146**	−0.0150**	−0.0156**	−0.0160**	−0.0158**
	−5.57	−5.71	−5.94	−6.10	−6.00
MktCap	−0.0279**	−0.0278**	−0.0280**	−0.0281**	−0.0295**
	−5.91	−5.89	−5.94	−5.98	−5.53
Net ratio	3.7906**	3.7880**	3.7946**	3.8037**	3.8287**
	5.95	5.51	5.63	6.15	8.61
Adj R-sq	0.3212	0.3209	0.3196	0.3186	0.3172

Panel C: ABS MIC	Coeff. t-value	Coeff. t-value	Coeff. t-value
Dummy [BMIC]	−0.0810**		0.3592**
	−4.56		6.37
Dummy [SMIC]		0.1172**	0.4609**
		6.96	7.95
Adj R-sq	0.0050	0.0104	0.0188

Panel D ABS MIC	[$t-3$, $t-1$] Coeff. t-value	[$t-5$, $t-1$] Coeff. t-value	[$t-10$, $t-1$] Coeff. t-value	[$t-20$, $t-1$] Coeff. t-value	[$t-30$, $t-1$] Coeff. t-value
Dummy [BMIC]	−0.0853**	−0.0853**	−0.0853**	−0.0853**	−0.0853**
	−5.10	−5.10	−5.10	−5.10	−5.05

(continued)

Panel D ABS MIC	[t−3, t−1] Coeff. t-value	[t−5, t−1] Coeff. t-value	[t−10, t−1] Coeff. t-value	[t−20, t−1] Coeff. t-value	[t−30, t−1] Coeff. t-value
CAR [$t-\tau$,_t−1]	−0.6544**	−0.4925**	−0.3493**	−0.2392**	−0.0001**
	−2.86	−2.77	−3.83	−3.56	−4.29
Volatility	2.4858**	2.5058**	2.5435**	2.5699**	2.5233**
	4.76	4.15	4.86	4.34	4.43
Spread	24.8161**	24.8270**	24.7964**	24.8306**	24.9102**
	7.83	7.87	7.79	7.89	7.04
Turnover	−2.5006**	−2.4859**	−2.4710**	−2.4436**	−2.6579**
	−4.57	−4.42	−4.27	−3.99	−4.13
Amihud	0.0046**	0.0043**	0.0041**	0.0039**	0.0051**
	4.10	3.85	3.62	3.51	4.51
ShortRate	−0.2190**	−0.2223**	−0.2296**	−0.2368**	−0.2061**
	−5.95	−6.13	−6.52	−6.91	−6.24
Return	−2.0345**	−2.0497**	−2.0472**	−2.0509**	−2.0370**
	−6.90	−6.38	−6.31	−6.42	−6.92
ShortAmt	0.0227**	0.0226**	0.0225**	0.0225**	0.0215**
	3.22	3.17	3.05	3.00	3.58
Price	−0.0485**	−0.0483**	−0.0481**	−0.0477**	−0.0487**
	−5.16	−5.97	−5.68	−5.26	−5.41
TrdAmt	0.0962**	0.0965**	0.0968**	0.0971**	0.0965**
	5.74	5.88	5.08	5.28	5.84
MktCap	0.0169**	0.0168**	0.0166**	0.0164**	0.0178**
	5.80	5.72	5.62	5.48	6.36
Buy ratio	1.4160**	1.4193**	1.4205**	1.4197**	1.3982**
	8.48	8.72	8.82	8.77	7.04
Adj R-sq	0.1053	0.1055	0.1056	0.1056	0.1036

ABS MIC	Coeff. t-value	Coeff. t-value	Coeff. t-value	Coeff. t-value	Coeff. t-value
Dummy [SMIC]	0.1069**	0.1070**	0.1070**	0.1070**	0.1070**
	6.89	6.89	6.90	6.91	6.91
CAR [$t-\tau$,_t−1]	−0.2293**	−0.1595**	−0.1110**	−0.0823**	−0.0001**
	−5.28	−4.97	−5.13	−5.88	−3.85
Volatility	2.5940**	2.6015**	2.6136**	2.6232**	2.6058**
	5.50	5.66	5.89	5.06	5.74
Spread	24.7306**	24.7364**	24.7271**	24.7357**	24.7664**
	7.05	7.07	7.04	7.07	7.15
Turnover	−2.5766**	−2.5760**	−2.5724**	−2.5580**	−2.6314**
	−6.19	−6.18	−6.14	−5.98	−6.79
Amihud	0.0064**	0.0063**	0.0063**	0.0062**	0.0065**
	5.92	5.84	5.77	5.71	6.05
ShortRate	−0.0252	−0.0260	−0.0283	−0.0314	−0.0200
	−1.42	−1.46	−1.59	−1.77	−1.13
Return	−0.8465**	−0.8515**	−0.8507**	−0.8522**	−0.8466**
	−7.87	−8.02	−8.00	−8.05	−7.87
ShortAmt	0.0211**	0.0211**	0.0211**	0.0211**	0.0207**
	3.06	3.01	3.97	3.99	3.48
Price	−0.0503**	−0.0502**	−0.0501**	−0.0500**	−0.0504**
	−6.58	−6.51	−6.39	−6.20	−6.74
TrdAmt	0.1095**	0.1096**	0.1097**	0.1098**	0.1100**
	6.71	6.75	6.81	6.89	7.01
MktCap	0.0179**	0.0179**	0.0178**	0.0177**	0.0181**
	5.85	5.84	5.82	5.75	6.00

(*continued*)

Table 3.

ABS MIC	Coeff. t-value	Coeff. t-value	Coeff. t-value	Coeff. t-value	Coeff. t-value
Sell ratio	2.4023**	2.4020**	2.4014**	2.4013**	2.4092**
	5.72	5.63	5.53	5.57	6.66
Adj R-sq	0.1645	0.1645	0.1645	0.1645	0.1643

ABS MIC	Coeff. t-value	Coeff. t-value	Coeff. t-value	Coeff. t-value	Coeff. t-value
Dummy [BMIC]	0.3215**	0.3217**	0.3218**	0.3221**	0.3227**
	5.59	5.62	5.64	5.69	5.77
Dummy [SMIC]	0.4251**	0.4252**	0.4253**	0.4257**	0.4263**
	7.76	7.79	7.81	7.87	7.94
CAR[$t-\tau$,_$t-1$]	−0.3842**	−0.2797**	−0.2008**	−0.1416**	−0.0001**
	−6.51	−6.76	−7.56	−7.94	−4.51
Volatility	2.6023**	2.6144**	2.6359**	2.6518**	2.6234**
	4.63	4.87	4.27	4.55	4.02
Spread	24.5902**	24.5982**	24.5801**	24.5986**	24.6473**
	6.72	6.74	6.69	6.75	6.86
Turnover	−2.5279**	−2.5226**	−2.5129**	−2.4933**	−2.6198**
	−4.67	−4.62	−4.52	−4.31	−5.60
Amihud	0.0094**	0.0093**	0.0091**	0.0091**	0.0097**
	8.37	8.24	8.10	8.02	8.60
ShortRate	−0.1922**	−0.1939**	−0.1983**	−0.2029**	−0.1836**
	−10.41	−10.50	−10.74	−10.98	−9.95
Return	−1.3124**	−1.3215**	−1.3206**	−1.3227**	−1.3096**
	−4.24	−4.52	−4.50	−4.56	−4.14
ShortAmt	0.0218**	0.0217**	0.0217**	0.0217**	0.0211**
	3.67	3.61	3.56	3.56	3.71
Price	−0.0411**	−0.0410**	−0.0408**	−0.0406**	−0.0412**
	−4.92	−4.80	−4.62	−4.36	−5.11
TrdAmt	0.0537**	0.0538**	0.0540**	0.0542**	0.0541**
	3.26	3.32	3.42	3.55	3.50
MktCap	0.0310**	0.0309**	0.0308**	0.0307**	0.0314**
	9.69	9.66	9.60	9.50	9.99
Net ratio	−0.4482**	−0.4468**	−0.4456**	−0.4459**	−0.4594**
	−5.64	−5.44	−5.29	−5.34	−5.08
Adj R-sq	0.0934	0.0934	0.0935	0.0935	0.0928

Note(s): This table reports the estimates and t-value from the regression in Equations (2)–(4) where the dependent variable is MIC defined as the Market Impact Cost of the NPS

$MIC_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Buy})_{i,t} + \beta_1 * CAR_{i,t-\tau,t-1} + \sum_{n=2}^{m} \beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t}$ (2)

$MIC_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Sell})_{i,t} + \beta_1 * CAR_{i,t-\tau,t-1} + \sum_{n=2}^{m} \beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t}$ (3)

$MIC_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Buy})_{i,t} + \beta_1 * D(\mathrm{Sell})_{i,t} + \beta_2 * CAR_{i,t-\tau,t-1} + \sum_{n=3}^{m} \beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t}$ (4)

The main independent variable is CAR estimated using the KOSPI returns. A dummy variable is added for the market impact cost of buys in Equation (2); and a dummy variable is added for the market impact cost of sells in Equation (3); and dummy variables are added for the market impact cost of buys and sells in Equation (4) to test the difference between buys and sells. We also adopt a model using the net market impact cost (NET MIC), which is the sum of the market impact cost of buys and sells, as a dependent variable, and a model using the market impact cost as a dependent variable by changing it to an absolute value (ABS MIC). Intraday volatility, spread, turnover ratio, Amihud measure, short selling ratio, daily rate of return, short selling amount, stock price, trading amount and market capitalization on the day, trading ratio are used as control variables. The sample period runs from January 2010 to December 2018. * and ** indicate statistically significant levels at the 5% and 1% levels, respectively

Table 3.

Panel A of Table 4 uses the net market impact cost of the NPS as a dependent variable and presents the results of regression analysis for the 20% group with the lowest CAR (Low), the middle 20% group (Middle) and the 20% group with the highest CAR (High), divided into 5 groups based on the short-term return of CAR(-3,-1) and the medium-term return of CAR(-30,-1). Using both buy and sell dummy variables, the influence of market impact cost from selling

	Low			Middle			High		
Panel A: NET MIC									
CAR	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
[t−3, t−1]	t-value	t-value	t-value	t-value	t-value	t-value	t-value	t-value	t-value
Dummy	0.3127**		0.3195**	0.3113**		0.3172**	0.3305**		0.3404**
[BMIC]	4.61		4.02	4.75		4.20	5.86		5.81
Dummy		−0.5297**	−0.5340**		−0.4118**	−0.4159**		−0.3880**	−0.4031**
[SMIC]		−4.09	−4.35		−5.63	−5.96		−6.96	−6.79
CAR	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
[t−30, t−1]	t-value	t-value	t-value	t-value	t-value	t-value	t-value	t-value	t-value
Dummy	0.3086**		0.3150**	0.3622**		0.3696**	0.3087**		0.3227**
[BMIC]	4.81		5.23	4.98		4.53	4.65		5.50
Dummy		−0.5195**	−0.5232**		−0.4093**	−0.4148**		−0.3556**	−0.3645**
[SMIC]		−5.46	−5.70		−5.85	−6.30		−5.67	−6.31
Panel B: ABS MIC									
CAR	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
[t−3, t−1]	t-value	t-value	t-value	t-value	t-value	t-value	t-value	t-value	t-value
Dummy	−0.2019**		0.3391**	−0.0810**		0.3437**	−0.0008		0.3870**
[BMIC]	−4.46		4.65	−4.52		4.32	−0.25		3.78
Dummy		0.2337**	0.5611**		0.1168**	0.4453**		0.0418**	0.4084**
[SMIC]		5.96	5.14		5.08	5.36		4.47	4.86
CAR	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
[t−30, t−1]	t-value	t-value	t-value	t-value	t-value	t-value	t-value	t-value	t-value
Dummy	−0.1644**		0.3424**	−0.0686**		0.3590**	−0.0282**		0.3740**
[BMIC]	−3.87		3.51	−4.34		3.15	−3.91		3.21
Dummy		0.1984**	0.5277**		0.1062**	0.4489**		0.0638**	0.4215**
[SMIC]		4.05	4.66		5.45	6.41		4.89	5.13

Note(s): This table reports the estimates and t-value from the regression in Equation (2) where the dependent variable is MIC defined as the Market Impact Cost of the NPS

$$\mathrm{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Buy})_{i,t} + \beta_1 * \mathrm{CAR}_{i,t-\tau,t-1} + \sum_{n=2}^{m} \beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t} \quad (2)$$

The main independent variable is CAR estimated using the KOSPI returns. A dummy variable is added for the market impact cost of buys (D(Buy)), or the market impact cost of sells (D(Sell)), or the market impact cost of buys and sells (D(Buy), D(Sell)). We also adopt a model using the net market impact cost (NET MIC), which is the sum of the market impact cost of buys and sells, as a dependent variable, and a model using the market impact cost as a dependent variable by changing it to an absolute value (ABS MIC). We also divide our sample into quintiles based on the cumulative abnormal returns for a certain period in the past and run a regression analysis using Equation (2) for groups belonging to the low returns (lowest 20% group), middle returns (middle 20% group), and high returns (highest 20% group). Intraday volatility, spread, turnover ratio, Amihud measure, short selling ratio, daily rate of return, short selling amount, stock price, trading amount and market capitalization on the day, trading ratio are used as control variables. The sample period runs from January 2010 to December 2018. * and ** indicate statistically significant levels at the 5% and 1% levels, respectively

Table 4. Comparison of market impact cost between buys and sells: by CAR

is relatively larger than that of market impact cost from buying. Consistent results are shown in all five groups based on short-term and medium-term returns. In particular, the lower CAR, the higher the absolute value of the market impact cost from selling. These results show that the selling influence of the NPS is greater in stocks with low past returns, that is, stocks whose stock price has fallen. Therefore, our findings suggest that the selling behavior of the NPS can act as bad news for market participants.

The result of panel B, which is a regression analysis on the absolute value of market impact cost as a dependent variable, also shows two features. First, the market impact cost of the NPS sells has a relatively greater influence than the market impact cost of buys. Second, the influence from selling by the NPS is greater when the past return is low. These results, like those of panel A, indicate that the selling by the NPS can act as bad news for the market. Since the NPS is planning a strategy to reduce the proportion of domestic stock investment in the future, an exit strategy could cause a bigger drop in the stock price than expected. For this reason, a strategy to reduce the market impact cost is necessary for the NPS.

Table 5 shows the result of regression analysis of a difference in the market impact cost of the NPS between buys and sells, divided into five groups based on liquidity. Panel A shows the results using the bid-ask spread for the 20% group with the lowest liquidity (Low), the middle 20% group (Middle) and the 20% group with the highest liquidity (High). As a result of the analysis, the market impact cost of by the NPS are large in stocks for the 20% group with the lowest liquidity. In addition, the market impact cost of the NPS from selling is relatively larger than that from buying in all groups. These results are consistently observed whether using the net market impact cost or the absolute value of the market impact cost.

Panel B shows the results using the Amihud measure for the 20% group with the highest illiquidity measure (Low), the middle 20% group (Middle) and the 20% group with the lowest illiquidity measure (High). Like using the spread, we find that the smaller the liquidity, the greater the market impact cost of the NPS. In addition, the market impact cost of the NPS from selling is relatively larger than that from buying. This result implies that the smaller the liquidity, the greater the impact on the stock due to the relatively higher market impact cost by the NPS.

Panel A of Table 6 is divided into 5 groups according to intraday volatility of stocks traded by the NPS and shows the results of regression analysis for the 20% group with the lowest volatility (Low), the middle 20% group (Middle) and the 20% group with the highest volatility (High). The greater the volatility, the higher the market impact cost of the NPS. In addition, the market impact cost from selling is larger than that from buying. These results are consistently shown in both cases using the net market impact cost and the absolute value of market impact cost.

Panel B presents the results of regression analysis for the lower, middle and upper groups, divided into five groups based on the buying amount of the NPS to the trading amount of the relevant stock on the day (Buy ratio). According to the results of regression analysis by dividing the NPS into five groups by the buy ratio, the market impact cost of the NPS continues to increase as the buy ratio increases. Interestingly, in a group with the highest buy ratio of the NPS, the market impact cost from buying is relatively higher than that from selling, which contrasts with the previous findings.

We find the negative sign of price impact cost asymmetry that the market impact cost from the NPS sells is generally higher than that from buys. However, the asymmetry can become positive under some conditions. Normally institutions buy stocks with positive information and sell stocks when they have negative information. New information about a stock gets impounded into the prices in the process of trades. Since the degree of the price impact is affected by the proportion of informed trading, the information content of the NPS trading increases in proportion to the trading intensity of the NPS. Therefore, the sign of the market impact cost asymmetry between the NPS buys versus sells is negative at the low level

Table 5. Comparison of market impact cost between buys and sells: by liquidity

	Low			Middle			High		
Panel A: Spread									
NET MIC	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
	t-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value
Dummy	0.4523**		0.4652**	0.2950**		0.3005**	0.2720**		0.2793*
[BMIC]	2.81		2.89	2.71		2.58	2.94		2.30
Dummy		−0.7066**	−0.7140**		−0.3615**	−0.3653**		−0.2743**	−0.2803**
[SMIC]		−3.05	−3.94		−3.14	−3.46		−3.57	−4.13
ABS MIC	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
	t-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value
Dummy	−0.2153**		0.5070**	−0.0555**		0.3443**	−0.0295**		0.2594**
[BMIC]	−3.35		2.92	−2.70		2.74	−2.90		2.73
Dummy		0.2821**	0.7633**		0.0872**	0.4176**		0.0494**	0.2998**
[SMIC]		5.81	4.98		2.72	3.03		2.91	3.02
Panel B: Amihud									
Net MIC	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
	t-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value
Dummy	0.3944**		0.4062**	0.3803**		0.3931**	0.2446**		0.2514**
[BMIC]	3.14		3.77	4.36		5.16	4.78		4.55
Dummy		−0.5024**	−0.5099**		−0.4654**	−0.4741**		−0.2761**	−0.2818**
[SMIC]		−4.46	−4.91		−6.12	−6.72		−5.36	−6.03
ABS MIC	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
	t-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value
Dummy	−0.1114**		0.4097**	−0.0946**		0.3769**	−0.0288**		0.2662**
[BMIC]	−5.49		4.02	−3.95		3.15	−3.52		3.04
Dummy		0.1514**	0.5444**		0.1329**	0.4936**		0.0552**	0.3095**
[SMIC]		4.72	5.86		3.70	4.83		4.07	5.21

Note(s): This table reports the estimates and *t*-value from the regression in Equations (5)–(6) where the dependent variable is MIC defined as the Market Impact Cost of the NPS

$\mathrm{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Buy})_{i,t} + \beta_1 * \mathrm{Spread}_{i,t} + \sum_{n=1}^{m}\beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t}$ (5)

$\mathrm{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Buy})_{i,t} + \beta_1 * \mathrm{Amihud}_{i,t} + \sum_{n=1}^{m}\beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t}$ (6)

The main independent variable is the spread and Amihud measure. The spread is the average value of the intraday spread, which is calculated by dividing the difference between the best bid quote and the best ask quote by the average of the two values. The Amihud measure is the absolute value of the daily return to trading amount ratio. A dummy variable is added for the market impact cost of buys (D(Buy)), or the market impact cost of sells (D(Sell)), or the market impact cost of buys and sells (D(Buy), D(Sell)). We also adopt a model using the net market impact cost (NET MIC), which is the sum of the market impact cost of buys and sells, as a dependent variable, and a model using the market impact cost as a dependent variable by changing it to an absolute value (ABS MIC). We also divide our sample into quintiles based on the cumulative abnormal returns for a certain period in the past and run a regression analysis using Equations (5)–(6) for groups belonging to the high group (highest 20% group), middle group (middle 20% group) and low group (lowest 20% group). Intraday volatility, spread, turnover ratio, Amihud measure, short selling ratio, daily rate of return, short selling amount, stock price, trading amount and market capitalization on the day, trading ratio are used as control variables. For the sake of brevity, the regression coefficients and *t*-values for specific variables are reported. The sample period runs from January 2010 to December 2018. * and ** indicate statistically significant levels at the 5% and 1% levels, respectively

Table 6.
Comparison of market impact cost between buys and sells: by volatility and trading intensity

	Low			Middle			High		
Panel A: Volatility									
Net MIC	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
	t-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value
Dummy	0.2917**		0.3016**	0.3921**		0.4002**	0.3867**		0.3930**
[BMIC]	3.66		3.60	3.40		3.00	3.23		3.54
Dummy		−0.3290**	−0.3376**		−0.4096**	−0.4158**		−0.5631**	−0.5660**
[SMIC]		−5.86	−6.69		−5.08	−5.59		−3.86	−4.03
ABS MIC	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
	t-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value
Dummy	−0.0560*		0.3058**	−0.0713**		0.3625**	−0.1418**		0.4045**
[BMIC]	−2.55		3.51	−3.60		2.95	−2.91		3.09
Dummy		0.0896**	0.3808**		0.1076**	0.4544**		0.1797**	0.5688**
[SMIC]		2.73	3.20		5.62	6.99		3.02	3.44
Panel B: Buy ratio									
Net MIC	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
	t-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value
Dummy	0.0106		0.0212	0.2435**		0.2551**	0.5462**		0.5561**
[BMIC]	0.89		1.81	5.03		5.49	7.33		7.59
Dummy		−0.5296**	−0.5307**		−0.4567**	−0.4586**		−0.2685**	−0.2699**
[SMIC]		−3.69	−3.74		−3.40	−3.54		−5.44	−5.58
ABS MIC	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
	t-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value
Dummy	−0.4284		0.0927	−0.0872**		0.3724**	0.2968**		0.6071**
[BMIC]	−1.27		1.84	−3.36		3.17	8.05		6.08
Dummy		0.4597**	0.5481**		0.1239**	0.4807**		−0.2556**	0.3251**
[SMIC]		5.56	4.38		3.28	3.61		−4.05	5.14
Panel C: Sell ratio									
Net MIC	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
	t-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value

(*continued*)

Table 6.

	Low			Middle			High		
Dummy	0.3701**		0.3719**	0.3578**		0.3606**	0.2447**		0.2469**
[BMIC]	3.39		3.56	4.80		5.03	5.19		5.28
Dummy		−0.0207**	−0.0269**		−0.3303**	−0.3416**		−0.8850**	−0.9022**
[SMIC]		−4.03	−5.30		−5.64	−6.12		−6.86	−7.00
ABS MIC	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
	t-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value	*t*-value
Dummy	0.3087**		0.3768**	−0.0312**		0.3732**	−0.5800**		0.3105**
[BMIC]	5.19		5.30	−5.29		5.64	−3.20		3.14
Dummy		−0.2382**	0.3825**		0.0384**	0.4082**		0.5817**	0.8918**
[SMIC]		−4.51	3.63		6.65	6.19		5.56	4.01

Note(s): This table reports the estimates and *t*-value from the regression in Equations (7)–(8) where the dependent variable is MIC defined as the Market Impact Cost of the NPS

$\text{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\text{Buy})_{i,t} + \beta_1 * \text{Volatility}_{i,t} + \sum_{n=1}^{m} \beta_{i,n} * \text{ControlVariables}_{i,n} + \varepsilon_{i,t}$ (7)

$\text{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\text{Buy})_{i,t} + \beta_1 * \text{TradeRatio}_{i,t} + \sum_{n=1}^{m} \beta_{i,n} * \text{ControlVariables}_{i,n} + \varepsilon_{i,t}$ (8)

The main independent variable is intraday volatility, which is the difference between intraday high and low prices divided by the average of the two values, and trading intensity, which represents the proportion of the transaction value of the NPS to the total transaction value of the day. A dummy variable is added for the market impact cost of buys (D(Buy)), or the market impact cost of sells (D(Sell)), or the market impact cost of buys and sells (D(Buy), D(Sell)). We also adopt a model using the net market impact cost (NET MIC), which is the sum of the market impact cost of buys and sells, as a dependent variable, and a model using the market impact cost as a dependent variable by changing it to an absolute value (ABS MIC). We also divide our sample into quintiles based on the cumulative abnormal returns for a certain period in the past and run a regression analysis using Equations (7)–(8) for groups belonging to the high group (highest 20% group), middle group (middle 20% group) and low group (lowest 20% group). Intraday volatility, spread, turnover ratio, Amihud measure, short selling ratio, daily rate of return, short selling amount, stock price, trading amount and market capitalization on the day, trading ratio are used as control variables. For the sake of brevity, the regression coefficients and *t*-values for specific variables are reported. The sample period runs from January 2010 to December 2018. * and ** indicate statistically significant levels at the 5% and 1% levels, respectively of NPS's trading intensity of buys (Buy ratio) and reverses at the high level of NPS's trading intensity of buys.

Panel C presents the results of regression analysis for the lower, middle and upper groups, divided into five groups based on the selling amount of the NPS to the trading amount of the relevant stock on the day (Sell ratio). As the sell ratio increases, the market impact cost of the NPS from sells also increases, but the market impact cost of the NPS from buys decreases. Regardless of the sell ratio of the NPS, the market impact cost from sells is relatively higher than that of buys. The fact that the market impact cost is large in stocks with high volatility and a high proportion of the NPS trading suggests that careful and appropriate consideration is necessary for the NPS's order submission and trading strategy.

4.4 Comparison of market impact cost considering order submission strategy

The NPS has a structure in which trades executes according to the internal committee's decision-making and fund execution decisions. Depending on the size of the funds and market conditions, funds may be executed at one time or several times through split trading. In addition, institutional investors who receive the NPS's funds must follow the instructions of the NPS.

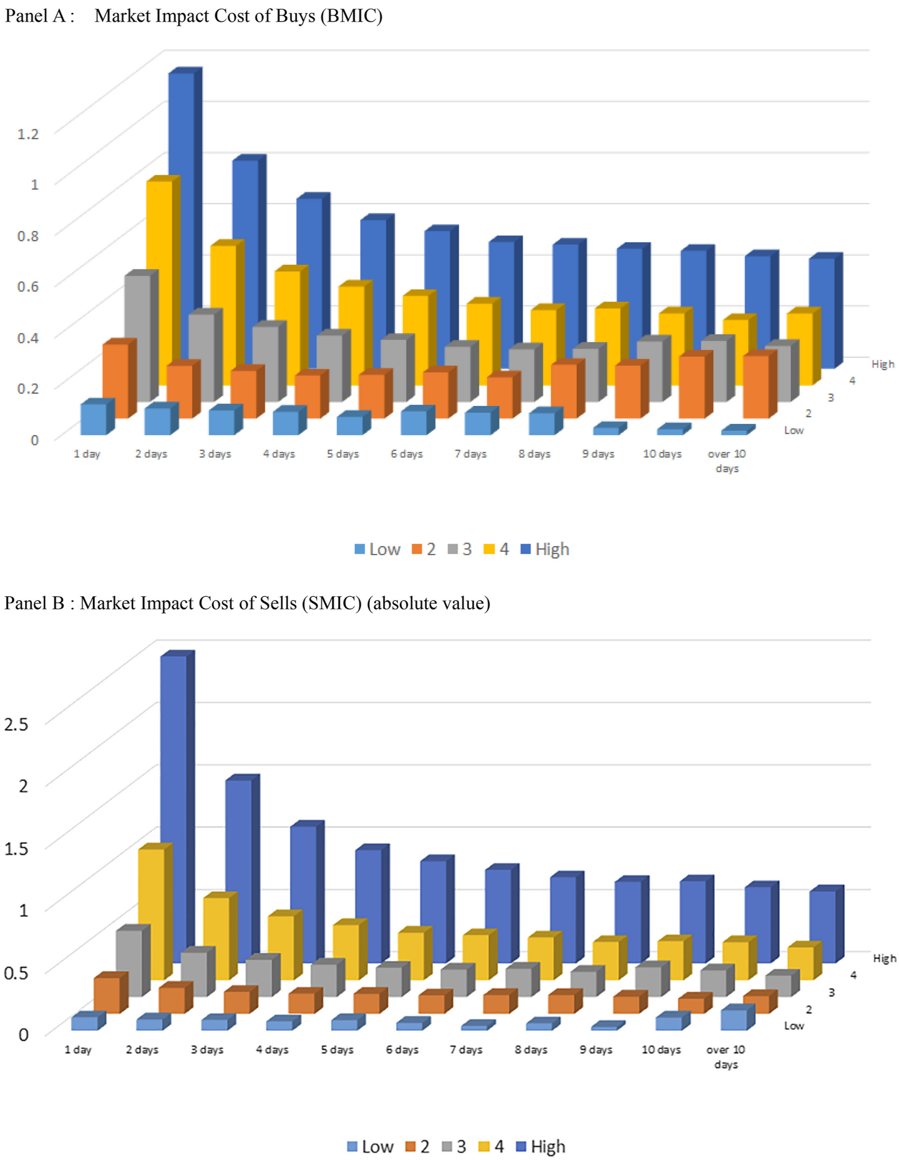
Since the actual state of fund execution by the NPS is unknown, we estimate the fund execution through the following process. First, when a buy (sell) order for the same stock is executed through consecutive business days, it is considered as one buy (sell) fund execution. Second, when a buy or sell order for a specific stock is executed with a lag of one day or more after the buy or sell order is executed for the same stock, it is considered as separate execution of funds.

As a result of estimating in this way, about 43% of trades executed by the NPS are made through one-day execution, and only 16% of the cases are split over 5 days or more. Figure 4 compares the market impact cost of buys and sells by order execution period and size. In the case of split execution over two days or more, the average market impact cost is calculated. In addition, since the execution of splits can be determined by the execution size, the sum of consecutive execution amounts is defined as the execution size. Based on the execution size, it is divided into five groups and the average market impact cost is calculated for each execution date. First, according to the figure, as the execution size increases, the market impact cost also increases consistently. Second, as the execution period increases, that is, as the number of split trading days increases, the average market impact cost decreases. Third, the absolute value of the market impact cost from sells is consistently larger than that from buys.

Table 7 shows regression analysis of whether there is a difference in the market impact cost between buys and sells based on the execution period of the order. In both Panel A, which is analyzed separately by buying-order execution period, and Panel B, which is analyzed separately by selling-order execution period, the market impact cost from sells has a relatively greater influence than the market impact cost from buys regardless of the execution period. Even after controlling for the size of the order execution of the NPS and the diversification effect of order execution, the market impact cost from sells is still larger than that from buys. This result is attributable to the NPS's more aggressive order submission on sell orders, which implies that there is a difference between the buying side and the selling side in the NPS's order submission and trading strategies.

5. Conclusion and implications

As of the end of March 2021, the NPS has managed 872.5tn won (KRW), the 3rd largest fund in the world after Japan and Norway. Of this, 20.5%, or 178.7tn won, is being managed as domestic stocks, but as the size of the fund increases, overseas investment is continuously expanding to pursue long-term stable profits. While domestic stock management grew 74.5%



Note(s): This figure shows the frequency according to the magnitude of the absolute value of the buying market impact cost buys (bar graph) and sells (dot graph) from January 2010 to December 2018. BMIC is the market impact cost from buys of the NPS, and SMIC is the market impact cost from sells of the NPS

Figure 4. Market impact cost by order execution period and size

from 102.4tn won in 2016 to 178.7tn won as of March 2021, overseas stocks grew by 150.6% from 85.7tn won in 2016 to 214.8tn won as of March 2021. This change in the asset allocation strategy is related to the NPS's exit strategy for domestic stocks. In the domestic stock

Table 7.
Market impact cost by order execution period

Variable	1 day Coeff. *t*-value	2 days Coeff. *t*-value	3 days Coeff. *t*-value	4 days Coeff. *t*-value	5 days Coeff. *t*-value	6 days Coeff. *t*-value	7 days Coeff. *t*-value	8 days Coeff. *t*-value	9 days Coeff. *t*-value	10 days Coeff. *t*-value	Over 10 days Coeff. *t*-value
Panel A: AVG BMIC											
Dummy	0.0200**	0.0515**	0.0451**	0.0589**	0.0704**	0.0443**	0.0580**	0.0620**	0.0461*	0.0450	0.0437**
BMIC	3.77	6.92	4.84	5.48	5.66	3.06	3.67	3.74	2.36	1.78	4.21
Dummy	0.0450**	0.0555**	0.0695**	0.0659**	0.0769**	0.0776**	0.0603**	0.0705**	0.0715**	0.0769**	0.0606**
SMIC	9.42	8.31	7.98	6.57	6.32	5.68	3.71	3.81	3.52	3.14	5.34
Buy	0.1166**	0.1338**	0.1421**	0.1433**	0.1438**	0.1444**	0.1430**	0.1424**	0.1398**	0.1357**	0.1142**
Amount	6.98	9.44	8.25	7.50	6.95	5.46	4.82	3.65	3.08	2.71	3.01
Sell	−0.0088**	−0.0193**	−0.0270**	−0.0329**	−0.0366**	−0.0394**	−0.0405**	−0.0443**	−0.0464**	−0.0487**	−0.0661**
Amount	−5.14	−9.77	−9.86	−9.30	−7.42	−5.49	−3.27	−3.25	−2.96	−3.10	−3.11
Panel B: AVG SMIC											
Dummy	−0.0316**	−0.0186	−0.0320	−0.0418*	−0.0465	−0.0314	−0.0519	−0.0153	−0.0667	0.0023	−0.0360
BMIC	−3.53	−1.52	−1.95	−2.16	−1.88	−1.12	−1.62	−0.46	−1.79	0.05	−1.83
Dummy	−0.0381**	−0.0821**	−0.0389*	−0.0697**	−0.1102**	−0.0677*	−0.0874**	−0.1084**	−0.1786**	−0.1068*	−0.1153**
SMIC	−4.72	−6.05	−2.22	−3.36	−4.37	−2.28	−2.66	−2.95	−4.61	−2.29	−5.36
Buy	0.0164**	0.0458**	0.0719**	0.0975**	0.1267**	0.1498**	0.1690**	0.1901**	0.2053**	0.2214**	0.2644**
Amount	5.53	4.29	6.42	7.70	7.79	6.57	5.63	4.65	3.89	3.20	4.74
Sell	−0.1561**	−0.2081**	−0.2430**	−0.2650**	−0.2963**	−0.3154**	−0.3283**	−0.3371**	−0.3501**	−0.3634**	−0.3565**
Amount	−8.62	−6.99	−5.08	−8.63	−6.52	−6.45	−5.23	−4.95	−4.29	−3.49	−8.47

Note(s): This table reports the estimates and *t*-value from the regression in Equation (9) where the dependent variable is MIC defined as the Market Impact Cost of the NPS

$\mathrm{MIC}_{i,t} = \alpha_0 + \beta_0 * D(\mathrm{Buy})_{i,t} + \sum_{n=1}^{10}\gamma_t * \mathrm{Trade}_t + \sum_{n=1}^{m}\beta_{i,n} * \mathrm{ControlVariables}_{i,n} + \varepsilon_{i,t}$ (9)

The main independent variable is the frequency and size of fund execution. The amount of fund execution is estimated by summing up the transaction values based on the continuity of trading details. A dummy variable is added for the market impact cost of buys (D(Buy)), or the market impact cost of sells (D(Sell)), or the market impact cost of buys and sells (D(Buy), D(Sell)). We also adopt a model using the market impact cost of buys(BMIC) and sells(SMIC). Intraday volatility, spread, turnover ratio, Amihud measure, short selling ratio, daily rate of return, short selling amount, stock price, trading amount and market capitalization on the day, trading ratio are used as control variables. For the sake of brevity, the regression coefficients and *t*-values for specific variables are reported. The sample period runs from January 2010 to December 2018. * and ** indicate statistically significant levels at the 5% and 1% levels, respectively market, where individual investors account for about 50% of the trading volume, foreign and institutional investors' buys of specific stocks are considered good news. If the NPS reduces the proportion of certain stocks and incurs significant market impact costs, it is highly likely to act as bad news for individual investors.

The purpose of this study is to examine the market impact cost asymmetry between buys and sells and to suggest a trading strategy for mitigating the market impact cost. From 2010 to 2018, the market impact costs of buys and sells are calculated based on the transaction history of the NPS, and the asymmetry is analyzed. The main analysis results of the questions posed by the authors are as follows. First, there is an asymmetry between the buying side and the selling side in the market impact cost of the NPS. The market impact cost of the NPS is gradually increasing over time, and the market impact cost from selling has increased significantly in recent years. Second, past returns, volatility, liquidity and trading intensity can be found as external factors affecting the asymmetric market impact cost of the NPS. Although there is no difference between the buying and selling ratios of the NPS, the market impact cost from sells is relatively higher than that from buys. After controlling for stock characteristics and past returns, the market impact cost of sells is still relatively larger than that of buys. Third, as an internal factor affecting the asymmetric market impact cost of the NPS, the differential order strategy between the sell order and the buy order of the NPS may be a factor. As a result of reflecting the order execution period and execution size of the NPS, the longer the trade execution period and the lower the market impact cost. This result implies that the strategy of splitting orders as a way to reduce market impact costs is effective. However, even considering the trade execution period, the market impact cost of sells is still higher than that of buys. This result is attributable to the NPS's more aggressive order submission on sell orders.

The trading strategy and market influence of the NPS have a significant impact on other investors directly or indirectly. The disposition of the NPS can act as bad news for the market. In particular, if excessive market impact costs are incurred, the adverse effect on the stock price will be further doubled. Since the NPS is planning a strategy to reduce the proportion of domestic stock investment in the future, an exit strategy could cause a bigger drop in the stock price than expected. Accordingly, it is necessary for the NPS to distribute market impact costs through trading splits in executing order submission and trading strategies in the domestic stock market.

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