Overnight Strategy of Foreign Day-traders and Their Performance: An Empirical Study from the Korea Stock Exchange

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Abstract

Using a unique intraday trade and quote data set of the Korea Stock Exchange which includes customized symbols identifying individual accounts, we investigate the overnight strategy of foreign day-traders to determine the factors that affect their overnight positions and their informational advantage in day-trading. We find that the overnight positions of foreign day-traders are likely to capture positive future stock movements, indicating that foreign day-traders are better informed than domestic ones even on extremely short term investment horizon. We also find that foreign day-traders consider currency movements in their decisions on overnight positions and benefit from appreciation in the KRW by holding Korean stocks overnight, whereas domestic day-traders do not.

Keywords: Day-traders, Overnight position, Foreign investors, Momentum trading, Disposition effect

JEL classification: G10; G14; G15

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1. Introduction

Among various types of investment strategies, day-trading has become a very dominant one, comprising a large proportion of trading volumes in global stock markets—a proportion that has steadily increased with the rapid development of the Internet and widespread online trading.[3] However, research on the behavior of day-traders and their trading strategies is sparse due to the limited availability of data on day-traders, and research on the behavior of foreign day-traders is even sparser. Unlike longer term investments, day-trading as a short term investment strategy is supposed to rely on past trading data, rather than on information on the fundamental values of firms, and therefore, any empirical results from existing literature which focus on the longer term behavior or performance of foreign investors in a local stock market lose their relevance.

In this paper, we investigate the overnight strategy of foreign day-traders in the Korean stock market to shed light on whether or not foreign day-traders have informational advantage or disadvantage compared with domestic investors on a very short term investment horizon. The major difference between existing literature and our paper is that we investigate the trading behavior of foreign day-traders who are supposed to use their judgment on extremely short-term movements in stock prices, and attempt to beat the market. If foreign day-traders are found to achieve superior performance than domestic investors, it will be mainly due to their superior ability to interpret the short-term movements of stock prices, rather than their ability to obtain and interpret the information on the fundamental values of firms.

Day-trading refers to a short-term trading strategy in which investors quickly and repetitively buy and sell the same stocks on a trading day to obtain small profits from each trade. Typically, day-traders tend to close out their positions by the end of the trading day and attempt to avoid the risk of overnight price changes from overnight positions. This topic is interesting because existing literature on the performance of foreign investors has used rather longer term data where the information set of foreign investors would include the information on the fundamental values of the firms they are

[3] Barber, Lee, Liu and Odean (2014) find that day-trading accounts for 17% of all volume on the Taiwan Stock Exchange (TSE). Choe and Kho (2009) analyze day-trading on the Korean Stock Exchange (KSE) and find that approximately 11% of the total trading value in January 1999 and 20.8% in December 2000 are composed of day-trading.

investing in. However, in our study where we use intra-day trading data, foreign day-traders would rely mostly on intra-day stock price movements on a very short term horizon, while information on fundamental values of firms would be quite occasional. Therefore, studying whether or not foreign investors would still have informational advantage or disadvantage on a very short term investment horizon, and investigating the source of information that affects the investment decision and the performance of foreign day-traders would extend our understanding on their behavior.

Related with the topic on day traders, earlier studies focused on analyzing their profitability and, generally, used only a small sample of investors or limited market transactions. Harris and Schultz (1998), who made the first attempt to investigate the profitability of Small Order Execution System (SOES) traders[4] using data from two separate brokerage firms from November 1993 to March 1994, find that SOES traders trade on information and can earn small profits. Similarly, Garvey and Murphy (2005a) investigate 15 proprietary stock day-trading teams with data on 96,000 transactions for three months in 2000. They find that their trading strategies worked well and profits were earned early against the trend. Garvey and Murphy (2005b) examine day-traders' trading profits and find a result similar to that of previous studies, which indicate that approximately half of the 1,386 day-traders generally earn a profit after paying commissions. Additionally, Seasholes and Wu (2007) analyze day-trading activities on the Shanghai Stock Exchange and insist that active day-traders can make substantial money by buying shares at their upper price limits and quickly selling their positions the following day. These academic studies support the evidence that day-traders can earn abnormal returns. Meanwhile, other researchers claim the opposite result. Jordan and Diltz (2003) use data from seven branches of national securities firms in the United States and indicate that day-traders lose money.

The fatal flaw of these studies is that they use only part of the trading data, thus depending on a segmented portion of information, which might lead to biased results. Recent studies attempt to reassess the results using a complete set of market data to analyze the profitability of day-trading. Mostly, they find that day-trading is not profitable, negating previous studies. Barber, Lee, Liu and Odean (2004) find that more than 80% of day-traders cannot earn profits but suffer losses during a six-month trading period. Other papers investigate the learning model of day-traders. Barber, Lee, Liu and Odean (2010) find that aggressive day-traders tend to lose money and do not support the learning model. In subsequent research, Barber, Lee, Liu and Odean (2011) analyze the learning model of day-traders in Taiwan and find that they seem to learn from trading but slowly, sub-optimally, and in a costly manner. Barber, Lee, Liu and Odean (2014) also investigate the cross-sectional differences in the intraday returns earned on trades and returns on open positions for the five days following a trade

[4] SOES traders are day-traders with access to the NASDAQ's SOES system.

made by day-traders in Taiwan. They find that significantly large cross-sectional differences exist among day-traders and that less than 1% of day-traders earn profits.

Lee, Park and Jang (2007) is the first academic paper that investigates the profitability and characteristics of day-trading in the Korea stock market using a four-month period intraday trade and quote data set in 2002 that includes information on the identity of each investor. They find that most day-traders lose money. Choe, Chung and Kho (2006) investigate how day-trading influences volatility and liquidity in the Korea Stock Exchange. They find that day-trading and return volatility positively affect each other and that day-trading is negatively related to bid–ask spreads.

In contrast to previous studies that focus on the trading behavior and profitability of day-traders during a trading day, our study aims to investigate the overnight positions of day-traders to determine the information content contained in their overnight position strategies focusing on the different behavior and performances across different types of investors. To investigate the informational advantage or disadvantage of different types of day-traders, we use their over-night inventory positions. Even though typical day-traders seldom take overnight positions, some occasionally maintain their inventory and are willing to face the risks inherent in overnight stock price movements. Using a unique intraday trade and quote data set that includes customized symbols identifying individual accounts, we define day-traders – as suggested by Harries and Schults (1997) – as traders who tends to equalize the number of stocks bought and the number of stocks sold during a trading day and finishes their trading without any inventory of stocks by the end of the day. Although by definition typical day-traders seldom take overnight positions and prefer to close out their positions by the end of each trading day, some occasionally maintain overnight inventory. We focus on these day-traders to investigate the factors that affect their overnight positions, and whether their overnight-positioning strategies contain information content on future stock price movements, thus having any informational advantage or disadvantage on a very short term investment horizon.

To answer these questions, we introduce a measure of the ratio of overnight day-traders, which is calculated as the number of overnight-positioners at time t among day-traders from t–5 to t–1. Statistical analysis of our data indicates that approximately 6 to 10% of day-traders take overnight positions by our definition. Using this measure of the ratio of overnight day-traders, we first examine the commonality of overnight strategies among different types of day-traders using principal component analysis (PCA) and investigate the dynamic relationships between the ratios of overnight day-traders and stock returns to determine the information content contained in their overnight positions.

To calculate stock returns, we use three different measures: *Ret1* is the log of the opening price at t+1 divided by the closing price at t, *Ret2* is the log of the closing price at t+1 divided by the closing price at t, and *Ret3* is the log of the closing price at t divided by the opening price at t. Each measure has a different purpose. *Ret3* captures stock price movements during a trading day and is used to investigate how the stock price movements from opening to closing on day t affect day-traders' overnight strategies. *Ret1* and *Ret2* are used to test whether day-traders' overnight strategies have information content for forecasting stock returns and whether or not overnight positioners can earn money.

In this paper, we use the intraday trade and quote data set of the Korean Stock Exchange (hereafter, KSE), which is one of the most active emerging stock markets in the world. Given the popularity of online trading and its low transaction costs, many investors in Korea follow short-term trading strategies. According to Choe, Chung and Kho (2006), day-trading comprises approximately 22.6% of the total trading value on the KSE during the sample period from 1999 to 2000. This property ensures that the KSE is an appropriate market for studying the behavior of day-traders and the relation between the portions of overnight day-traders and stock returns. The KSE adopts a purely electronic limit order market system, which opens at 9:00 and closes at 15:00.

This study explores three related hypotheses to assess the properties of the overnight strategy of day-traders and the reasons day-traders of different types decide to hold inventories.

First, we investigate whether foreign or domestic day-traders tend to hold overnight positions because of the disposition effect or as part of a return-chase strategy. Shefrin and Statman (1985), and Locke and Mann (2005) argue that investors tend to be risk averse when they achieve profits at current stock prices, and become risk lovers when they experience losses at current stock prices by holding on to losing stocks. Using 300 professional traders who are active in four commodities traded on the Chicago Mercantile Exchange, Locke and Mann (2005) find that professional investors, institutions, and foreigners also exhibit the disposition effect. In this context, we conjecture that day-traders in general choose to hold overnight positions just because they may be reluctant and afraid to close out their day's losing position in the hope of recouping their losses and test whether some day-traders hold overnight positions as a result of downward movements in stock prices, making them reluctant to close out their positions. On the other hand, Bohn and Tesar (1996), Brennan and Cao (1997), Choe, Kho and Stulz (1999), and Grinblatt and Keloharju (2000) argue that foreign investors are momentum followers and adopt a return-chasing or trend-chasing strategy by buying past winning stocks and selling past losing stocks. However, their investment horizons are more than weeks or months.

In our paper, we investigate whether foreign day-traders follow the momentum strategy in their overnight positions. Day-traders, unlike long-term investors, do not want to be exposed to overnight risk; therefore, they face a trade-off between the overnight inventory risk and the additional return that they can expect with their open positions. We conjecture that foreign day-traders still follow a trend-chase strategy when facing overnight risk even on a short term investment horizon. The research question is academically viable since existing literature on the momentum trading behavior of foreign investors are based on longer term investments. Of course, we will naturally have a momentum trading on longer term investments if foreign investors follow the momentum trading strategy on short term investments, but not vice versa.

Second, we investigate who are better informed between foreign and domestic investors in short-term investments such as day-trading. If a certain type of day-traders hold overnight positions because they have some information on future stock price movements and intentionally maintain open positions to benefit from upward stock price movements, we expect an upward price movement the next day with their increased open positions. To confirm our conjecture, we look into the relationship between the stock price movements on the next trading day and the proportion of overnight day-traders across different types of investors.

Finally, we test hypotheses that foreign day-traders would consider the movements in foreign exchange rate as well as stock returns as an additional factor in their decision on overnight positions while domestic investors would not.

The followings are the major findings and implications drawn from the empirical analysis of day-traders' overnight positions in the Korean stock market.

First, we find that domestic day-traders, whether they are individual or institutional, are reluctant to close out their losing day positions and prefer to maintain overnight positions, thus supporting the disposition effect hypothesis. In contrast, foreign day-traders tend to hold overnight positions if stock prices move upward during a trading day, thus following a momentum strategy in their overnight positions, which are consistent with previous findings on longer investment horizons (Bohn and Tesar (1996), Brennan and Cao (1997), Choe, Kho and Stulz (1999), and Grinblatt and Keloharju (2000), etc). Our result are interesting because foreign day-traders are maintaining their positions overnight despite of the risk they usually try to avoid as a day-trader, and also because the information involved in their decision on short term trading is mainly the trading information including past stock price movements, not information on the fundamental values of the firms.

Second, we find that the proportions of foreign day-traders holding overnight positions are positively related to the positive movements of stock prices during subsequent trading days. This finding supports the existing view that foreign investors are informed traders (Froot and Ramadorai (2008), Froot, O'Connel and Seasholes (2001), Grinblatt and Keloharju (2000)), but is interesting since their investment decisions are based on past trading information, which is typical public information, and therefore it would be their superior ability to interpret trading information in forecasting future price movements, which is quite different from the source of information foreign investors are supposed to use for superior performance as confirmed in the existing literature.

Third, we find that overnight foreign day-traders are currency-informed traders expecting and enjoying appreciation of the KRW by holding Korean stocks overnight while domestic investors are not. This empirical finding in foreign exchange market strengthens the previous results that foreign investors are informed traders even on a very short investment horizon.

This paper is organized as follows. In Section 2, we describe the data set and the variables used. Section 3 states the hypotheses and Section 4 reports the empirical results. Lastly, in Section 5, we briefly summarize the results of the study.

2 Data Description

2.1 Data Source

We use intraday transaction and quote data for firms listed on the KSE. The sample period covers January 2006 through December 2006 (total 240 days). We use only stocks with no fewer than 20 transactions per day and stocks that are traded on more than 30 days during the period, which results in a final selection of 1,457 stocks. The unique feature of the data is that it is possible to track each individual's trading activity throughout the data period because the intraday transaction and quote data set includes customized codes that identify individual accounts.

Our unique data set includes the following information:

- Firm codes;
- Customized trade codes;
- Order arrival times and order types;
- Indicator of buy or sell;
- Order price and size;
- Cancellation, amendment, or withdrawal of an order and time;
- Transaction price and quantity of a trade; and,
- Time and price of an executed order.

2.2 Definitions of Variables and Empirical Estimation

In this section, we introduce our method for defining day-traders and overnight positioners among them. Additionally, to validate whether the ratio of overnight day-traders affects or is affected by stock price movements, and whether a lead-lag relationship exists between the proportion of overnight day-traders and stock returns, we calculate three different stock return measures.

2.2.1 Day-traders and Overnight Day-traders

We follow the definition of day-traders suggested by Harries and Schults (1997).[5] Day-traders are investors who buy and sell the same stocks frequently during a trading day. Typical day-traders rarely take overnight inventories but prefer to close out their positions at the end of each trading day to avoid the risk incurred from holding overnight positions. However, some day-traders occasionally hold overnight positions.

[Insert Table 1 about here.]

Table 1 provides an example of how day-traders trade and close out their positions over time. We observe that a day-trader, whose account name is "*.3=":2/)9.8c*," starts a day buying 150 shares of the stock KR7000220004 on May 22, 2006, sells 30 shares, and then 30 more shares, and finally closes out his position by selling the remaining 90 share at 12:34 p.m. This day-trader also closes out his positions by the end of the trading day on May 23, 24, and 25, 2006. However, on May 29, 2006, he does not sell the shares that he purchased earlier that day, and holds 1,000 shares overnight.

The purpose of this paper is to investigate the occasional decisions that day-traders make to maintain inventories and to examine whether such overnight day-traders have information for forecasting future stock returns.

In this paper, we first identify the traders who equalize the number of shares bought and the number of shares sold of a stock during a day, and finish their trading day without any inventory. Then we define them as day-traders if they satisfy the above condition for five consecutive days. To simplify the analysis, traders who take short positions during the day are excluded from the sample.

We define overnight day-traders as day-traders who hold positions overnight at time t among the day-traders from t–5 to t–1, as previously defined. We chose the five-day criterion for a day-trader simply to ensure that he tends to close out his positions in general but also decides to occasionally maintain an open position.

[Insert Table 2 about here.]

For the case in Table 2, the accounts (a, c, g) are classified as overnight day-traders for the stock KR700002008 and the accounts (d, g, k) are similarly classified as overnight day-traders for the stock KR7000150003.

2.2.2 Ratio of Overnight Day-traders

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[5] Harris and Schultz (1998) actually do not examine day-traders but study traders called "SOES bandits."

This study intends to examine whether overnight day-traders have some commonality and information content on future stock returns and whether their strategies can earn money. To provide evidence on this question, we introduce a measure of the ratio of overnight day-traders (hereafter, *Overnight_ratio*), which is defined as the number of overnight day-traders at time t for each stock relative to the total number of day-traders from t–5 to t–1 for each stock.

$$Overnight\_ratio_{\,t,i} = \frac{\text{Number of overnight day−traders at time t among daytraders from t−5 to t−1}_{\,i}}{\text{Number of day−traders for firm i from t−5 to t−1}_{\,i}} \quad (1)$$

In Table 2, the number of day-traders from t–5 to t–1 of stock KR700002008 is 10 (a, b, c, d, g, h, i, j, x, z) and the number of overnight day-traders of stock KR700002008 is three (a, c, g). Thus, $Overnight\_ratio_{\,t,i}$ of stock KR700002008 on December 25 is 3/10=0.3. For stock KR7000150003, the number of day-traders from t–5 to t–1 is fifteen (a, b, c, d, e, f, g, h, k, l, m, r, v, w, x), and the number of overnight day-traders is three (d, g, k), resulting in an $Overnight\_ratio_{\,t,i}$ of stock KR7000150003 on December 25 of 3/15=0.2.

We assume that each of the investor group, foreign, domestic individuals, and domestic institutional investors is motivated by different sets of information in their trading. We conduct the analysis by each investor group and designate the ratio of overnight day-traders for foreigners as *Overnight_ratio_for*, the ratio of overnight day-traders for individuals as *Overnight_ratio_ind*, and the ratio of overnight day-traders for institutions as *Overnight_ratio_ins*, respectively.

2.2.3 Stock Returns

We use three different stock return measures. *Ret1* is calculated as the log of the opening price at t+1 divided by the closing price at t, and *Ret2* is calculated as the log of the closing price at t+1 divided by the closing price at t. *Ret3* is calculated as the log of the closing price at t divided by the opening price at t. Each return has a different meaning for our analyses. *Ret1* and *Ret2* are used to test whether the overnight day-traders engage in an information-based strategy that attempts to obtain profits from favorable stock price movements from the closing of the market on day t to the opening or closing on day t+1.

Stock returns are aggregately equal-weighted averaged across stocks for the time-series analysis. In addition, because this paper conducts an analysis on each investor group, stock returns are averaged for each investor group. Therefore, we introduce measures such as *Ret1_for (Ret2_for, Ret3_for)*, *Ret1_ind (Ret2_ind, Ret3_ind)*, and *Ret1_ins (Ret2_ins, Ret3_ins)* for foreigners, individuals, and institutional investors, respectively.

3. Hypotheses

To assess the properties of overnight day-traders and the reasons they adopt such a strategy, we test the following three hypotheses.

Hypothesis 1: Domestic day-traders tend to hold overnight positions because of the disposition effect.

Most investors are inclined to hold losers long and sell winners soon. This investor trait stems from the tendency to become risk averse when they earn profits at current stock prices and to become risk lovers when they experience losses at current stock prices in the hope of breaking even by continuing to hold losing stocks. Shefrin and Statman (1985) term such an investment tendency the disposition effect, i.e., the traits of investors to ride losses and realize gains. Many studies attempt to examine the existence of the disposition effect in financial markets.[6]

In this context, we suppose that though typical day-traders rarely take overnight inventories and prefer to close out their positions at the end of each trading day to avoid the risk incurred from holding overnight positions, day-traders sometimes choose to hold overnight positions because they may be reluctant and afraid to close out their day's losing position in the hope of recouping their losses. Whether day-traders also show the disposition effect is an interesting question since they are the types of short-term investors who trade mainly on short-term volatility of stock prices, and want to avoid the overnight risk. The fact that they decide to maintain their open positions over the night after a losing day implies that their aversion to the realization of loss might be even stronger than longer-term investors.

Under this assumption, we test whether some day-traders hold overnight positions as a result of downward movements in stock prices, making them reluctant to close out their positions. This scenario is consistent with the disposition effect hypothesis. We investigate how stock price movements on a trading day, from opening to closing at t, affect day-traders' overnight positions.

Additionally, some researchers find that the degrees of the tendency to follow the disposition effect differ across different investor groups. Locke and Mann (2005) examine 300 professional traders active in four commodities traded on the Chicago Mercantile Exchange and find that professional investors, institutions, and foreigners also exhibit the disposition effect. We hypothesize and examine that the disposition effect may vary across three different day-traders and compare overnight strategies across the three different investor groups of domestic individuals, domestic

[6] See Odean (1998), Grinblatt and Keloharju (2001) Ranguelova (2001), Shapira and Venezia (2001), Goetzmann and Massa (2003), Wermers (2003), Feng and Seasholes (2005), Jin and Scherbina (2005), Dhar and Zhu (2006), Frazzini (2006), Kumar (2009), Locke and Mann(2005), and Choe and Eom (2009).

institutions, and foreigners.

Hypothesis 2: Foreign day-traders tend to hold overnight positions as part of a return-chase or trend-chase strategy.

Numerous prior studies argue that foreign investors cannot obtain as much private information on domestic companies as domestic investors can; therefore, the former tends to invest more in larger firms than smaller firms to avoid the informational disadvantage, to be momentum followers, and to adopt a return-chasing or trend-chasing strategy by buying past winning stocks and selling past losing stocks (e.g., Bohn and Tesar (1996), Brennan and Cao (1997), Choe, Kho and Stulz (1999), Grinblatt and Keloharju (2000)). We verify whether foreign day-traders also follow the momentum strategy in their overnight positions if upward movements in stock prices occur during a trading day. Day-traders, unlike long-term investors, do not want to be exposed to overnight risk; therefore, they face a trade-off between the additional risk from an overnight position and the additional return that they can expect under a momentum strategy. We verify that foreign day-traders still follow a trend-chase strategy when facing overnight risk.

If foreign day-traders tend to trade more in line with this trait and hold overnight positions through a momentum strategy, past and current returns would be positively related to *Overnight_ratio_for* at time t. In other words, foreign day-traders tend to hold overnight positions if stock prices show an upward trend during a trading day from opening to closing.

Hypothesis 3: The overnight positions of day-traders are the result of information on future stock returns.

If day-traders hold overnight positions because they have information on future stock returns[7] and intentionally maintain open positions to target upward stock price movements, we expect an upward price movement the next day, showing a positive correlation between the next day's stock returns and *Overnight_ratio. We investigate whether Ret1*, the price movement from the closing at time t to the opening at time t+1, or *Ret2*, the price movement from the closing at time t to the closing at time t+1 shows a positive correlation with *Overnight ratio*.

One additional issue we are interested in is the effect of change in foreign exchange rate on the investment behavior of day-traders. Unlike domestic investors, the final returns for foreign investors are comprised of two components: KRW-based stock returns and returns due to the changes in the

[7] Froot and Ramadorai (2008), Froot, O'Connel and Seasholes (2001), and Grinblatt and Keloharju (2000) argue that foreign investors are well-informed traders.

USD/KRW exchange rate. Therefore, in the decision to hold overnight position, foreign day-traders are affected not only by stock price return but also by the dynamics of the exchange rate.

First, we examine whether foreign day-traders are currency-informed traders who intentionally hold overnight positions to enjoy the profits from the changes in exchange rates over the night and the next trading day using the exchange rate of the London time zone. In addition, using NDF rates measured in the Tokyo time zone, we investigate how foreign day-traders respond to and are affected by changes in exchange rates during a stock market trading day. More concretely, we test the following two hypotheses.

Hypothesis 4: The overnight positions of foreign day-traders are the result of currency-informed trading.

If foreign day-traders are currency-informed traders and expect future exchange rates to decrease the following day, they would prefer to hold an overnight position than to close out. Doing so enables them to enjoy an increase in the value of Korean stocks given the next day's appreciation in the KRW. In this respect, we examine whether the overnight positions of foreign day-traders have some information content on future exchange rate movements and allow them to earn profits from their overnight positions given an appreciation in the KRW. Under this hypothesis, we may expect that when the ratio of overnight foreign day-traders increases at time t, the London NDF exchange rate, which captures the change in the exchange rate from the closing at t to the opening at t+1 of stock market, will increase.

Hypothesis 5: When the local currency appreciates during a trading day, foreign day-traders may sell local stocks to rebalance their portfolio weights, whereas domestic investors do not. [Portfolio Rebalancing Hypothesis]

Hau and Rey (2004) and Hau and Rey (2006) argue that a foreign investor's investment decisions are adjusted to rebalance their portfolios that are exposed to exchange rate shocks. For instance, if the KRW currency appreciates during a trading day, which induces an increase in the value of Korean stocks invested in by foreigners, then foreign investors may attempt to sell their Korean stocks. Foreign investors sell their stocks to decrease their investment portion and rebalance their portfolio in the Korean market, which stabilizes their portfolio weights on Korean stocks and optimizes the exposure to exchange risk, thus possibly inducing outflows of foreign capital from the Korean equity market. If this hypothesis is supported, foreign day-traders will close out their positions to decrease their increased weights on Korean stocks when the KRW appreciates, and the ratio of overnight foreign day-traders at time t will decrease with the appreciation of the KRW during a trading day.

4. Empirical Results

4.1 Descriptive Statistics

We analyze all intraday trades and quotes to disentangle day-traders and overnight day-traders from other types of investors. Few studies exist on the overnight strategy of day-traders given the difficulties in determining whether or not an investor is an overnight day-trader. Therefore, checking the descriptive statistics of overnight day-traders and comparing them with those of general day-traders would be worthwhile.

[Insert Table 3 about here.]

Table 3 reports the descriptive statistics for day-traders and overnight day-traders during the sample period from January 2006 to December 2006. Panel A in Table 3 indicates the daily statistics on orders, executions, and cancellations on day-traders and overnight day-traders. The daily average trading volume of day-traders is 380,783 shares and that of overnight day-traders is 100,551 shares. The order sizes of overnight day-traders are smaller than those of day-traders. The average daily order amount of day-traders is 1,438,630, whereas that of overnight day-traders is 591,779. The order execution rate of day-traders is 26.46% and that of overnight day-traders is lower, at 16.99%. More specifically, the execution rate of buy (sell) orders for day-traders is 23.30% (30.61%), whereas that for overnight day-traders is 15.49% (17.71%). The lower execution rates of overnight day-traders imply that their asks (or bids) are farther from current market prices. Interestingly, the cancellation rate of day-traders' buy orders (32.42%) is similar to that of overnight day-traders (32.75%), whereas the cancellation rate of day-traders' sell orders (29.25%) is smaller than that of overnight day-traders (35.12%). The higher sell order cancellation rate suggests that overnight day-traders tend to maintain their overnight positions by cancelling their sell orders because they decide not to close out their positions by the end of a trading day. The lower execution rate and higher cancellation rate of overnight day-traders also suggests that they, in general, employ a more aggressive order strategy than other general day-traders. More specifically, they may submit sell orders at prices much higher than current market prices, possibly because they expect an upward movement in prices. Alternatively, they may be reluctant to sell losing stocks and finally decide to hold overnight positions by cancelling their sell orders.

Table 3 presents the descriptive statistics of *Overnight_ratio* by investor group. We compute *Overnight_ratio* for each stock and then average these values for all listed stocks (1,457 stocks) on the KSE, as presented in Panel B. The aggregate values for *Ret1*, *Ret2*, and *Ret3* are also presented in

Panel B in Table 3. Note that the stocks that each investor group invests in are not the same, resulting in different values for each investor group.

The *Overnight_ratio* tends to be higher for foreign day-traders, at 0.1219, and is 0.0950 for domestic institutional investors and 0.0714 for individual investors. Panel C in Table 3 indicates the correlations of *Overnight_ratio* with individual, institutional, and foreign investor groups. The overall correlations are relatively low for each other, suggesting that each investor group has different information or intentions when holding overnight positions. First, we observe that the *Overnight_ratio* for all investors is negatively correlated to *Ret1* and positively correlated to *Ret2*, indicating that overnight day-traders may not obtain positive profits by the opening on t+1 but may obtain positive profits at the end of the closing time on t+1. The correlation for *Overnight_ratio* and *Ret3* is negative, supporting the disposition effect hypothesis that day-traders may tend to hold overnight positions given the downward movement of stock prices during a trading day.

Next, the behavior of each investor group has different correlations with stock returns. We observe a positive correlation between *Overnight_ratio_for* and *Ret1_for (Ret2_for)*. We conjecture that overnight foreign day-traders are driven to capture positively upward future stock movements, suggesting that they are informed traders. The positive correlation between *Overnight_ratio_for* and *Ret3_for* implies that foreign day-traders seem to be momentum followers and adopt return-chasing or trend-chasing strategies by buying previous winning stocks and selling previous losing stocks.

In contrast, the negative correlation between *Ret3_ind (Ret3_ins)* and *Overnight_ratio_ind (Overnight_ratio_ins)* supports the disposition effect hypothesis among domestic investors. The negative correlation between *Ret1_ins* (or *Ret2_ins)* and *Overnight_ratio_ins* also implies that institutional investors in general do not gain from positive overnight stock returns. Interestingly, the correlation for individual investors is positive, suggesting that they might benefit from their overnight positions.

[Insert Figure1 about here.]

Finally, Figure1 indicates the time series of *Overnight_ratio* for all and each investor group. The ratio for domestic institutional investors indicates higher variability over time than those for other investor groups.

4.2 PCA analysis

Before investigating the reasons that day-traders hold overnight positions, we first explore whether investors' decisions on overnight positions result from some commonality within each investor group, or whether each investor belonging to a group just holds an overnight position because of different information or objectives without any commonality. To examine whether or not overnight day-traders co-move within each group, we conduct PCA using individual stocks' *Overnight_ratio* listed in KOSPI 200 index.

PCA is a useful statistical technique for finding patterns in data of high dimension and in identifying the data in a manner that highlights their similarities and differences. This analysis also has the advantage of being able to compress the data by reducing the number of dimensions without loss of information once patterns in the data are found.

Panel A in Figure 2 presents scree plots for *Overnight_ratio* for each type of investor. The x-axis of the scree plot presents the principal components sorted by the decreasing fraction of total variance explained, and the y-axis indicates the fraction of the total variance explained. In Figure 2, the eigenvalues (y-values) rapidly decrease when the second principal component is added. Hence, we conclude that the first principal component is the most important explanatory component for the ratio of overnight positioners compared with the second or third components.

Panel B in Figure 2 indicates the proportion of the i-th component in explaining *Overnight_ratio*. The first components of all and each type of investor are greater than 10%, whereas the second and third components are less than 5%. If the first component has a greater proportion compared with the second or third components, then greater commonality exists for overnight strategies of day-traders in the first component. Therefore, we interpret that overnight strategies among day-traders relatively co-move within each other and contain some information content.

Regarding each investor group, the first principal component of institutional investors explains more than 35% of the ratio of overnight day-traders and is higher than those for foreigners or individuals. Therefore, institutional overnight day-traders have greater commonality than other day-trader groups.

In general, these results imply that the decisions by overnight day-traders have some commonality within groups to some degree and that some information content exists in their overnight strategies. Therefore, we now investigate day-traders' intentions on their overnight strategies, whether overnight day-traders have some information content on future stock price movements, and how their strategies affect future stock price movements. We also verify whether overnight positions lead to profits for day-traders.

4.3 OLS Regression

Having identified some commonality in the overnight strategies of day-traders, simple OLS regressions are implemented to examine why day-traders sometimes hold overnight inventories rather than close out their positions. We also check the relations between stock price movements and the ratio of overnight day-traders.

Initially, we conduct simple OLS regressions using the stock return measure, *Ret3*, as follows to examine how stock price movements during a trading day affect *Overnight_ratio*.

$$Overnight\ ratio_{\ t} = \alpha_0 + \alpha_1 Ret3_t + e_t \qquad (2)$$

Additionally, to verify the hypothesis that overnight day-traders are informed traders who attempt to obtain profits from stock price movements for the next day, we conduct simple OLS regression analysis using the stock return measure of *Ret1* and *Ret2* as follows:

$$Ret1_t = \alpha_0 + \alpha_1 Overnight\ ratio_{\ t} + e_t, \qquad (3)$$

$$Ret2_t = \alpha_0 + \alpha_1 Overngiht\ ratio_{\ t} + e_t. \qquad (4)$$

Table 4 provides the results of the simple OLS regression estimations. Newey and West (1987) standard errors are used in all estimations.

[Insert Table 4 about here.]

The left four columns in Table 4 present the result for equation (2). The result for equation (2) indicates negative significance for the coefficient on *Ret3* for all investors. This result suggests that downward stock price movements during a trading day make day-traders in general reluctant to close out their positions and force them to hold overnight positions that support the disposition effect hypothesis, as argued in Shefrin and Statman (1985), and Locke and Mann (2005).

However, when we conduct OLS regressions for each of the three investor groups to compare overnight strategies across these groups, the coefficient of *Ret3* for foreigners is significantly positive and those for individuals and institutions are negative. The positive coefficient for foreign day-traders implies that such day-traders tend to hold overnight positions if the stock price during a trading day experiences an upward movement. This overnight strategy of foreign day-traders is consistent with Bohn and Tesar (1996), Brennan and Cao (1997), Choe, Kho and Stulz (1999), and Grinblatt and Keloharju (2000), who document that foreign investors seem to be momentum followers and adopt return-chasing or trend-chasing strategies by buying past winning stocks and selling past losing stocks.

Unlike the results for foreign day-traders, the coefficients for individual and institutional day-traders are negative, which implies that these day-traders tend to be reluctant to close out their losing day positions, thus supporting the disposition effect hypothesis. However, the negative coefficients are not significant.

The next eight columns in Table 4 present the result for equation (3) and (4). The results of equations (3) and (4), which test whether day-traders' overnight strategy contains information on future stock price movements for the next day, indicate that the coefficients of *Overnight_ratio* for all day-traders are insignificant for equations (3) and (4). However, when we run the same regression for each investor type, the coefficients of *Overnight_ratio* for foreign day-traders are significantly positive for equations (3) and (4), signifying that the overnight strategies of these day-traders are likely to capture positively upward future stock movements and that foreign investors are informed traders. The coefficient of *Overnight_ratio* for individual day-traders is positive in equation (4), implying that individual day-traders also seem to be informed traders who are included to target the next-day returns. However, the significance level for individual day-traders is relatively low at 10%. In the case of institutional day-traders, the coefficient is negative, implying that institutions tend to lose their money after holding overnight positions; however, this result is statistically insignificant.

4.4 VAR Analysis

Previous tests indicate that overnight day-traders' decisions have commonality within groups and that statistically significant relationships exist between stock price movements and day-traders' overnight positions. In this section, we use the more sophisticated VAR model to investigate the dynamic relationships between *Overnight_ratio* and stock price movements. The VAR model is a natural extension of the univariate autoregressive model to a dynamic multivariate time series and is a tool to observe predictable relationships among variables. In the VAR model, all variables are treated as endogenous, indicating that one equation exists for each variable as a dependent variable and each equation has lagged values of all of the included variables as dependent variables, including the dependent variable itself. The VAR model also captures the linear interdependencies among multiple time series because they incorporate the joint generation mechanisms of the variables involved.

A p-th order VAR model can be represented as follows:

$$Y_t = \alpha + B(L)Y_t + e_t, \quad (5)$$

where $Y_t = (\ Y_{1,t}, \dots, Y_{K,t}\ )$ is a vector time series of variables, α is a k-vector of intercepts, and B(L) is a polynomial in the lag operator L. e_t present the error terms assumed to follow an i.i.d. normal distribution with zero vector expectation and a variance matrix, $e_t \sim iid(0, \Sigma)$.

In this study, we implement a bivariate VAR model using *Overnight_ratio* and stock returns, i.e., $Y_t = (Overnight_{ratio_t}, Ret_t)$,[8] to capture their dynamics. A p-th order bivariate VAR for our study can be written as follows:

$$\begin{bmatrix} Overnight\_\text{ratio}_t \\ Ret_t \end{bmatrix} =$$

$$\begin{bmatrix} \alpha_{Overnight\_\text{ratio}} \\ \alpha_{Ret} \end{bmatrix} + \begin{bmatrix} b_{11}(L) & b_{12}(L) \\ b_{21}(L) & b_{22}(L) \end{bmatrix} \begin{bmatrix} Overnight\_\text{ratio}_{t-1} \\ Ret_{t-1} \end{bmatrix} + \begin{bmatrix} e_t^{Overnight\_\text{ratio}} \\ e_t^{Ret} \end{bmatrix}. \quad (6)$$

We compute the *Overnight_ratio* for each stock and then average those values for all stocks (1,457 stocks) listed on the KSE. α_k are intercepts and the b(L) are polynomials in the lag operator L.

$e_t^{Overnight\_ratio}$ and $e_t^{Overnight\_ratio}$ are error terms assumed to follow an i.i.d. normal distribution with a zero vector expectation and a variance matrix,

$$e_t \sim iid(0, \Sigma), \quad \Sigma = \begin{bmatrix} \sigma^2_{Overnight\_ratio} & \rho\sigma_{Overnight\_ratio}\sigma_{Ret} \\ \rho\sigma_{Overnight\_ratio}\sigma_{Ret} & \sigma^2_{Ret} \end{bmatrix}.$$

In equation (6), the diagonal coefficients $b_{11}(L)$ and $b_{22}(L)$ denote conditional momentum in *Overnight_ratio* and stock return. The off-diagonal coefficients, $b_{12}(L)$, denote the impact of the lagged stock return on *Overnight_ratio* and $b_{21}(L)$ denotes the impact of the lagged *Overnight_ratio* on the stock return.

Along with a bivariate VAR, we also implement a structural VAR approach proposed by Bernanke (1986) and Sims (1986) to analyze contemporaneous effects in the model. The structural equation we use is as follows:

$$\text{A}Y_t = C(L)Y_t + Bu_t, \quad (7)$$

where u_t is the structural innovations vector that contain serially uncorrelated elements. We rewrite equation (7) as a reduced form:

$$Y_t = A^{-1}C(L)Y_t + A^{-1}Bu_t, \quad (8)$$

where $A^{-1}Bu_t = e_t$ is the residual of the reduced form. Then, we finally derive the relationship between structural innovations and reduced innovations, and the system of contemporaneous

[8] Defined for each investor group as i.

innovations is as follows:

$$Ae_t = Bu_t, \qquad (9)$$

$$\begin{bmatrix} 1 & a_{12} \\ a_{21} & 1 \end{bmatrix} \begin{bmatrix} e_{Overnight\_ratio,t} \\ e_{Ret,t} \end{bmatrix} = \begin{bmatrix} u_{Overnight\_ratio,t} \\ u_{Ret,t} \end{bmatrix}, \qquad (10)$$

where A is a 2×2 matrix, a_{ij} represents the parameters that stand for the contemporaneous causal relations among *Overnight_ratio*, *Ret*, e_t represents the observed (nonorthogonalized) innovations at time t, and u_t represents the unobserved (orthogonalized) shocks.

As previously mentioned, we use three different methods to calculate stock returns, and each return has different implications for the relation to *Overnight_ratio*.

If day-traders hold overnight positions because they have information about future stock price movements, as previously assumed in *Hypothesis 3*, this situation may lead to a contemporaneous impact of *Overnight_ratio* on *Ret1*, which captures the price movement from the closing at time t to the opening at time t+1, or *Ret2*, which captures the price movement from the closing at time t to the closing at time t+1. In contrast, *Ret1* or *Ret2*, which represent future price movements and are not observed at time t, affects *Overnight_ratio* at time t does not make sense. Therefore, we impose a restriction $a_{12} = 0$ on equation (10), implying that the series of unexpected shocks in *Overnight_ratio* has a contemporaneous impact on the series *Ret1* or *Ret2*, whereas the reverse relationship is not valid. Finally, we test the following equation:

$$\begin{bmatrix} 1 & 0 \\ a_{21} & 1 \end{bmatrix} \begin{bmatrix} e_{Overnight\_ratio,t} \\ e_{Ret1(2),t} \end{bmatrix} = \begin{bmatrix} u_{Overnight\_ratio,t} \\ u_{Ret1(2),t} \end{bmatrix}. \qquad (11)$$

As previously noted in Hypotheses 1 and 2, some day-traders may tend to hold overnight positions given downward movements in the stock price during a trading day, as in the disposition effect hypothesis. Other day-traders, particularly foreigners, may hold overnight positions as part of return-chasing behavior or a momentum strategy. Therefore, we assume and attempt to examine whether stock returns during a trading day, from the opening to the closing at t, affect day-traders' decisions on their overnight positions at time t. We provide a short-term restriction $a_{21} = 0$ on equation (10) in which we assume that the series for unexpected shocks in *Ret3* contemporaneously affects the series for *Overnight_ratio*, whereas the reverse relationship is not valid. For the *Ret3* case, we test the following equation:

$$\begin{bmatrix} 1 & a_{12} \\ 0 & 1 \end{bmatrix} \begin{bmatrix} e_{Overnight\_ratio,t} \\ e_{Ret3,t} \end{bmatrix} = \begin{bmatrix} u_{Overnight\_ratio,t} \\ u_{Ret3,t} \end{bmatrix}. \qquad (12)$$

The first step in the VAR model is to check whether the time series of each variable follows a stationary process.

[Insert Table 5 about here.]

Table 5 presents the results of the augmented Dickey-Fuller (ADF) and the PP unit root test to verify that each variable follows a stationary process. Table 5 indicates that the null hypothesis is strongly rejected at the 1% significance level for all variables, indicating that all variables follow a stationary process. Therefore, we conduct the VAR model without considering a co-integration test or the Vector Error Correction Model (VECM).

[Insert Table 6 about here.]

Table 6 reports the results from the following VAR with the number of lags(p) selected using the Hanna-Quinn information Criterion (HQC). Panel A in Table 6 displays the VAR results for the ratio of the overnight day-traders' equations. We note several interesting findings.

First, foreign day-traders seem to hold overnight positions as a return-chasing or trend-chasing strategy. A review of the Panel A results using *Ret1* indicates that the coefficients of lagged 1 returns are all insignificant except for the foreign day-traders. This result implies that only foreign day-traders are affected by the past *Ret1*. The coefficient of *Ret1* at lagged 1 for foreigners is significantly positive, which implies that a change in stock prices from the closing at time t–1 to the opening at time t positively affects the overnight decisions of foreign day-traders. This result supports and is consistent with Hypothesis 2, which states that foreign day-traders hold overnight positions as a return-chasing or trend-chasing strategy. This result is also consistent with existing studies on a longer-term investment horizon, as Bohn and Tesar (1996), Brennan and Cao (1997), Choe, Kho and Stulz (1999), and Grinblatt and Keloharju (2000) argued. When considering the Granger causality test for the null hypothesis, $\mathrm{H}_0: b_{12}(L) = 0$, the statement that lagged *Ret1* does not Granger-cause *Overnight_ratio* is strongly rejected only for foreign day-traders. This result is also consistent with the previous analysis in the VAR confirming that the past stock price movement of *Ret1* affects the decision of foreign day-traders to hold overnight positions.

The second interesting finding is that individuals and institutions tend to display the disposition effect. *Ret2* at lagged 1 term is negatively related to *Overnight_ratio* for individuals and institutions even though the coefficients are insignificant. This result implies that a (an) decrease (increase) in the stock price from the closing at time t–1 to the closing at time t may lead to an (a) increase (decrease) in the ratio of overnight day-traders at time t. Thus, the premise that individual and institutional day-traders exhibit the disposition effect is supported and in line with the results in other studies, such as Shefrin and Statman (1985), and Locke and Mann (2005).

For foreign day-traders, *Ret2* at lagged 1 term significantly and positively affects *Overnight_ratio*, which implies that the overnight ratio of foreign day-traders increases at time t as the stock price increases from the closing at time t–1 to the closing at time t, confirming again the return-chasing or trend-chasing strategy of foreign day-traders. The Granger causality test to examine the lagged terms of *Ret2* does not Granger-cause *Overnight_ratio*, and is strongly rejected for foreign day-traders. Therefore, the lagged terms of *Ret2* significantly affect *Overnight_ratio*. However, the Granger causality tests are not rejected for individuals or institutional day-traders.

All of the coefficients of *Overnight_ratio* at lagged 1 in Panel A using *Ret1*, *Ret2*, and *Ret3* for all, foreign, individuals, and institutions are significantly positive. This result implies that overnight day-traders tend to continue to hold overnight positions for approximately one day.

Moving on to the return equations shown in Panel B in Table 6, the results using *Ret3* indicate that *Overnight_ratio* at lagged 1 is significantly and positively related to *Ret3* for all day-traders. This result implies overnight day-traders may be informed traders attempting to make profits by capturing the upward movement of stock prices, supporting our *Hypothesis 3*. We also examine each investor group to determine whether informed trading differs among different groups. The coefficients of *Overnight_ratio* at lagged 1 are positive for all three types of investors, but are significant only for foreign day-traders. This result indicates that informed trading traits in day-traders are primarily the result of foreign day-traders.

The p-values of the Granger causality, which tests the coefficients of the lagged term of *Overnight_ratio* on the *Ret3* equation for all and foreign day-traders, are jointly equal to zero, 0.0154, and 0.0096, respectively. This result reaffirms the previous finding that *Overnight_ratio* has a significant impact on the next day's stock prices.

As previously mentioned, overnight day-traders who are informed traders may lead to a contemporaneous impact of *Overnight_ratio* onto *Ret1* or *Ret2*. Along with this hypothesis, to verify our *Hypotheses 1* and *2* for which day-traders are supposedly subject to the disposition effect or follow return (trend)-chasing strategies, we also conduct a structural VAR test.

[Insert Table 7 about here.]

Panel A in Table 7 displays the structural VAR results of the test for the previously described specifications with a short-term restriction of $a_{12} = 0$ on the equations, which does not allow an unexpected shock of *Ret1*(or *Ret2*) to contemporaneously affect *Overnight_ratio*. The contemporaneous parameters (a_{21}) in Panel A in Table 7 are significantly negative for foreign day-traders with respect to *Ret1* and foreign and individual day-traders with respect to *Ret2*. These results suggest that a positive shock on *Overnight_ratio_for* and *Overnight_ratio_ind* results in a contemporaneous increase in the next day stock price.

The negative coefficients of foreign day-traders in the *Ret1* equation and the negative coefficients of all, foreign, and individual day-traders in the *Ret2* equation suggest that an unexpected increase (decrease) in *Overnight_ratio* may be contemporaneously associated with informed trading attempting to capture stock price movements from the closing at time t to the opening (closing) at time t+1.

The results of Panel B in Table 7 indicate a structural VAR with a short-term restriction $a_{21} = 0$ on the equation that does not allow the unexpected shock of *Overnight_ratio* to affect the unexpected *Ret3*, but that allows the unexpected shock of *Ret3 to* affect the unexpected shock in *Overnight_ratio*. As shown in Panel B of Table 7, for all, individual, and institution day-traders, the unexpected *Ret3* negatively affects the unexpected change in *Overnight_ratio* at time t.

This result indicates that, overall, day-traders take more (less) overnight positions when faced with downward (upward) stock price changes, which is consistent with the disposition effect—a tendency to hold losers long and sell winners soon. Meanwhile, for foreign day-traders, the estimates of a_{12} are significantly negative, implying that *Overnight_ratio_for* positively responds to concurrent unexpected positive shocks from stock price movements during a trading day. We cautiously infer from this result that foreign day-traders are return or trend chasers.

To examine the dynamic relationship between the innovations in the ratio of overnight day-traders and in stock returns, we implement the impulse response analysis, which allows us to see the estimated dynamic response of a variable to a unit standard deviation shock in other variables.

[Insert Figure3 about here.]

Figure 3 plots the results of the impulse response functions. The first and second columns indicate the response of *Ret1* and *Ret2* to a one standard deviation shock in *Overnight_ratio* during 15-day periods in a structural VAR model assuming that *Ret1 (Ret2)* can be contemporaneously affected by *Overnight_ratio* but not vice versa. The third column displays the response of *Overnight_ratio* to a one standard deviation shock in *Ret3* in a structural VAR model, assuming that *Overnight_ratio* can be contemporaneously affected by, but cannot contemporaneously affect, *Ret3*. Each shock is structurally decomposed to allow for short-term restrictions on each equation. For each impulse response function, 95% confidence intervals are computed on the basis of 1,000 times the bootstrap-method,[9] as suggested by Killian (1998).

[9] The residuals from the VAR are resampled with replacement and an artificial dataset is constructed using the original parameter estimates and the resampled residuals.

A review of the first column, which indicates the response of *Ret1* and *Ret2* to a unit standard deviation shock in the ratio of overnight day-traders, indicates that shocks to the ratio of overnight day-traders for foreigners and individuals have a positive impact on *Ret1* and *Ret2* for the subsequent two days. Thereafter, the impact dissipates to zero. However, shocks to the ratio of institutional overnight day-traders seem to negatively impact *Ret1* and *Ret2*.

From the IRF results of the first and second columns, we infer that shocks to the overnight foreign and individual day-traders can be driving forces for increases in stock prices. The impulse response results are consistent with the results of the VAR test, which concludes that overnight foreign day-traders are informed traders.

Column 3 indicates how stock price movement shocks during a trading day, from opening at time t to closing at time t, affect the ratio of overnight day-traders. When reviewing the IRF of all day-traders, in general, shocks in *Ret3* negatively impact the ratio of overnight day-traders during the subsequent two days. Therefore, the disposition effect prevails among day-traders. In contrast, the response of the ratio of overnight foreign day-traders to unexpected shocks of *Ret3* is positive and lasts more than two days, whereas the response for individuals and institutions is negative and lasts for more than one day. These results also support the phenomenon that foreign day-traders may hold overnight positions to chase trends, whereas individual and institutional day-traders hold overnight positions given the disposition effect.

4.5 Effect of Foreign Exchange Rate

[Insert Figure 4 about here.]

In this section, we use two different exchange rates to examine the relations between the overnight strategy of foreign day-traders and exchange rates.

First, to test our conjecture, non-deliverable forward rate (NDF) contracts measured in the Tokyo time zone and the London time zone are used for the exchange rate. The NDF markets are open 24 hours a day and Bloomberg provides reference exchange rates at the opening and closing of a trading day for three different currency market time zones: Tokyo, London, and New York.

Figure 4 presents the time line of the Korean stock market and the NDF market. The blue solid line represents the time line of the Korean stock market, whereas the red thin dotted line represents the time line of the Tokyo NDF market. The black thick dashed line represents the time line for the London NDF market. As Figure 4 indicates, the Korean stock market opens at 09:00 and close at 15:00. The Tokyo time zone, where currency market opens at 07:00 to 16:00 in Korean standard time, nearly coincides with the Korean stock market trading time of 09:00 to 15:00. Therefore, we use NDF rates measured in the Tokyo time zone to examine how exchange rate changes during a stock market trading day affect foreign day-traders' decisions to hold overnight positions.

Meanwhile, after the Korean stock market closes at 15:00, the London NDF market opens at 16:00 and closes at 24:00 in Korean standard time (which are 08:00 and 16:00, respectively, in London standard time). By using NDF rates measured in the London time zone, we investigate how foreign day-traders' overnight strategy affect the exchange rate, including the intention of foreign day-traders to take overnight positions and their expectations of the exchange rate after the closing of the domestic stock market.

Among various types of NDF contracts, we assume that foreign investors use one-month non-deliverable forward rate (NDF) contracts to lock in the change in exchange rates because they have the largest transaction volume among contracts with different maturities.

To examine how the exchange rate movements during a trading day affect day-traders' overnight decisions as in *Hypothesis 5*, simple OLS regressions using *Overnight_ratio* and the log difference of the one-month NDF rate measured in the Tokyo time zone are implemented as follows:

$$Overnight\_ratio_{\mathrm{t}} = \alpha_0 + \alpha_1 Ln\_diff\_ndf\_1m\_Tokyo_{\mathrm{t}} + \mathrm{e}_{\mathrm{t}}, \qquad (13)$$

where $Overnight\_ratio_{\mathrm{t}}$ is the ratio of overnight day-traders on day t and *Ln_diff_ndf_1m_Tokyo* refers to the return on the one-month KRW/USD NDF rate from the opening to the closing price at t measured in the Tokyo time zone.

Additionally, a simple OLS regression analysis using the one-month NDF measured in the London time zone is conducted to examine whether the ratio of overnight day-traders has some predictability about future exchange rate movements.

$$Ln\_diff\_ndf\_1m\_London_{\mathrm{t}} = \alpha_0 + \alpha_1 Overnight\_ratio_{\mathrm{t}} + \mathrm{e}_{\mathrm{t}} \qquad (14)$$

[Insert Table 8 about here.]

Panel A in Table 8 reports the daily summary statistics of one-month KRW/USD NDF rate measured in the Tokyo (London) time zone. *Ndf_1m_Tokyo_op* (*Ndf_1m_London_op*) is the opening one-month KRW/USD NDF rate measured in the Tokyo (London) time zone. *Ndf_1m_Tokyo_cl*(*Ndf_1m_London_cl*) is the closing one month KRW/USD NDF rate measured in the Tokyo(London) time zone. *Ln_diff_ndf_1m_Tokyo(Ln_diff_ndf_1m_London)* refers to the return on the one-month KRW/USD NDF rate from the opening to the closing price at t measured in the Tokyo(London) time zone. The average value for ln_diff_ndf_1m_Tokyo is -0.0003 and -0.0002 for

London one-month ndf exchange rate.

Panel B of Table 8 shows the results of the coefficient estimates for the OLS regressions estimations using the Newey and West (1987) standard errors. The left four columns in Panel B of Table 8 present the result for equation (13). The negative coefficient on the log difference of the one-month NDF rate measured in the Tokyo time zone in equation (13) indicates that the appreciation in KRW may significantly and positively affect the overnight position of foreign day-traders. That is, we find no evidence of foreign day-traders rebalancing their portfolios or avoiding the exchange rate risk caused by an appreciation of the KRW, as suggested by Hau and Rey (2004) and Hau and Rey (2006).

The next four columns in Panel B in Table 8 present the result including *Ret3* in the equation. The statistical significance of the coefficient on the log difference of the one-month NDF rate measured in the Tokyo time zone still remains, even after including *Ret3* in the equation.

The next four columns in Panel B in Table8 present the result for equation (14). The results of testing equation (14) in Panel B in Table 8 indicate a negative coefficient for *Overnight_ratio_for*, which implies that the overnight positions of foreign day-traders are likely to capture the appreciation of the KRW after the close of the Korean stock market. This result also represents evidence that foreign overnight day-traders might be currency-informed traders. Foreign day-traders may choose to hold overnight positions in Korean stocks rather than close them out to obtain profits from these stocks' increasing value attributable to an appreciation of the KRW by the next day. These results confirm *Hypothesis 4*.

To more precisely analyze the contemporaneous causal patterns of shocks in two variables, we implement a structural VAR equation as follows:

$$Ae_t = Bu_t, \qquad (16)$$

$$\begin{bmatrix} 1 & a_{12} \\ a_{21} & 1 \end{bmatrix} \begin{bmatrix} e_{Overnight\_ratio,t} \\ e_{Ln\_diff\_ndf\_1m\_Tokyo(London),t} \end{bmatrix} = \begin{bmatrix} u_{Overnight\_ratio,t} \\ u_{Ln\_diff\_ndf\_1m\_Tokyo(London),t} \end{bmatrix}, \qquad (17)$$

where A is a 2×2 matrix, a_{ij} represents the parameters for the contemporaneous causal relations between *Overnight_ratio* and *Ln_diff_ndf_1m_Tokyo(London)*, $e_{i,t}$ represents the observed (nonorthogonalized) innovation at time t, and $u_{i,t}$ represents the unobserved (orthogonalized) shocks.

As previously mentioned, we assume that fluctuations in exchange rates during a stock market trading day may affect the overnight decisions of foreign day-traders. We use the NDF rates measured in the Tokyo time zone as a variable that captures the exchange rate movements during a stock market trading day. We place a short-term restriction $a_{21} = 0$ on equation (17) through which we assume that the series of unexpected shocks of *Ln_diff_ndf_1m_Tokyo* contemporaneously affects the series of *Overnight_ratio*, whereas the reverse is not valid. We test the following equations using

Ln_diff_ndf_1m_Tokyo:

$$\begin{bmatrix} 1 & a_{12} \\ 0 & 1 \end{bmatrix} \begin{bmatrix} e_{Overnight\_ratio,t} \\ e_{Ln\_diff\_ndf\_1m\_Tokyo,t} \end{bmatrix} = \begin{bmatrix} u_{\text{Overnight\_ratio},t} \\ u_{Ln\_diff\_ndf\_1m\_Tokyo,t} \end{bmatrix}. \qquad (18)$$

Along with this analysis, we also test whether foreign day-traders are currency-informed traders and intentionally hold overnight positions to enjoy the increasing value of stocks attributable to the appreciation of the KRW.

Again, we impose a short-term restriction of $a_{12} = 0$ on equation (17), which implies that the series of unexpected shocks of *Overnight_ratio* contemporaneously affects the series *Ln_diff_ndf_1m_London*, whereas the reverse is not valid. Finally, we test the following equation:

$$\begin{bmatrix} 1 & 0 \\ a_{21} & 1 \end{bmatrix} \begin{bmatrix} e_{Overnight\_ratio,t} \\ e_{Ln\_diff\_ndf\_1m\_London,t} \end{bmatrix} = \begin{bmatrix} u_{Overnight\_ratio,t} \\ u_{Ln\_diff\_ndf\_1m\_London,t} \end{bmatrix}. \qquad (19)$$

[Insert Table 9 about here.]

Panel A in Table 9 shows the contemporaneous coefficients of the structural VAR equation (18) , assuming that *Overnight_ratio* shocks are determined by *Ln_diff_ndf_1m_Tokyo*. If portfolio rebalancing hypothesis holds, x foreign overnight daytraders would sell their Korean stocks whose values are increased due to the appreciation of KRW currency to stabilize their international portfolio weights on Korean stock market. So in this case, contemporaneous parameter (a_{12}) for a foreign day-trader should be negative, which implies that foreign daytraders would rather close out their position rather than take overnight position inducing the decrease in *Overnight_ratio when* KRW appreciates. However, the coefficient of a_{12} for a foreign day-trader is positive, which does not support the portfolio rebalancing hypothesis (*Hypothesis 5).*

Panel B in Table 9 presents the structural VAR results with a short-term restriction $a_{12} = 0$ on equation (19). The contemporaneous parameter (a_{21}) of the foreign day-trader in Table 9 is significantly positive, suggesting that a positive shock on the ratio of foreign overnight day-traders results in a contemporaneous appreciation of the KRW (depreciation of the USD) the next day. This result implies that overnight foreign day-traders may be currency-informed traders expecting and enjoying the appreciation of the KRW by holding Korean stocks.

Figure 5 presents the results of an impulse response analysis that indicates the dynamic relationship between innovations in the ratio of overnight day-traders and in stock returns.

[Insert Figure 5 about here.]

The first column indicates the response of the ratio of overnight day-traders to a one standard deviation shock in *Ln_diff_ndf_1m_Tokyo* during 15-day periods in a structural VAR model. This result assumes that the ratio of overnight day-traders can be contemporaneously affected by changes in the exchange rate during a stock market trading day but not vice versa.

The result indicates that the shocks in *Ln_diff_ndf_1m_Tokyo* negatively affect the ratio of overnight foreign day-traders during the subsequent two days. This finding does not support the portfolio rebalancing hypothesis (*Hypothesis 5)*. The second column displays the response of *Ln_diff_ndf_1m_London* to a one standard deviation shock of the ratio of overnight day-traders in a structural VAR model, assuming that the ratio of overnight day-traders can contemporaneously affect *Ln_diff_ndf_1m_London* but not vice versa. From the second column, the shocks in the ratio of overnight foreign day-traders negatively affect *Ln_diff_ndf_1m_London* during the subsequent two days; therefore, we infer that foreign overnight day-traders are currency-informed traders attempting to capture the appreciation of the KRW by holding Korean stocks, thus supporting *Hypothesis 4*.

All in one, we find overnight foreign day-traders are currency-informed traders expecting and enjoying appreciation of the KRW by holding on to their Korean stocks. These empirical findings in exchange market are consistent with the evidence that the foreign day-traders are informed traders as we already observed in the stock market.

5. **Conclusion**

This paper focuses on the behavior of overnight day-traders and investigates the interaction of the ratio of overnight day-traders and stock returns focusing on the behavior and performance of foreign day-traders vis-a-vis domestic investors. Using a unique intraday trade and quote data set that includes customized symbols to identify individual accounts from January 2006 to December 2006, we examine the commonality of overnight day-traders and the lead–lag relationship between the ratio of overnight day-traders and stock returns to confirm the information contents contained in the overnight strategy of day-traders. The following major findings and implications are drawn from the empirical analysis of the Korean stock market.

PCA presents strong evidence that overnight day-traders relatively co-move within groups, suggesting that some information content exists in their overnight strategies. We also find that foreign day-traders tend to hold overnight positions if an upward movement in stock prices occurs during a trading day, consistent with most previous findings on longer-term investment behavior (Bohn and Tesar (1996), Brennan and Cao (1997), Choe, Kho and Stulz (1999), Grinblatt and Keloharju (2000)) that document that foreign investors seem to be momentum traders adopting return-chasing or trend-chasing strategies. In contrast to foreign day-traders, individual and institutional day-traders are reluctant to close out their losing day positions, thus supporting the disposition effect hypothesis as argued in existing papers on longer-term investment horizons.

Testing the hypothesis that day-traders intentionally retain open positions to target upward stock price movements, we find that only the overnight positions of foreign day-traders are positively correlated with stock price movements of the next day. This finding supports the view that foreign investors are well-informed traders even on a short-term investment horizon.

Finally, we confirm that foreign day-traders are currency-informed traders expecting and enjoying the appreciation of the KRW by holding Korean stocks while domestic investors are not. The empirical analyses indicate that, in general, foreign investors are more informed than local investors on a short-term horizon in their investments in local stocks as well as on a longer-term horizon as confirmed in existing studies.

These results are rather surprising because the informational advantage of foreign investors is known to be based more on their knowledge either on the fundamental values of local stocks or on the macro-economic trends of local economies, enabling them to perform better in long-term investments rather than in short-term investments. Further analysis of the source of the informational advantage of foreign investors in short-term investments would be another interesting topic for future research.

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Table1. Case of Overnight Day-trader Trading Strategy

Table 1 presents day-traders' trades over time and the closing out of their positions. dt represents date and isu_cd represents the company code. ofr_bid_typ is the bid–ask indicator, where 1 represents ask and 2 represents bid. Act_no represents customized symbols identifying individual accounts. tm represents the time when each order is transacted. tr_vl and tr_pr are the volume and the price transacted, respectively. cum_tr_vl represents cumulated transaction volume from adding tr_vl if ofr_bid_typ is 2 and subtracting tr_vl if ofr_bid_typ is 1, and this value is computed on each day and for each stock. localcount indicates the number of times an account is transacted each day. daytr is an indicator that takes the value of 1 for day-trading and 0 for leaving overnight positions.

dt	isu_cd	ofr_bid_typ	act_no	tm	tr_vl	tr_pr	cum_tr_vl	localcount	daytr
20060522	KR7000220004	2	.3=":2/)9.8c	9182616	150	15300	150	1	1
20060522	KR7000220004	1	.3=":2/)9.8c	11175252	30	15050	120	2	1
20060522	KR7000220004	1	.3=":2/)9.8c	11273762	30	15100	90	3	1
20060522	KR7000220004	1	.3=":2/)9.8c	12341760	90	15000	0	4	1
20060523	KR7000220004	2	.3=":2/)9.8c	9084127	520	14500	520	1	1
20060523	KR7000220004	1	.3=":2/)9.8c	9545534	240	14400	280	2	1
20060523	KR7000220004	1	.3=":2/)9.8c	9595844	280	14550	0	3	1
20060524	KR7000220004	2	.3=":2/)9.8c	10372517	20	14400	20	1	1
20060524	KR7000220004	2	.3=":2/)9.8c	10472061	100	14400	120	2	1
20060524	KR7000220004	1	.3=":2/)9.8c	12332441	120	14300	0	3	1
20060525	KR7000220004	2	.3=":2/)9.8c	9043728	110	14100	110	1	1
20060525	KR7000220004	1	.3=":2/)9.8c	10123852	70	14200	40	2	1
20060525	KR7000220004	1	.3=":2/)9.8c	10383780	10	14150	30	3	1
20060525	KR7000220004	1	.3=":2/)9.8c	10482667	30	14200	0	4	1
20060529	KR7000220004	2	.3=":2/)9.8c	9240821	190	14100	190	1	0
20060529	KR7000220004	2	.3=":2/)9.8c	9342265	10	14100	200	2	0
20060529	KR7000220004	2	.3=":2/)9.8c	12140902	130	14350	330	3	0
20060529	KR7000220004	2	.3=":2/)9.8c	13402261	30	14300	360	4	0
20060529	KR7000220004	2	.3=":2/)9.8c	13552509	10	14200	370	5	0
20060529	KR7000220004	2	.3=":2/)9.8c	14343275	630	14450	1000	6	0

Table 2. Case of Day-traders and Overnight Day-traders (Case for 2 Stocks)

Table 2 indicates how we define overnight day-traders, a measure of the ratio of overnight day-traders, which is defined by the number of overnight-positioners at time t among day-traders from t–5 to t–1 relative to the number of day-traders from t–5 to t–1 of each stock. The number of day-traders from t–5 to t–1 on the stock KR700002008 is 10 (a, b, c, d, g, h, i, j, x, z) and the number of overnight day-traders of the stock KR700002008 is 3 (a, c, g). Thus, $Overnight\_ratio_{i,t}$ of the stock KR700002008 on December 25 is 3/10=0.3. For the stock KR7000150003, the number of day-traders from t–5 to t–1 is 15 (a, b, c, d, e, f, g, h, k, l, m, r, v, w, x) and the number of overnight day-traders is 3 (d, g, k); therefore, the $ratio\_day\_ov_{i,t}$ of the stock KR7000150003 on December 25 is 3/15=0.2.

date	t-n	Firm code	day-traders	overnight traders	*Overnight day-traders*
20th Dec	t-5	KR700002008	a, b, c		
		KR7000150003	d, e, f		
21st Dec	t-4	KR700002008	g, h, i, j		
		KR7000150003	d, k, l, m		
22nd Dec	t-3	KR700002008	d, g, h, i		
		KR7000150003	k,		
23rd Dec	t-2	KR700002008	a, b, d, i		
		KR7000150003	c, d, v, x,		
24th Dec	t-1	KR700002008	a, b, c, x, z		
		KR7000150003	e, g, r		
25th Dec	t	KR700002008	a, b, g	**a, c, g,** u, t	**a, c, g**
		KR7000150003	a, b, e, h, w	**d, g, k,** p, t, u	**d, g, k**

Table 3. Descriptive Statistics

Table 3 reports descriptive statistics for our analysis for the sample period from January 2006 to December 2006. Panel A indicates the daily summary statistics of day-traders and overnight day-traders for 1,457 stocks traded on the Korea Exchange. Panel B reports the average ratio of overnight day-traders and the average returns for a sample of 1,457 stocks. Panel C indicates the correlations between the ratios of overnight day-traders for all, individuals, institutions, and foreign investors, and the average returns for the sample of 1,457 stocks.

Panel A. Descriptive statistics for day-traders and overnight day-traders

	Day-traders	*Overnight day-traders*
Trading volume (A)	380,783	100,551
Total order volume (B)	1,438,630	591,779
Execution rate of orders (A/B) (%)	26.46%	16.99%
Executed buy orders (C)	192,696	50,449
Total buy orders (D)	826,895	325,618
Execution rate of buy orders (C/D) (%)	23.30%	15.49%
Executed sell orders (E)	195,867	47,552
Total sell orders (F)	639,678	268,434
Execution rate of sell orders (E/F) (%)	30.61%	17.71%
Cancelled orders (G)	455,261	200,935
Cancellation rate of orders (G/B)	31.65%	33.95%
Cancelled buy orders (H)	268,113	106,648
Cancellation rate of buy orders (H/D)	32.42%	32.75%
Calcelled sell orders (I)	187,148	94,287
Cancellation rate of sell orders (I/F)	29.25%	35.12%

Panel B. Descriptive statistics on the ratio of overnight day-traders and stock returns for the total sample of stocks (1,457 stocks)

Variable	Mean	Median	Minimum	Maximum	Std. Dev.	Skewness	Ex. kurtosis	Obs
Overnight_ratio	0.0664	0.0659	0.0071	0.1117	0.0104	-0.7978	9.8139	240
Ret1	-0.0008	0.0001	-0.0343	0.0188	0.0064	-1.2403	5.1370	240
Ret2	-0.0005	0.0014	-0.0731	0.0294	0.0125	-1.8796	7.6762	240
Ret3	0.0003	0.0016	-0.0589	0.0259	0.0098	-1.5875	6.8369	240
Overnight_ratio_for	0.1219	0.1215	0.0120	0.2104	0.0329	0.0182	0.7016	240
Ret1_for	-0.0004	0.0011	-0.0398	0.0217	0.0080	-1.6386	5.8061	240
Ret2_for	-0.0005	0.0014	-0.0731	0.0294	0.0125	-1.8808	7.6729	240
Ret3_for	0.0003	0.0016	-0.0589	0.0258	0.0098	-1.5866	6.8315	240
Overnight_ratio_ind	0.0714	0.0665	0.0018	0.2621	0.0315	3.0666	14.8550	240
Ret1_ind	-0.0008	0.0001	-0.0343	0.0188	0.0064	-1.2403	5.1370	240
Ret2_ind	-0.0005	0.0014	-0.0731	0.0294	0.0125	-1.8796	7.6762	240
Ret3_ind	0.0003	0.0016	-0.0589	0.0259	0.0098	-1.5875	6.8369	240
Overnight_ratio_ins	0.0950	0.0483	0.0070	0.7853	0.1407	2.8087	7.5059	240
Ret1_ins	-0.0008	0.0001	-0.0343	0.0188	0.0064	-1.2403	5.1370	240
Ret2_ins	-0.0005	0.0014	-0.0731	0.0294	0.0125	-1.8796	7.6762	240
Ret3_ins	0.0003	0.0016	-0.0589	0.0259	0.0098	-1.5875	6.8369	240

Panel C. Correlation matrix of the ratio of overnight day-traders and overnight stock returns

	Overnight_ratio	*Overnight_ratio*	*Overnight_ratio _ind*	*Overnight_ratio _ins*	*Ret1*	*Ret2*	*Ret3*	*Ret1_for*	*Ret2_for*	*Ret3_for*	*Ret1_ind*	*Ret2_ind*	*Ret3_ind*	*Ret1_ins*	*Ret2_ins*	*Ret3_ins*
Overnight_ratio	1	0.3944	0.2818	0.1516	-0.0323	0.124	-0.2983	-0.2206	0.124	-0.2983	-0.0323	0.124	-0.2983	-0.0323	0.124	-0.2983
	(<.0001)	(<.0001)	(<.0001)	(0.0188)	(0.6187)	(0.0551)	(<.0001)	(0.0006)	(0.055)	(<.0001)	(0.6187)	(0.0551)	(<.0001)	(0.6187)	(0.0551)	(<.0001)
Overnight_ratio		1	0.1193	0.0601	0.0324	0.1711	0.2599	0.3226	0.171	0.2599	0.0324	0.1711	0.2599	0.0324	0.1711	0.2599
		(<.0001)	(0.0651)	(0.3537)	(0.6174)	(0.0079)	(<.0001)	(<.0001)	(0.0079)	(<.0001)	(0.6174)	(0.0079)	(<.0001)	(0.6174)	(0.0079)	(<.0001)
Overnight_ratio _ind			1	0.0055	0.0761	0.1105	-0.0604	0.0398	0.1108	-0.06	0.0761	0.1105	-0.0604	0.0761	0.1105	-0.0604
			(<.0001)	(0.9322)	(0.2403)	(0.0878)	(0.3516)	(0.5391)	(0.0868)	(0.3546)	(0.2403)	(0.0878)	(0.3516)	(0.2403)	(0.0878)	(0.3516)
Overnight_ratio _ins				1	-0.0624	-0.0172	-0.0238	-0.0873	-0.0172	-0.0239	-0.0624	-0.0172	-0.0238	-0.0624	-0.0172	-0.0238
				(<.0001)	(0.3356)	(0.7911)	(0.714)	(0.1775)	(0.7907)	(0.7129)	(0.3356)	(0.7911)	(0.714)	(0.3356)	(0.7911)	(0.714)
Ret1					1	0.6305	0.2454	0.6103	0.6306	0.2453	1	0.6305	0.2454	1	0.6305	0.2454
					(<.0001)	(<.0001)	(0.0001)	(<.0001)	(<.0001)	(0.0001)	(<.0001)	(<.0001)	(0.0001)	(<.0001)	(<.0001)	(0.0001)
Ret2						1	0.1607	0.3758	1	0.1608	0.6305	1	0.1607	0.6305	1	0.1607
						(<.0001)	(0.0127)	(<.0001)	(<.0001)	(0.0126)	(<.0001)	(<.0001)	(0.0127)	(<.0001)	(<.0001)	(0.0127)
Ret3							1	0.8054	0.1604	1	0.2454	0.1607	1	0.2454	0.1607	1
							(<.0001)	(<.0001)	(0.0129)	(<.0001)	(0.0001)	(0.0127)	(<.0001)	(0.0001)	(0.0127)	(<.0001)
Ret1_for								1	0.3755	0.8055	0.6103	0.3758	0.8054	0.6103	0.3758	0.8054
								(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
Ret2_for									1	0.1605	0.6306	1	0.1604	0.6306	1	0.1604
									(<.0001)	(0.0128)	(<.0001)	(<.0001)	(0.0129)	(<.0001)	(<.0001)	(0.0129)
Ret3_for										1	0.2453	0.1608	1	0.2453	0.1608	1
										(<.0001)	(0.0001)	(0.0126)	(<.0001)	(0.0001)	(0.0126)	(<.0001)
Ret1_ind											1	0.6305	0.2454	1	0.6305	0.2454
											(<.0001)	(<.0001)	(0.0001)	(<.0001)	(<.0001)	(0.0001)
Ret2_ind												1	0.1607	0.6305	1	0.1607
												(<.0001)	(0.0127)	(<.0001)	(<.0001)	(0.0127)
Ret3_ind													1	0.2454	0.1607	1
													(<.0001)	(0.0001)	(0.0127)	(<.0001
Ret1_ins														1	0.6305	0.2454
														(<.0001)	(<.0001)	(0.0001)
Ret2_ins															1	0.1607
															(<.0001)	(0.0127)
Ret3_ins																1
																(<.0001)

Table 4. OLS Results

Table 4 indicates the OLS regression results for all, foreign, individual, and institutional investor groups during the period of January 6, 2006 to December 28, 2006 (240 trading days). Equation (1) presents the coefficient estimates for OLS regressions of stock return on the ratio of overnight day-traders. Equations (2) and (3) report the coefficient estimates for OLS regressions of the ratio of overnight day-traders on stock return. The OLS equations for the aggregate equal-weighted averaged stock return during day t (*Ret3*), the aggregate equal-weighted averaged stock return from the end of day t to the start of day t+1 (*Ret1*), and the aggregate equal-weighted averaged stock return during day t+1(*Ret2*) are as follows:

$$Overnight\_ratio_{\,t} = \alpha_0 + \alpha_1 Ret3_t + e_t \quad (1)$$
$$Ret1_t = \alpha_0 + \alpha_1 Overnight\_ratio_t + e_t \quad (2)$$
$$Ret2_t = \alpha_0 + \alpha_1 Overnight\_ratio_{\,t} + e_t \quad (3)$$

where $Overnight\_ratio_{\,t}$ is the ratio of overnight day-traders on day t. Standard errors are corrected using Newey-West procedures. The t-statistics are shown in parentheses below each coefficient estimate, and *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Overnight_ratio				*Ret1*				*Ret2*			
	All	Foreigner	Individual	Institutional	All	Foreigner	Individual	Institutional	All	Foreigner	Individual	Institutional
Intercept	0.0664*** (73.096)	0.1216*** (46.7079)	0.07144*** (28.2037)	0.0951*** (7.1777)	0.0005 (0.2920)	-0.0099*** (-4.5962)	-0.0018** (-2.0096)	-0.0004 (-1.0088)	-0.0104 (-1.1205)	-0.0084* (-1.9219)	-0.0036* (-1.6987)	-0.0004 (-0.3859)
Ret3	-0.3181*** (-4.9841)	0.8759*** (3.9733)	-0.195 (-0.8496)	-0.3428 (-0.4210)								
Overnight_ratio					-0.01985 (-0.6800)	0.0787*** (5.1092)	0.0154 (1.5056)	-0.0028 (-0.9005)	0.1486 (1.0859)	0.0648** (1.9964)	0.0437* (1.727)	-0.0015 (-0.4265)
$\overline{Adj}\ R^2$	0.089	0.0675	0.0036	0.0006	0.001	0.1041	0.0058	0.0039	0.0154	0.0292	0.0122	0.0003
Obs	240	240	240	240	240	240	240	240	240	240	240	240

Table 5: Unit Root Test

Table 5 reports the unit-root test result for each variable. We use the augmented Dickey-Fuller (ADF) test and the Phillips and Perron (PP) test to determine whether a variable has a unit root. P-values are MacKinnon (1996) one-sided p-values.

Overnight_ratio		ADF		PP	
		Intercept	Trend and Intercept	Intercept	Trend and Intercept
All	test-statistics	-11.9300	-12.1897	-12.0986	-12.3521
	p-value	[0.0000]	[0.0000]	[0.0000]	[0.0000]
	lag length/Band width	0	0	6	6
Foreigners	test-statistics	-12.0433	-12.4416	-12.0304	-12.4193
	p-value	[0.0000]	[0.0000]	[0.0000]	[0.0000]
	lag length/Band width	0	0	2	6
Individuals	test-statistics	-11.6038	-11.6721	-11.5583	-11.6557
	p-value	[0.0000]	[0.0000]	[0.0000]	[0.0000]
	lag length/Band width	0	0	3	2
Institutions	test-statistics	-4.07044	-4.1782	-12.6712	-12.7526
	p-value	[0.0013]	[0.0056]	[0.0000]	[0.0000]
	lag length/Band width	3	3	9	9

Table 6. Bivariate VAR Models

Table 6 presents the results from the bivariate vector autoregression (VAR) using the ratio of overnight day-traders and stock returns, as follows:

$$\begin{bmatrix} Overnight\_ratio_t \\ Ret_t \end{bmatrix} = \begin{bmatrix} \alpha_{Overnight\_ratio} \\ \alpha_{iRet} \end{bmatrix} + \begin{bmatrix} b_{11}(L) & b_{12}(L) \\ b_{21}(L) & b_{22}(L) \end{bmatrix} \begin{bmatrix} Overnight\_ratio_{t-1} \\ Ret_{t-1} \end{bmatrix} + \begin{bmatrix} e_t^{Overnight\_ratio} \\ e_t^{Ret} \end{bmatrix}$$

where $Overnight\_ratio_t$ is calculated using the number of overnight-positioners at time t among day-traders from t–5 to t–1 of each firm. This value is averaged aggregately for the sample of 1,457 stocks listed on the KSE. Ret_t is also an aggregate average using the sample of 1,457 stocks. α_k are intercepts and b(L) is a polynomial in the lag operator L. $e_t^{Overnight\_ratio}$ and $e_t^{Overnight\_ratio}$ are error terms that are assumed to follow an i.i.d. normal distribution with the zero vector expectation and the variance matrix $e_t \sim iid(0, \Sigma)$, $\Sigma = \begin{bmatrix} \sigma^2_{Overnight\_ratio} & \rho\sigma_{Overnight\_ratio}\sigma_{Ret} \\ \rho\sigma_{Overnight\_ratio}\sigma_{Ret} & \sigma^2_{Ret} \end{bmatrix}$.

Panel A reports the coefficients of the ratio of overnight day-traders equations in bivariate VAR for all, foreign, individual, and institutional investor groups. Panel B reports the coefficients of return equations in bivariate VAR for all, foreign, individual, and institutional investor groups. The optimal lag length p is chosen by the Hanna-Quinn information criterion (HQC). The null hypotheses of the Granger causality tests, *Ret* do not Granger-cause *Overnight_ratio* for the ratio of the overnight day-traders equation and *Overnight_ratio* does not Granger-cause *Ret* for the return equations. These hypotheses are tested and the p-values are reported. The sample period covers January 6, 2006 to December 28, 2006 (240 trading days).

Panel A. Ratio of overnight day-traders equations

	Ret1				*Ret2*				*Ret3*			
	All	Foreigners	Individuals	Institutions	All	Foreigners	Individuals	Institutions	All	Foreigners	Individuals	Institutions
Const	0.0442***	0.0647***	0.0543***	0.04171***	0.0445***	0.0679***	0.0511***	0.0338***	0.0461***	0.0845***	0.0510***	0.0423***
(t-stat)	(8.8406)	(4.8732)	(9.0614)	(3.609)	(11.5705)	(5.2078)	(10.4392)	(2.8759)	(10.9662)	(10.7535)	(10.4864)	(3.6546)
Overnight_ratio lag1	0.2009***	0.2583***	0.2687***	0.2560***	0.3241***	0.2305***	0.2801***	0.1976***	0.3014***	0.3029***	0.2812***	0.2545***
(t-stat)	(3.1388)	(3.8758)	(4.1045)	(4.038)	(5.6688)	(3.5094)	(4.4668)	(3.0364)	(4.8174)	(4.8442)	(4.5098)	(4.032)
Overnight_ratio lag2	0.1272**	-0.0267	-0.0263	0.0061		-0.0337		0.0065				0.0115
(t-stat)	(2.0642)	(-0.3907)	(-0.4064)	(0.0930)		(-0.5014)		(0.1014)				(0.1771)
Overnight_ratio lag3		0.0865		0.2763***		0.0843		0.22955***				0.2899***
(t-stat)		(1.2755)		(4.343)		(1.2847)		(3.5441)				(4.6021)
Overnight_ratio lag4		-0.0771				-0.0385		0.1964***				
(t-stat)		(-1.1564)				(-0.5847)		(3.0143)				
Overnight_ratio lag5		0.2190***				0.1942***						
(t-stat)		(3.5038)				(3.2987)						
Ret lag1	-0.0736	1.1225***	0.4221	-1.2118	-0.2450***	0.8264***	-0.0506	-0.5274	0.0503	0.2889	0.1792	-0.7560
(t-stat)	(-0.7675)	(4.3859)	(1.3628)	(-0.8932)	(-5.1560)	(5.5639)	(-0.3198)	(-0.7846)	(0.7568)	(1.369)	(0.8898)	(-0.8778)
Ret lag2	0.0470	-0.7737***	0.2920	-1.0828		0.2708*		-0.5532				-0.8355
(t-stat)	(0.4897)	(-2.8534)	(0.9376)	(-0.8031)		(1.7022)		(-0.8158)				(-0.8194)
Ret lag3		-0.2613		0.0625		-0.3841**		-0.3587				-0.3090
(t-stat)		(-0.9449)		(0.0461)		(-2.4366)		(-0.5290)				(-0.3586)
Ret lag4		-0.1076				-0.1091		-0.1714				
(t-stat)		(-0.3887)				(-0.6817)		(-0.2545)				

Ret lag5		0.0596				-0.0487						
(t-stat)		(0.2243)				(-0.3048)						
$\overline{Adj}\ R^2$	0.0805	0.2273	0.0883	0.1876	0.1812	0.2737	0.0780	0.2206	0.0912	0.1156	0.0807	0.1886
Granger-Causality	0.6898	0.0001	0.2144	0.6418	0.0000	0.0000	0.7494	0.7361	0.4499	0.1723	0.3745	0.5833
Obs	240	240	240	240	240	240	240	240	240	240	240	240

Panel B. Return equations

	Ret1				*Ret2*				*Ret3*			
	All	Foreigners	Individuals	Institutions	All	Foreigners	Individuals	Institutions	All	Foreigners	Individuals	Institutions
Const	0.0034	-0.003	-0.0011	0.0000	0.0057	-0.001	0.0012	-0.0000003	-0.0099**	-0.0059**	-0.0014	0.0005
(t-stat)	(1.0352)	(-0.8376)	(-0.9160)	(0.0401)	(1.1048)	(-0.1627)	(0.6255)	(-0.0034)	(-2.3453)	(2.4081)	(-0.9091)	(0.5630)
Overnight_ratio lag1	-0.0139	0.0233	0.0051	-0.0059*	-0.0933	0.0302	-0.0232	-0.0050	0.1543**	0.0513**	0.0240	0.0010
(t-stat)	(-0.3238)	(1.3157)	(0.3784)	(-1.9491)	(-1.1972)	(1.0224)	(-0.9062)	(-0.7880)	(2.4402)	(2.6095)	(1.1950)	(0.2065)
Overnight_ratio lag2	-0.0501	0.0085	-0.00004	-0.0029		-0.015		-0.0095				0.0020
(t-stat)	(-1.2128)	(0.4678)	(-0.0030)	(-0.912)		(-0.496)		(-1.5032)				(0.3982)
Overnight_ratio lag3		-0.0138		0.0008		-0.0508*		0.00441				-0.0045
(t-stat)		(-0.762)		(0.2801)		(-1.7216)		(0.6941)				(-0.9339)
Overnight_ratio lag4		-0.0158				0.0425		0.00481				
(t-stat)		(-0.887)				(1.4325)		(0.7519)				
Overnight_ratio lag5		0.0192				-0.0036						
(t-stat)		(1.1542)				(-0.1364)						
Ret lag1	0.1499**	0.3148**	0.1514**	0.1522**	0.1388**	0.1234*	0.1356**	0.1276*	0.0926	-0.0006	0.0487	0.0453
(t-stat)	(2.3290)	(4.6209)	(2.3402)	(2.3159)	(2.1426)	(1.8468)	(2.0944)	(1.9325)	(1.3772)	(-0.0089)	(0.7497)	(0.6905)
Ret lag2	-0.1664**	-0.094	-0.1663**	-0.1897***		-0.0173		-0.0051				0.0127
(t-stat)	(-2.5832)	(-1.3027)	(-2.5565)	(-2.9038)		(-0.2421)		(-0.0769)				(0.1931)
Ret lag3		0.0299		0.07812		0.0332		0.0173				-0.0934
(t-stat)		(0.4054)		(1.1890)		(0.4675)		(0.2608)				(-1.4218)
Ret lag4		-0.0321				-0.0044		-0.0795				
(t-stat)		(-0.436)				(-0.0618)		(-1.2023)				
Ret lag5		-0.1490**				-0.1408*						
(t-stat)		(-2.1057)				(-1.9595)						
$\overline{Adj}\ R^2$	0.0516	0.1573	0.0442	0.0779	0.0226	0.0596	0.0201	0.0387	0.0265	0.03	0.0079	0.0148
Granger-Causality	0.3750	0.4359	0.9260	0.1100	0.2324	0.3238	0.3657	0.4072	0.0154	0.0096	0.2333	0.8197
Obs	240	240	240	240	240	240	240	240	240	240	240	240

Table 7. Contemporaneous Coefficients in Structural VAR Models

Table 7 presents the estimation results of the structural VAR model and the equation tested to determine the relationship between structural innovation and reduced innovation, and the system of contemporaneous innovations are as follows:

$$Ae_t = Bu_t$$

$$\begin{bmatrix} 1 & a_{12} \\ a_{21} & 1 \end{bmatrix} \begin{bmatrix} e_{Overnight\_ratio,t} \\ e_{Ret,t} \end{bmatrix} = \begin{bmatrix} u_{Overnight\_ratio,t} \\ u_{Ret,t} \end{bmatrix}$$

where A is a 2×2 matrix, a_{ij} represents the parameters for the contemporaneous causal relations among *Overnight_ratio*, *Ret*, e_t represents the observed (nonorthogonalized) innovations at time t, and u_t represents the unobserved (orthogonalized) shocks.

Panel A reports the structural VAR results from imposing the short-term restrictions $a_{12} = 0$ on the equation, allowing an unexpected shock of *Overnight_ratio* to contemporaneously affect *Ret1* (*Ret2)* but not the reverse. Panel B reports a structural VAR by imposing the short-term restriction $a_{21} = 0$ on the equation, allowing an unexpected shock of *Ret3* to contemporaneously affect *Overnight_ratio* but not the reverse. The sample period covers January 6, 2006 to December 28, 2006 (240 trading days).

Panel A. Contemporaneous coefficients of structural models in *Ret1* and *Ret2* equations

	Ret1				*Ret2*			
	All	Foreigners	Individuals	Institutions	All	Foreigners	Individuals	Institutions
a_{21} (z − stat)	0.0108 (0.2501)	-0.0646*** (-3.8345)	-.01475 (-1.0912)	0.0010 (0.3309)	-0.3119*** (-3.5546)	-0.0642*** (-2.2102)	-0.0554*** (-2.0997)	0.0008 (0.1347)
obs	240	240	240	240	240	240	240	240

Panel B. Contemporaneous coefficients of structural models in *Ret3* equations

	Ret3			
	All	Foreigners	Individuals	Institutions
a_{12} (z − stat)	0.3396*** (5.6910)	-0.7088*** (-3.5245)	0.2707 (1.3445)	0.1901 (0.2230)
obs 240	240 240	240 240	240 240	240 240

Table 8. OLS Results

Panel A indicates the daily summary statistics of one-month KRW/USD NDF rate measured in the Tokyo(London) time zone. *Ndf_1m_Tokyo_op*(*Ndf_1m_London_op*) is the opening one-month KRW/USD NDF rate measured in the Tokyo(London) time zone. *Ndf_1m_Tokyo_cl*(*Ndf_1m_London_cl*) is the closing one month KRW/USD NDF rate measured in the Tokyo(London) time zone. *Ln_diff_ndf_1m_Tokyo(Ln_diff_ndf_1m_London)* refers to the return on the one-month KRW/USD NDF rate from the opening to the closing price at t measured in the Tokyo(London) time zone.

Panel B shows the results of the coefficient estimates for the OLS regressions of *Overnight_ratio* with a log difference of one-month KRW/USD NDF during the period from January 6, 2006 to December 28, 2006 (240 trading days). The OLS equations are as follows:

$$Overnight\_ratio_{\,t} = \alpha_0 + \alpha_1 Ln\_diff\_ndf\_1m\_Tokyo_t + e_t$$

$$Overnight\_ratio_{\,t} = \alpha_0 + \alpha_1 \mathrm{Ret3}_t + \alpha_2 Ln\_diff\_ndf\_1m\_Tokyo_t + e_t$$

$$Ln\_diff\_ndf\_1m\_London_{\,t} = \alpha_0 + \alpha_1 Overnight\_ratio_{\,t} + e_t$$

where $Overnight\_ratio_t$ is the ratio of overnight day-traders on day t, *Ln_diff_ndf_1m_Tokyo* refers to the return of the one-month KRW/USD NDF rate measured in the Tokyo time zone, and *Ln_diff_ndf_1m_London* is measured in the London time zone. Standard errors are corrected using Newey-West procedures. The t-statistics are shown in parentheses under each coefficient estimate, and *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Discriptive Statistics

Variable	Mean	Median	Minimum	Maximum	Std. Dev.	Skewness	Ex. kurtosis	Obs
ndf_1m_Tokyo_op	953.624	955.5	912.5	990.3	16.0579	-0.1201	-0.5094	240
ndf_1m_Tokyo_cl	953.929	955.8	912.4	990.4	15.9379	-0.1300	-0.4807	240
Ln_diff_ndf_1m_Tokyo	-0.0003	-0.0003	-0.0160	0.0176	0.0046	-0.0483	2.2374	240
ndf_1m_London_op	953.907	955.5	913.1	992.75	16.0483	-0.1130	-0.4962	240
ndf_1m_London_cl	954.123	955.375	914	992.5	16.0417	-0.1072	-0.4916	240
Ln_diff_ndf_1m_London	-0.0002	0.0000	-0.0151	0.0188	0.0044	0.1235	1.9100	240

Panel B.

	Overnight_ratio				*Overnight_ratio*				*Ln_diff_ndf_1m_London*			
	All	For	Ind	Ins	All	For	Ind	Ins	All	For	Ind	Ins
const	0.0663*** (72.9341)	0.1214*** (43.9995)	0.0712*** (28.8078)	0.0963*** (7.1106)	0.0664*** (73.1414)	0.1212*** (46.473)	0.0713*** (28.7935)	0.0963*** (7.1108)	-0.0003 (-0.1838)	0.1216*** (44.1397)	0.0713*** (28.5115)	0.0959*** (7.1537)
Ret3					-0.3224*** (-5.0243)	0.8020*** (3.4613)	-0.2259 (-0.9963)	-0.0574 (-0.0743)				
Ln_diff_ndf_1m_Tokyo	0.0367 (0.3257)	-1.3162*** (-3.1193)	-0.3792 (-1.0442)	4.1701 (1.3718)	-0.0622 (-0.6018)	-1.0688** (-2.5811)	-0.4484 (-1.2666)	4.1525 (1.3854)				
Overnight_ratio									0.0009 (0.0365)	-1.0427** (-2.3741)	-0.2316 (-0.6309)	4.3038 (1.4116)
R-squared	0.0003	0.0342	0.0031	0.0188	0.0897	0.0896	0.0079	0.0188	0.000004	0.0196	0.0011	0.0182
Obs	240	240	240	240	240	240	240	240	240	240	240	240

Table 9. Contemporaneous Coefficients in Structural VAR Models

Table 9 presents the estimation results of the structural VAR model and the equation tested to determine the relationship between structural innovation and reduced innovation. The systems of contemporaneous innovations are as follows:

$$Ae_t = Bu_t$$

$$\begin{bmatrix} 1 & a_{12} \\ a_{21} & 1 \end{bmatrix} \begin{bmatrix} e_{Overnight\_ratio\ t} \\ e_{Ln\_diff\_ndf\_1m\_Tokyo(or\ London)t} \end{bmatrix} = \begin{bmatrix} u_{Overnight\_ratio\ t} \\ u_{Ln\_diff\_ndf\_1m\_Tokyo(or\ London)\ t} \end{bmatrix}$$

where A is a 2×2 matrix, a_{ij} represents the parameters for the contemporaneous causal relationships among *Overnight_ratio* and *Ln_diff_ndf_1m_Tokoy(or London)*, e_t represents the observed (nonorthogonalized) innovations at time t, and u_t represents the unobserved (orthogonalized) shocks.

Panel A reports the structural VAR results from imposing the short-term restriction $a_{21} = 0$ on the equation, allowing an unexpected shock of *Ln_diff_ndf_1m_Tokyo* to contemporaneously affect *Overnight_ratio* but not the reverse. Panel B reports a structural VAR by imposing the short-term restriction $a_{12} = 0$ on the equation, allowing an unexpected shock of *Overnight_ratio* to contemporaneously affect *Ln_diff_ndf_1m_London* but not the reverse. The sample period covers January 6, 2006 to December 28, 2006 (240 trading days).

Panel A. *Ln_diff_ndf_1m_Tokyo*

	Ln_diff_ndf_1m_Tokyo			
	All	Foreigners	Individuals	Institutions
a_{12} $(t-\text{stat})$	-0.0893 (-0.6789)	1.1604*** (2.7238)	0.3510 (0.8248)	-4.0733** (-2.2709)
Obs	240	240	240	240

Panel B. *Ln_diff_ndf_1m_London*

	Ln_diff_ndf_1m_London			
	All	Foreigners	Individuals	Institutions
a_{21} $(z-\text{stat})$	-0.0116 (-0.3780)	0.0192** (2.0834)	0.0065 (0.6904)	-0.0039 (-1.7413)
Obs	240	240	240	240

Figure 1: The ratio of overnight day-traders

Figure 1 indicates the time series of the aggregate *Overnight_ratio* for each investor group

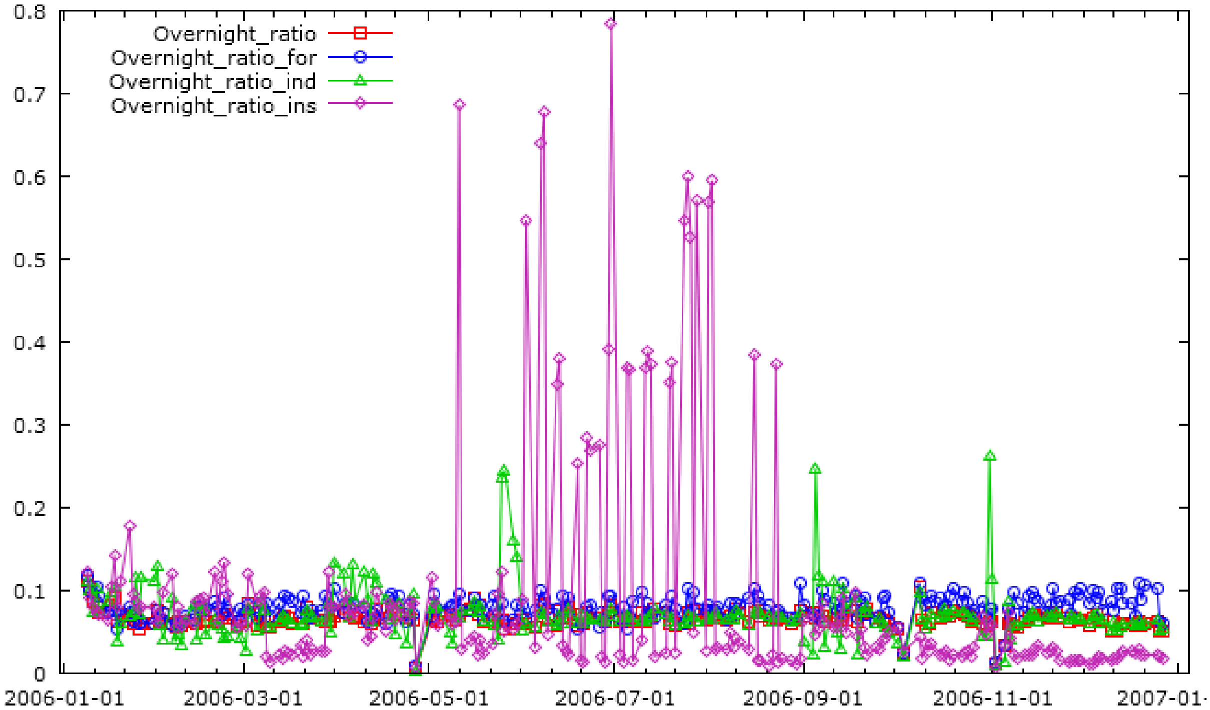
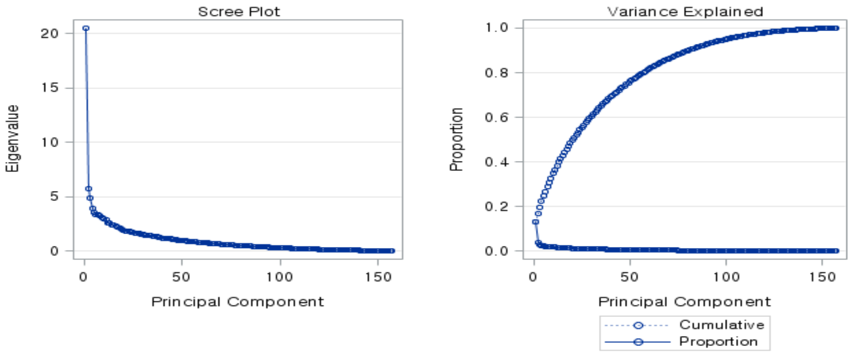


Figure 2. *Overnight_ratio*: PCA results

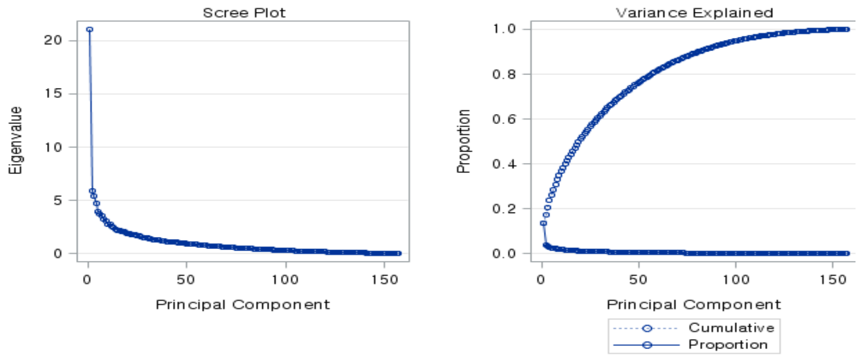
The figures in Panel A indicate scree plots for *Overnight_ratio* for each type of investor. The x-axis of the scree plot presents the principal components sorted by a decreasing fraction of the total variance explained and the y-axis indicates the fraction of the total variance explained. Panel B indicates the proportion of the i-th component in explaining *Overnight_ratio*.

Panel A. Scree plot

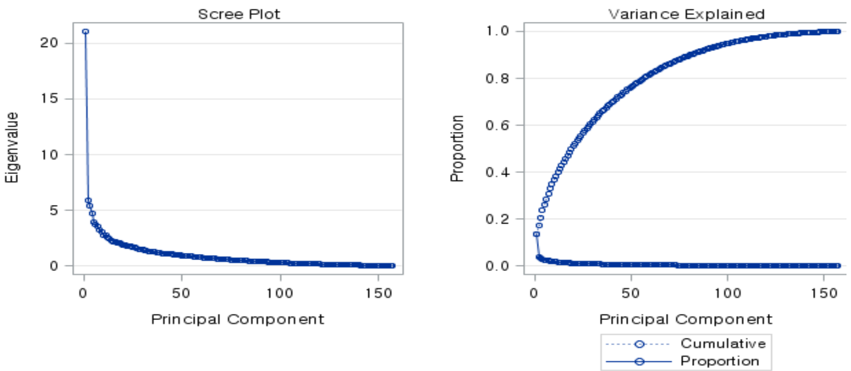
(a) All



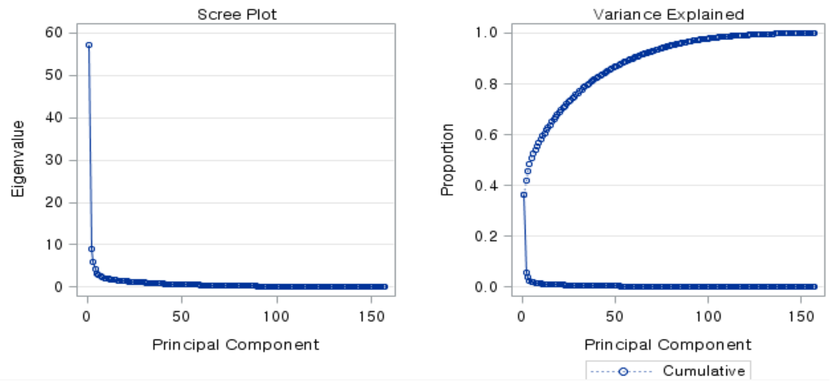
(B) Foreigners



(C) Individuals



(D) Institutions



Panel B. Proportions of i-th component

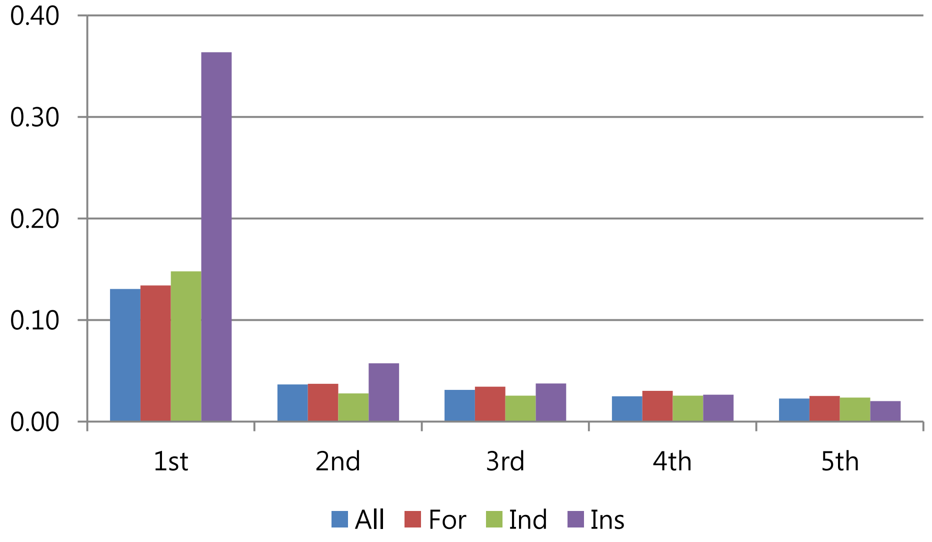


Figure 3. Impulse responses

Figure 3 indicates the results of the impulse response functions. The first and second columns present the response of *Ret1* and *Ret2* to a one standard deviation shock in *Overnight_ratio* in a structural VAR model, assuming that *Ret1 (Ret2)* can be contemporaneously affected by *Overnight_ratio* but not the reverse. The third column displays the response of *Overnight_ratio* to a one standard deviation shock in *Ret3* in a structural VAR model, assuming that *Overnight_ratio* can be contemporaneously affected by *Ret3* but the reverse. The time scale on the horizontal axis is days. The VAR is estimated separately for all, foreign, individual, and institution day-traders. Shocks are structurally decomposed to allow for short-term restrictions on the equation. For each impulse response function, 95% confidence intervals are computed using the 1,000 times bootstrap-method suggested by Killian (1998).

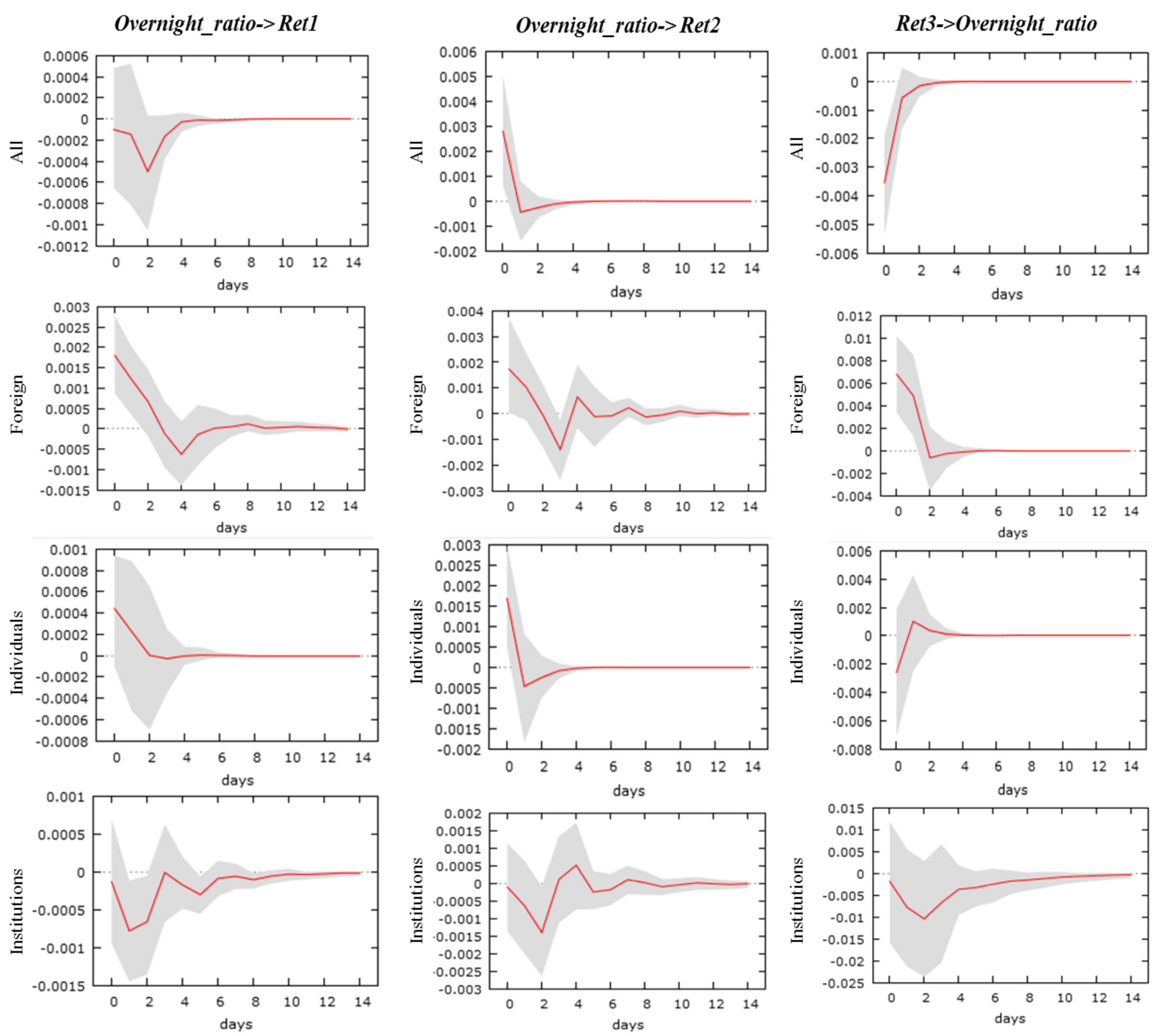


Figure 4. Time line of Korean stock market and NDF market

Figure 4 presents the time line of the Korean stock market and the NDF market. The blue solid line represents the time line of the Korean stock market, whereas the red thin dotted line represents the time line of the Tokyo NDF market. The black thick dashed line represents the time line for the London NDF market.

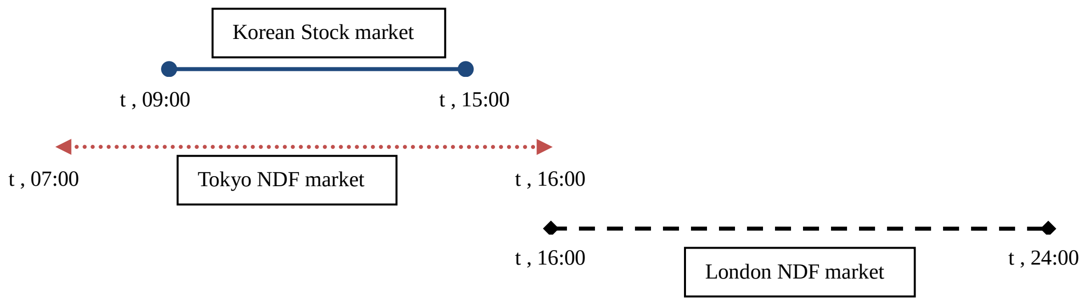


Figure 5. Impulse responses

Figure 5 indicates the results of the impulse response function. The first column presents the response of *Overnight_ratio* to a one standard deviation shock in *Ln_diff_ndf_1m_Tokyo* in a structural VAR model, assuming that *Ln_diff_ndf_1m_Tokyo* can contemporaneously impact *Overnight_ratio* but not the reverse.

The second column displays the response of *Ln_diff_ndf_1m_London* to a one standard deviation shock in *Overnight_ratio* in a structural VAR model, assuming that *Overnight_ratio* can contemporaneously affect *Ln_diff_ndf_1m_London* but not the reverse. The time scale on the horizontal axis is days. The VAR is estimated separately for all, foreign, individual, and institutional day-traders. Shocks are structurally decomposed to allow for short-term restrictions on the equation. For each impulse response function, 95% confidence intervals are computed using the 1,000 times bootstrap-method suggested by Killian (1998).