

# Who has an edge in trading index derivatives?\*

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## Abstract

Using transaction data of a leading index derivatives market, we find that foreign institutional investors make huge average profits from both intraday and overnight trading, while domestic individuals lose almost the same amount. Foreign investors' intraday trading performance is stable over time and highly significant after risk adjustment for conventional factors, but their overnight trading performance is relatively unstable and becomes somewhat weaker when adjusted for risk factors. Foreign investors pay more penalties for demanding liquidity than earned as reward for supplying liquidity, which implies that liquidity provision cannot be a source of their outperformance. Our evidence supports that the large trading profits of foreign investors are mainly due to superior market-wide information about intraday changes in the underlying index.

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## 1. Introduction

It has been one of important issues for both finance researchers and policy makers who performs better when foreign and domestic investors trade with each other. If a long distance with different nationality makes it difficult to get information of good quality, domestic investors may enjoy an information advantage over foreign investors and exploit the information asymmetry. On the other hand, if foreign investors are mostly institutions with superior skills and vast experience in sophisticated trading, they can show better performance than domestic investors do. Many studies have investigated which story fits the reality more closely by looking at the performance of foreign versus domestic investors in different markets, but the empirical results are inconclusive. For example, Grinblatt and Keloharju (2000), Seasholes (2000), and Barber, Lee, Liu and Odean (2009) document evidence supporting that foreign investors outperform domestic investors, while Choe, Kho and Stulz (2005) and Dvořák (2005) find foreign investors' underperformance.

Though the previous studies have failed to draw consistent conclusions on whether domestic or foreign investors earn more profits and have an information advantage, they have one thing in common: most of existing works have focused on individual equities or equity options markets. If we assume that the investment performance mainly results from informed trading, the outperforming investors in individual equities and equity options markets are likely to have superior information about both firm-specific and market-wide conditions. On the other hand, this study focuses on an index derivatives market, where the investment performance depends exclusively on market-wide information. We conjecture that, while foreign investors may be at a disadvantage compared to domestic investors in access to firm-specific information, they can be better informed about market-wide, macroeconomic conditions. Since foreign institutional investors invest globally, they are more willing to collect macroeconomic information affecting stock markets in various countries and can interpret such information better than domestic investors from a global perspective.

We use a unique dataset of the complete history of all transactions for futures and options written on

the Korea Stock Price Index (KOSPI) 200, a leading equity index in Korea.<sup>1</sup> The data include information of each trader account with an encoded identifier and the time when buy and sell orders for each trade are received, and moreover, each trader account can be categorized into three types, foreign institutional investors, domestic institutional investors, and domestic individual investors. Based on this information, we examine trading profits and losses earned by the three investor groups in the KOSPI 200 index derivatives market and investigate what drives their performance. One advantage of our dataset is that we can exactly identify which investor group has submitted an order first for each trade.

In addition, our account-level dataset allows us to calculate daily profits of each investor from intraday and overnight trading separately. Previous studies using transactions data do not separate intraday and overnight trading profits, possibly due to lack of account-level information.<sup>2</sup> We calculate in this study the intraday trading profits for each trader account by multiplying the total positions that are established and liquidated within a day by the difference between the average buy and sell prices during the day, and regard the remaining part of the total profits as the overnight trading profits. We believe this approach has an incremental contribution to the literature because it enables us to attribute the performance of the investor group with the highest trading profits to information on either intraday or overnight movements in the underlying stock market index. There are a considerable number of overnight traders in the index derivatives market who try to exploit an information advantage over a relatively longer horizon compared to day traders, and the source of these investors' performance may be completely different from that of day traders.

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<sup>1</sup> The dataset is publicly unavailable but provided for our research by the Korea Exchange (KRX).

<sup>2</sup> For example, Grinblatt and Keloharju (2000) measure performance of investors in the Finnish stock market by examining whether the buy ratio of future winning stocks exceeds the buy ratio of future losing stocks. Choe, Kho, and Stulz (2005) compute the volume-weighted average price for all purchases and sales separately for each investor group in the Korean stock market and examine which investor group trades at a disadvantageous price. Choe and Eom (2009) and Lee (2015) use a similar intraday dataset with ours on the KOSPI 200 futures market but simply calculate trading profits under the assumption that remaining position at the market close were closed at the end of each trading day. Other examples that measure the investment performance using transaction-level data include Hau (2001), Dvořák (2005), Chen, Johnson, Lin, and Liu (2009), and Phansatan, Powell, Tanthanongsakkun, and Treepongkaruna (2012).

Our empirical findings show that foreign investors earn a large average profit in both the KOSPI 200 futures and options markets. Domestic institutions earn only a small profit, and individuals lose almost the same amount as earned by foreigners in both futures and options. On the other hand, when decomposing the total trading profit into the intraday and overnight trading profits, foreign investors earn comparable profits on average from intraday and overnight trading in both markets. However, their overnight trading profits substantially vary across times whereas their intraday trading profits are stable over the whole sample period. The overnight trading profit of foreign investors sharply increases on several exceptional days of stock market crashes, especially for put options trading.

We also compare the risk-adjusted performance of each investor group by calculating daily returns on the index derivatives portfolios held by each group and adjusting them for five risk factors, including three stock market risk factors of Fama and French (1993) and two option market factors related to the variance risk premium. Our results show that foreign investors earn positive and significant average risk-adjusted returns from intraday trading in the futures market and both intraday and overnight trading in the options market. Their risk-adjusted performance from overnight futures trading, however, is not statistically significant. Overall, our findings indicate that foreign investors earn relatively weak and unstable profits from overnight trading and these suggest that foreign overnight traders may invest in index derivatives for event-driven trading or hedging purpose rather than informed trading.

On the other hand, one possible source of the large and robust intraday trading profits earned by foreign investors may be reward for net supply of liquidity in the market. Based on the accurate information of the times when buy and sell orders for each trade are received, we investigate whether foreign investors trade aggressively or passively and find that more than 60% of their total trades are initiated by themselves, indicating that they demand rather than supply liquidity on average in both the futures and options markets. We further examine what fraction of the trading profits of foreign investors can be attributed to net supply of liquidity by calculating the benefit from passive trades and the cost from aggressive trades, and find that foreign investors pay substantial penalties for demanding liquidity by trading at disadvantageous prices. Therefore, the huge intraday trading profits of foreign investors cannot be due to compensation for net

supply of liquidity, and their trading profits become even greater when the outcomes of liquidity taking activity are excluded.

Finally, we examine whether foreign investors are better informed about the underlying stock index than domestic investors and their outperformance can be attributed to superior information. In daily frequency, we find only weak evidence in the futures market that the delta-weighted net demand of foreign investors can marginally predict the next-day return on the underlying index, which implies that their outperformance from overnight futures trading can be at most only partially attributed to superior information about overnight directional changes in the underlying index. In the options market, information about two- and three-day-ahead volatility can partially explain their overnight trading performance. In intraday frequency, we find stronger evidence that foreign investors' net demand for directions in 5- or 1-minute-ahead index returns has generally significant predictive power, in both the futures and options markets. These results support that a main source of the large intraday trading profits of foreign investors may be short-term information about intraday changes in the underlying stock index. However, it seems to be insufficient to completely explain their huge profits from options trading and, because many foreign investors in the option market trade extremely frequently, a considerable fraction of their intraday option trading profits may be associated with algorithmic trading or high frequency trading.

The remaining part of the paper is organized as follows. The KOSPI 200 index derivatives markets and our dataset are explained in Section 2. Section 3 shows the trading performance of domestic and foreign investors. We investigate the source of foreign investors' trading performance in Section 4 and conclude the paper in Section 5.

## **2. The Index Derivatives Markets in the Korea Exchange**

### **2.1 Description of KOSPI 200 futures and options markets**

The Korea Exchange (KRX) has launched equity index futures and options in May 1996 and July 1997, respectively. The index futures and options are based on the Korea Stock Price Index 200 (KOSPI 200), a leading equity index in Korea. The equity index derivatives market in Korea has rapidly grown during its

relatively short history, and it is now one of the most active markets in terms of trading volume in the world. According to the Futures Industry Association (FIA) annual volume survey, total volume in KOSPI 200 options has been ranked top in the world for nearly a decade until 2012. After 2012, trading in KOSPI 200 options has been hugely decreased as a result of a fivefold increase in the contract multiplier for the index options by KRX.<sup>3</sup> Notwithstanding, the KOSPI 200 options market still holds the third place in the world as of 2013, and the KOSPI 200 futures market has been consistently ranked within top 20 in the world during the year 2010 to 2012.

The KOSPI 200 index derivatives market is an electronic order-driven market, devoid of designated market makers. The trading hours are 9:00 to 15:15, Monday through Friday, but the trading of matured contracts ends at 14:50 on the last trading day for each contract. The KRX introduces the overnight trading section linked to the Chicago Mercantile Exchange (CME) Globex for the KOSPI 200 futures since November 16, 2009. For the KOSPI 200 options, it has been cooperating with Eurex from August 30, 2010. During the overnight section from 18:00 to 5:00 on the next day, investors can enter into a new position or close existing ones in the KOSPI 200 futures and options as in the regular daytime trading section. The overnight section facilitates immediate risk management of foreign investors, thus it makes the KOSPI 200 index derivatives more attractive to them. The last trading day of futures and options is the second Thursday of the contract month.

The contract months of futures are March, June, September, and December. For options contracts, the contract months are the three nearest consecutive months and a month within six months among March, June, September, and December. The KOSPI 200 options contract is European, exercisable only at its expiration. In both futures and options markets, trading prices are determined by continuous auction except for the last ten minutes when orders are collected for the closing call auction. The minimum tick size is 0.05

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<sup>3</sup> The change in the multiplier has begun taking effect on March 9 and ended on June 15 in 2012. The main purpose of the change is to discourage individual investors from speculating in the index options market, by making each contract five times as expensive to trade. It has been considered that one of key success factors of KOSPI 200 options is the relatively small size of the contract, which attracts many retail investors in the market. During the sample period, retail trading volume accounts for approximately one third of total volume in the market.

index point, which corresponds to a value of 25,000 Korean Won (KRW), for futures and options with 3 points or higher of premiums, and 0.01 index point for options with premiums below 3 points.

## **2.2 Data**

We use a proprietary dataset of complete history of trades in the KOSPI 200 futures and options markets provided by KRX. It includes all transactions on KOSPI 200 futures and options occurred during the period January 4, 2010 to June 30, 2014. While our sample period is relatively short due to data availability, it includes the period of an increase in the contract multiplier for the KOSPI 200 options since March 9, 2012, thus we can investigate the effect of the policy change by dividing the full sample period into sub-periods. The data include, for each trade, an encoded identifier for each trading party and a code of investor types classified as either of domestic individuals, domestic institutions, or foreign investors. Our dataset also provides the time in milliseconds when each of buy and sell orders is received, and this information allows us to determine the trading party by which the trade is initiated. Based on the data, we can calculate daily open positions at the closing time and daily cash flows at an account level for each investor as well as at an aggregated level for each type of investors in the index derivatives market. An account is regarded as participating in the market if it trades at least once during a day or holds any positions not closed in the previous trading day.

## **2.3 Trading activities by the type of investors**

Table 1 presents summarized information on trading activity by three types of investors in both the KOSPI 200 futures and options markets. We first construct variables in daily frequency at an account level, and then aggregate them by types of investors. We report the averages of daily variables for each investor type in Table 1. The first row shows the total number of accounts that have any transaction records during a day or open positions at the market opening and the second row shows the total number of trades for each investor group. Although foreign investors have a much smaller number of accounts in both markets, on average, than domestic individuals do, they trade almost as many times as domestic individuals in the

futures market (81.30% of domestic individual investors) and even trade more than domestic individuals do in the options market (102.03% of domestic individual investors). This indicates that foreign investors tend to trade more frequently than domestic investors do on average, and this tendency is more prominent in the options market than in the futures market. During our sample period, each foreign investor, on average, trades more than 3,000 times a day in the options market, which is about 100 times more frequent than domestic individual investors. This feature implies that at least a part of foreign investors may be classified as high frequency traders.

To take a closer look into trading activity in the KOSPI 200 index derivatives markets, we report the aggregate trading volume for each investor group, represented in a billion KRW, and each group's share of the total trading volume in each of the futures and options markets. The aggregate trading volume for each investor group is the sum of buy and sell volumes, and therefore the sum of the aggregate trading volumes of all investor groups is twice the actual trading volume in the market. The daily average trading volumes in the futures and options markets are 33,426.19 and 1,263.93 billion KRW, respectively. The total trading volume of the KOSPI 200 index derivatives is about 2.57% of the annual GDP of Korea averaged over 2010 to 2013, and about 2.93% of the total market capitalization of stocks listed in KRX at the end of 2013. Although the trading volume of foreign investors takes the highest proportion of 35.33% in the futures market and 49.63% in the options market, the participation of domestic individual investors is remarkably large compared to large derivatives markets in other countries. In terms of trading volume, each group of domestic individuals, domestic institutions, and foreign investors takes a considerable portion of the KOSPI 200 index derivatives markets.<sup>4</sup> This feature makes the KOSPI 200 index derivatives market an attractive target to compare trading profits among those investor groups. We also report the absolute value of open interests in a billion KRW for each investor group, as well as each group's share of the total absolute open

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<sup>4</sup> During the early years of the KOSPI 200 index derivatives markets, trading volume of domestic individual investors has accounted for approximately two thirds of the total volume in the market, which is an exceptionally high level. Throughout the 2000s, however, participation of both domestic institutions and foreign investors has gradually increased, and the proportions of three investor groups have become similar.

interests. In terms of open interests, each investor group holds a considerable portion, but foreigners comprise a substantially larger proportion compared to the other investor groups.

To examine how aggressively each group participates in the index derivatives market, Table 1 also reports the aggregate trading volume of aggressive trades of each investor group. To determine whether a trader is aggressive or passive, we use the information of the times when buy and sell orders for each trade are received, provided by our unique dataset. For each trade, we regard the trading party who initiates the trade as aggressive and the other party as passive. For domestic individual investors, the aggressive trading volume makes up 42.83% and 33.98% of their total trading in the futures and options markets, respectively. Domestic institutions trade more aggressively than domestic individuals do but the difference between the two groups is not big. In contrast, the aggressive trades of foreign investors account for 62.97% and 64.17% of their total trades of futures and options, respectively, which is remarkably higher than those of domestic investors. This indicates that foreign investors trade more aggressively than domestic investors in the KOSPI 200 index derivatives market. The difference in aggressiveness between domestic and foreign investors may be due to different levels of information and trading skills, or it may just reflect the difference in activeness of trading not necessarily related to asymmetric information between the two groups. If foreign investors trade aggressively based on superior information compared to domestic investors, they should earn larger trading profits than domestic investors do in the index derivatives market. On the other hand, if there is no difference in information or trading skills across investor groups, the aggressive trading of foreigners means that they pay for demanding liquidity in the markets whereas domestic investors earn compensation for providing liquidity, which should result in better performance of domestic investors than foreign investors.

For each investor group, the aggregate trading volume can be divided into three parts according to the type of the counterparty of each trade. In Table 1, the final set of variables indicates, for each investor group, the total volume of trades executed between the given group and domestic individuals, domestic institutions, and foreigners, respectively. In both the futures and options markets, domestic individuals trade more with foreign investors than with domestic institutions, and domestic institutions trade more with foreign

investors than with individuals. Foreign investors trade evenly with domestic individuals and institutions in the futures market, but more than twice with individuals than with institutions in the options market. These imply that substantial profits or losses are likely to be made through trading between domestic individual and foreign traders in the index derivatives markets.

### **3. Performance of Foreign Investors in the Index Derivatives Markets**

#### **3.1 Trading profits by types of investors**

We calculate daily trading profits of each investor group by tracking the whole history of trades at an account level in the KOSPI 200 futures and options markets. We define the total trading profits (PRF) in a trading day as the sum of cash flows from trading during the day (i.e., realized profits) and the daily change in the market values of unsettled positions (i.e., unrealized profits). The unsettled position for each trading day is calculated as the difference in the cumulative number of contracts between buys and sells during the sample period, and then it is multiplied by the closing price of the contract on the day to obtain the daily market value of it.

To uncover sources behind trading profits of each investor group, we further decompose the total trading profits into two parts, one related to intraday trading and the other related to overnight trading. To obtain the profits from intraday trading, we assume that any open positions in a contract are closed by entering the opposite positions in the same contract during a day. Therefore, we regard the smaller one between the total long and short positions in a contract during a day as the total positions that are established and liquidated within the same day. The intraday trading profit (ITPRF) is defined as the total positions that are established and liquidated within a day multiplied by the difference between the average buying and selling prices during the day. In other words, the intraday trading profit is determined by the intraday price changes as well as the size of positions terminated shortly within a day. On the other hand, we define the overnight trading profit (OTPRF) as the remaining part of the total trading profits, that is, the difference between PRF and ITPRF. The total, intraday, and overnight trading profits are first calculated at an account level and then

are aggregated by type of investors.

Table 2 presents the trading profits of domestic individuals, domestic institutions, and foreign investors and profits for each group from trading with other investor groups in the futures and options markets. Panel A reports the daily average trading profits of each investor group. In both of the futures and options markets, foreign investors earn huge profits while domestic individuals lose almost the same amount of money during the sample period. The total trading profits of foreign investors are 0.955 billion KRW and 2.349 billion KRW a day, on average, in the futures and options markets, respectively, whereas domestic individuals lose 1.027 billion KRW and 2.334 billion KRW a day, on average, in the same markets. The average profits of domestic institutions, 0.072 billion KRW from futures trading and 0.016 billion KRW of loss from options trading a day, are relatively small in magnitude compared to the profits or losses of the other investor groups. For domestic institutions, the averages of the total, intraday, and overnight trading profits are not much different from zero considering their standard errors, indicating that they are likely to display a substantial variation in the time-series.

When decomposing the total profits into the intraday and overnight trading profits, the results indicate that foreign investors earn considerable profits from intraday trading in the futures market and both intraday and overnight trading in the options market. In the futures market, foreign investors have a significantly positive ITPRF whereas their OTPRF is insignificant, although the average ITPRF is somewhat smaller in magnitude than the average OTPRF. In the options market, foreign investors earn more profits from day trading than from overnight trading, but the two profit measures are both positive and significant. These indicate that foreign investors outperform domestic investors in both intraday and overnight trading of the KOSPI 200 index derivatives. The result in Table 1 that foreign investors trade more aggressively than domestic investors do suggests that the huge average profit of foreigners is unlikely due to compensation for liquidity provision, and therefore foreign investors may have informational advantage on both intraday and overnight changes in the KOSPI 200 index. We investigate this possibility and provide supporting evidence in Section 4.

On the other hand, for domestic institutions, the average intraday trading profits are positive while the

average overnight trading profits are negative in both markets. This indicates that domestic institutions make profits from day trading but losses from overnight trading, resulting in the net trading profit of near zero. These results also suggest that domestic institutions may have superior information on intraday price changes, but no information on daily price changes. Domestic individuals, who make the largest trading losses in both of the futures and options markets, incur most of their losses through overnight trading. This result implies that the underperformance of individual traders may result from lack of information on overnight changes in the KOSPI 200 index or late response to new information.

Panel B of Table 2 reports the daily average profits for each investor group from trading with other groups. In the futures market, the average daily loss of domestic individuals is 0.409 billion KRW from trading with domestic institutions and 0.618 billion KRW from trading with foreign investors, indicating that the huge losses of domestic individuals shown in Panel A come from trading with both domestic institutions and foreign investors. While domestic institutions earn considerable profits from trading with domestic individuals, they lose 0.337 billion KRW per day from trading with foreign investors. Since futures trading is a zero-sum game, these results show that the largest profit earned by foreign investors shown in Panel A primarily comes from trading with domestic individuals and secondarily from trading with domestic institutions. In the options market, domestic institutions profit from trading with domestic individuals and lose from trading with foreign investors, both of which are similar in size with those from futures trading. They consistently lose from both futures and options trading with foreign investors, and these losses are offset by the profits from trading with domestic individuals, which makes the almost zero net profits as shown in Panel A. It is noteworthy that domestic individual investors lose from options trading with foreign investors much more greatly than from futures trading with the same investors. Foreign investors earn an average daily profit of 1.912 billion KRW from options trading with domestic individuals, more than 3 times that from futures trading with the same investors. This explains the total profits of both domestic individuals and foreign investors much larger in magnitude from options trading than from futures trading.

Figure 1 presents the time-series of cumulative trading profits of each investor group in the futures and

options markets. Panel A shows the cumulative total trading profits (PRF). The cumulative profit of foreign investors continuously increases during the sample period, which indicates that the large average profit of foreign investors reported in Table 2 is consistently earned over the whole sample period. Foreign investors make profits and domestic individuals make losses steadily over the whole period in both the futures and options markets. They confirm that the substantial differences in the average trading profits among investor groups are not due to a particular sub-period, but consistently observed during the whole sample period. A notable pattern is that the cumulative profit of foreign investors mirrors in the opposite direction those of domestic institutions in the futures market and domestic individuals in the options market, respectively. These patterns are consistent with the results in Panel B of Table 2 that foreign investors earn profits from futures and options trading with both domestic institutions and individuals but their options trading profits are largely earned against domestic individuals.

Panels B and C of Figure 1 present the time-series of cumulative intraday trading profits (ITPRF) and overnight trading profits (OTPRF), respectively. The profits of foreign investors from intraday trading show consistently increasing patterns in both the futures and options markets but those from overnight trading substantially vary with time, particularly in the futures market. In the options market, the cumulative overnight trading profit sharply rises for foreigners and plummets for domestic individuals during the period of the U.S. credit rating downgrade, August 5 to August 9 in 2011. During this period of three trading days, the daily average overnight trading profit of foreign investors is 217.897 billion KRW. Most of this profit comes from put option positions with the average daily overnight trading profit of 216.062 billion KRW. Similar patterns of exceptional profits of foreign investors and losses of domestic institutions from overnight trading are observed in the futures market, although relatively smaller in magnitude, during the period of May 16 to May 18 in 2012 with heightened anticipation of upcoming Grexit.<sup>5</sup> Foreign investors

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<sup>5</sup> On August 5 in 2011, Standard & Poor's downgraded the credit rating of the U.S. from AAA to AA+ for the first time, which caused a dramatic decrease in the Korean stock market. On the subsequent Monday, August 8, KRX temporarily halted program trading, called a 'sidecar', on stocks and the KOSPI 200 futures. During this period, the KOSPI 200 fell by 10.71% for three trading days, from 261.54 points on August 4 to 233.52 points on August 9. Likewise, the KOSPI 200 fell by 6.53% from 252.32 points on May 15, 2012 to 235.85 points on May 18, 2012, which results from the credit rating downgrades of the Spanish and Greek central banks with increasing speculation of Grexit.

make the average daily overnight trading profit of 94.417 billion KRW during this period in the futures market. Domestic institutions steadily earn profits from intraday trading but lose from overnight trading in both markets, which is consistent with the results in Table 2.

### **3.2 Options trading profits, moneyness, and multiplier change**

In this section, we focus on performance of options trading and whether the profits from options trading vary with option types, moneyness, and the increase in the multiplier during the sample period. To examine whether the trading profits of each investor group differ across option types and moneyness, we categorize each of call and put options into five groups according to their moneyness: deep in-the money (Deep ITM), in-the-money (ITM), at-the-money (ATM), out-of-the-money (OTM), and deep out-of-the-money (Deep OTM). A call (put) option is classified as Deep ITM if its strike-to-spot (spot-to-strike) ratio is less than 0.93, ITM if the same ratio is between 0.93 and 0.97, ATM if the ratio is between 0.97 and 1.03, OTM if the ratio is between 1.03 and 1.07, and Deep OTM if the ratio is larger than 1.07, respectively, where all these intervals include the lower bound but exclude the upper bound. Table 3 shows measures of trading activity and profits of each investor group for various options classified by option types and moneyness.

Panels A and B of Table 3 report the aggregate trading volume and absolute value of open interests, respectively, represented in a billion KRW. Not surprisingly, all the three investor groups trade most actively ATM options, in terms of both trading volume and open interests. Moreover, they tend to trade more actively ATM calls than ATM puts but the difference between calls and puts is not large. Panel C reports the total trading profits (PRF) of each investor group shown in a million KRW by option types and moneyness. Foreign investors earn profits in most groups and particularly the largest profits from ATM options and considerable ones from OTM options. They make substantial losses from Deep ITM puts, but the average loss is not statistically significant. Domestic individuals incur losses mostly from ATM and OTM options, and their profits from Deep ITM options are positive though insignificant. Domestic institutions make losses from ATM options but earn profits from Deep OTM calls and puts, OTM calls, and Deep ITM puts.

Panels D and E of Table 3 report the intraday (ITPRF) and overnight trading profits (OTPRF) by option

types and moneyness, respectively. From intraday trading, not only do foreign investors earn large profits from ATM and OTM options, but they also make profits on average from all other categories. These suggest that foreign investors may have superior information on intraday changes in the KOSPI 200 index. From overnight trading, foreign investors make considerable profits in ATM calls and puts and ITM puts, but lose in Deep ITM puts, OTM puts, and Deep OTM calls and puts. Domestic individuals make negative intraday profits mainly from ATM options and negative overnight profits from ATM, OTM, and Deep OTM options. Domestic institutions earn intraday profit from ATM options, but incur considerable losses from overnight trading of ATM options. In sum, the average trading profits of three investor groups are largely determined by their performance of ATM options trading, but foreign investors tend to make profits from other moneyness categories as well whereas domestic individuals make losses from most of the moneyness categories.

Since our sample contains the period during which the policy of the multiplier change has been put in force, we examine the effect of the multiplier change on performance of three investor groups. In an options market, a change in the contract multiplier may affect investment environment of market participants and hence lead to changes in trading volume, trading activity, trading frequency, and performance of many investors. The increase in the multiplier from 100 thousand KRW to 500 thousand KRW has started on March 9 in 2012, gone through a period of transition to June 14, and been completed on June 15. During the transition period, options with both the old and new multipliers have been traded together. Therefore, we divide the sample period into three sub-periods, the pre-increase period of January 4, 2010 to March 8, 2012, the transition period of March 9, 2012 to June 14, 2012, and the post-increase period of June 15, 2012 to June 30, 2014.

Table 4 shows trading activity and profits of foreign investors, who earn the largest trading profits during the whole sample period, for each sub-period in both the futures and options markets. We exclude the period of the U.S. credit rating downgrade, August 5 to August 9 in 2011, in which foreign investors earn exceptionally large profits from options trading, because these abnormal profits may distort the average performance measured in relatively short sub-periods. On average, there is no noticeable change in the

trading volume of foreign investors. However, the size of open interests in options is significantly reduced from the pre- to the post-increase period. These imply that a considerable number of foreign investors who have superior information on or hedging demands against daily price movements may leave the market after the multiplier change.

The intraday profits of foreign investors from options trading do not seem to be much influenced by the multiplier change, although they decline slightly. However, the overnight trading profits decrease significantly after the multiplier change. It is consistent with the sharp drop in open interest in the options market. Although we do not report in the table, the losses of domestic individuals from both intraday and overnight trading are not reduced after the multiplier change, as shown in Figure 1. Instead, the average overnight trading loss of domestic institutions shrinks much more. On the whole, the policy of increasing the multiplier constricts trading activities and leads to an outflow of foreign overnight traders, but falls short of its goal to reduce trading losses of retail speculators.

## **4. What Drives Outperformance of Foreign Investors?**

### **4.1 Risk-adjusted performance in the index derivatives markets**

In the previous section, we document that foreign investors make huge trading profits in the KOSPI 200 index derivatives market. Since investors can earn higher average returns as they bear higher risk, the better performance of foreign investors may be fair reward for bearing higher risk, compared to domestic investors, and not result from their informational advantage. Therefore, we examine whether foreign investors perform much better than domestic investors even after considering exposure to risk factors.

To this end, we employ a five-factor model to explain risk premiums of index derivatives and test if our model can explain expected option returns in the KOSPI 200 derivatives market.<sup>6</sup> The five-factor model we employ includes three risk factors in stock markets and two risk factors from the options literature.

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<sup>6</sup> We use only options portfolios excluding futures portfolios as test assets for our five-factor model, because the market factor, i.e. the spot index excess returns, surely explains the futures returns.

Following Fama and French (1993), the market factor (MKT), size factor (SMB), and book-to-market factor (HML) are included as stock market risk factors. Fama and French (1993) document that these three risk factors can explain both stock and bond returns successfully, and moreover, the three risk factors have been widely used by numerous empirical studies regardless of countries and asset classes in the finance literature. Therefore, it is natural to consider these three factors to explain expected returns on index options in Korea. We construct the Fama and French (1993) three factors using daily stock market data in the Korea Stock Exchange during the sample period, following the method described by Fama and French (1993).

On the other hand, previous studies on option returns indicate that the variance risk premium is an important factor to explain option returns, which makes a distinction between option and stock returns. For example, Coval and Shumway (2001) shows that zero-beta, at-the-money straddle positions yield a substantially negative return of  $-3\%$  per week, on average, even after taking the market beta into account, and suggests that an additional factor related to the straddle positions is priced in the cross-section of option returns. Carr and Wu (2009) provide evidence that the variance risk premium, measured by the difference between the realized variance and the risk-neutral expected variance, is significantly negative and the Fama–French (1993) three factors cannot explain it. More recently, Daniel and Moskowitz (2016) calculate the daily excess returns to a variance swap on the S&P 500 using daily observations on the S&P 500 index and the VIX, to explain call option-like behavior of the momentum strategy and assess its exposure to variance risk. Following these studies, we construct two option market factors related to the variance risk premium. First, using daily returns on at-the-money KOSPI 200 call and put options during the sample period, we calculate returns on zero-beta straddle positions and define the zero-beta straddle return (ZSR) factor as the difference between the straddle returns and 91-day CD rates, which is used as a reference rate in interest rate derivatives markets in Korea. Second, following the method of Daniel and Moskowitz (2016), we also calculate the daily variance swap returns using daily data on the KOSPI 200 index and the VKOSPI, the implied volatility index of KOSPI 200, and call these the variance swap return (VSR) factor.<sup>7</sup>

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<sup>7</sup> Specifically, the daily return on a variance swap, from day  $t - 1$  to day  $t$ , is calculated as

To test whether the five factors we calculate can well explain expected option returns, we construct test portfolios of KOSPI 200 options classified by option moneyness. For call and put options, respectively, we divide all traded options into five moneyness categories defined as the previous section, and then calculate daily equal-weighted portfolio returns for each category. We use these test portfolio returns to estimate the following time-series regression:

$$r_{i,t} - r_{f,t} = \text{Alpha}_i + \beta_{i,1}\text{MKT}_t + \beta_{i,2}\text{SMB}_t + \beta_{i,3}\text{HML}_t + \beta_{i,4}\text{ZSR}_t + \beta_{i,5}\text{VSR}_t + \varepsilon_{i,t} \quad (1)$$

where  $r_i$  and  $r_f$  represent a daily rate of returns on portfolio  $i$  and the 91-day CD, respectively, and MKT, SMB, HML, ZSR, and VSR are the Fama–French (1993) three factors, the zero-beta straddle return factor and the variance swap return factor, respectively. If our five factors represent priced risk in the KOSPI 200 options market, the estimated alpha of each portfolio should be zero.

Table 5 reports the estimated results of the time-series regression model in Equation (1) for each test portfolio. Panel A shows tests on the five moneyness portfolios of all call options, and Panel B shows tests on the five moneyness portfolios based on call options of the nearest maturity only. Similarly, Panels C and D show tests on the five portfolios of all put options and put options of the nearest maturity only, respectively. Focusing on the results in Panel A, the estimated alphas of all five option portfolios are not significantly different from zero at the 5% significance level, which indicates that our five-factor model seems to explain well the expected option returns. The adjusted  $R^2$  values, which range from 62.39% to 87.68%, show that our five factors account for a considerable portion of time-series variations in returns of the option portfolios. The results shown in Panels B to D are not much different from those in Panel A. All the estimated alphas are not statistically significant with only two exceptions of the OTM and Deep OTM put options portfolios of the nearest maturity, shown in Panel D. These portfolios have negative alphas with

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$$\text{VSR}_t = D_t \left[ \frac{1}{21} \left( 252 \left[ 100 \cdot \log \left( \frac{S_t}{S_{t-1}} \right) \right]^2 - V_{t-1}^2 \right) + \frac{20}{21} (V_t^2 - V_{t-1}^2) \right],$$

where  $S_t$  is the level of the KOSPI 200 at the end of day  $t$ ,  $V_t$  is the level of the VKOSPI quoted at the end of day  $t$ , and  $D_t$  is the 20 trading day discount factor,  $D_t = (1 + r_t)^{-20/252}$ , based on the annualized 91-day CD rate  $r_t$  as of day  $t$ .

$t$ -values of  $-2.11$  and  $-3.79$ , respectively, which is consistent with the result of Constantinides, Jackwerth, and Savov (2013) who document that OTM put options with short remaining maturity have negative abnormal returns. It implies that put options may be abnormally overvalued, the so-called "overpriced puts puzzle." If an investor makes a profit by selling overvalued put options, his or her risk factor loadings should be opposite to those of put option returns. Therefore, we use the five-factor model in Equation (1) to compare the risk-adjusted trading performance of foreign and domestic investors.

To examine the risk-adjusted performance of three investor groups from futures and options trading, we calculate daily returns on portfolios held by each investor group. To let a rate of return in a day include both realized and unrealized profits of the day, we assume that all investors close any remaining positions at the end of a day and then enter into the same positions again at the beginning of the next day, which means that all trading profits are presumed realized as cash flows on a daily basis. With this assumption, we can simply define a rate of return in a day as the difference between the daily cash inflows and outflows divided by the daily cash outflows. In case of futures and options trading, cash inflows and outflows to investors indicate cash flows received from taking short positions and cash flows paid for taking long positions in a contract, respectively, irrespective of whether a short or long position is entered into earlier. Since our measure of the total trading profit (PRF) already include both realized and unrealized profits, the difference between daily cash inflows and outflows, the numerator of a daily return, is identical to the daily total trading profit itself. Daily cash outflows, the denominator of a daily return, are the sum of cash flows paid for taking a long position during a day. Due to our assumption, cash outflows during a day indeed include the values of long positions not closed by the end of the previous day and short positions not closed at the end of the day, as well as realized cash outflows paid during the day.

Table 6 reports the estimated results of the time-series regression in Equation (1) for daily excess returns from futures trading of domestic individuals, domestic institutions, and foreign investors. All returns are annualized in decimal form. Panel A shows the average risk-adjusted total return of each investor group. Domestic individuals earn a negative and significant five-factor alpha, while both domestic institutions and foreign investors earn positive but insignificant alphas, respectively. Even after the risk adjustment,

domestic individuals suffer a serious loss of  $-22.7\%$  per annum on average in the futures market. For foreign investors, the large total profits from futures trading, reported in Table 2, is not significant after considering exposures to conventional risk factors.

Panels B and C show the average risk-adjusted returns from intraday and overnight trading, respectively, in the futures market. Consistent with the results in Table 2, both domestic institutions and foreign investors earn positive and significant risk-adjusted returns from intraday futures trading. The estimated alpha of foreign investors is  $7.5\%$  ( $t$ -value = 9.41) per annum, much larger than that of domestic institutions,  $4.1\%$  ( $t$ -value = 4.97) per annum. On the other hand, the average risk-adjusted returns from overnight futures trading are negative for domestic institutions and positive for foreign investors, but they are both not statistically different from zero. However, the abnormally low returns of domestic individuals are also significant for overnight trading performance, which suggests that neither individual day traders nor overnight traders may trade based on relevant information but they speculate on the futures market. One interesting point shown in Table 6 is that the portfolio of foreign investors loads on each of the five factors oppositely from that of domestic institutional investors. In particular, foreign investors have a negative loading on the market factor, which suggests that foreign investors would benefit from futures trading in bear markets.

Table 7 reports the risk-adjusted performance from options trading of domestic individuals, domestic institutions, and foreign investors. Panel A shows the average risk-adjusted total return, and Panels B and C show the average risk-adjusted returns from intraday and overnight trading, respectively, of each investor group. Overall, the findings based on the average trading profits shown in Table 2 are confirmed even after the risk adjustment. In Panel A, foreign investors earn a positive and significant five-factor alpha of  $29.3\%$  ( $t$ -value = 7.24) per annum from options trading, while domestic individuals earn a five-factor alpha of  $-52.4\%$  ( $t$ -value =  $-8.10$ ) per annum. These sharply contrasting performance of foreign investors and domestic individuals are observed in both intraday and overnight trading returns, as shown in Panels B and C respectively, although the risk-adjusted performance of foreign investors is less pronounced for overnight trading than for intraday trading. The risk-adjusted total return of domestic institutions in the options market

is negative and marginally significant,  $-18.6\%$  ( $t$ -value =  $-1.61$ ), although they earn a positive and significant alpha through intraday trading.

Like the preceding results of futures trading, the option portfolios of three investor groups show very different factor loadings as well in Table 7. Foreign investors have factor loadings with the opposite signs to those of domestic individuals in most cases, particularly for the two option market factors, ZSR and VSR. They have positive coefficients on these two factors related to the variance risk premium. Given the empirical evidence of a negative variance risk premium in the literature (e.g., Coval and Shumway, 2001; Goyal and Saretto, 2009), these results indicate that foreign investors achieve much better performance than domestic individuals do even with positive exposure to variance risk.<sup>8</sup> Interestingly, the factor loadings of overnight trading on the market factor are negative, while those on the ZSR is significantly positive. It is similar to those of put options rather than call options reported in Table 5, which implies that put options mainly contribute to the significant overnight trading performance of foreigners and selling overvalued put options cannot explain their performance. Meanwhile, the overnight trading returns of domestic individuals, which account for most of their huge losses from options trading, have negative loadings on both ZSR and VSR. This indicates that domestic individuals are unlikely to trade options to hedge against volatility in the stock market.

The empirical findings in this section are summarized as follows. Foreign investors earn positive and significant abnormal returns from intraday trading in the futures market and both intraday and overnight trading in the options market even after controlling for risk factors. These indicate that the outstanding performance of foreign investors may not be due to compensation for bearing high risk but due to superior information mainly on intraday changes in the KOSPI 200. Their overnight trading performance, however, is not stable and has risk exposures similar to put options. This indicates that foreign investors do not consistently profit from overnight trading but conditionally on stock market crashes as put options do. On

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<sup>8</sup> The averages of ZSR and VSR during our sample period are  $-95.61\%$  ( $t$ -value =  $-1.84$ ) and  $-267.67\%$  ( $t$ -value =  $-0.94$ ) per annum, respectively.

the other hand, domestic individuals seem to speculate without relevant information in both the futures and options markets. Although the derivatives market provides additional investment opportunities for both domestic and foreign investors, our results show that domestic individuals suffer seriously from disadvantageous trading with informed traders in the KOSPI 200 index derivatives market.

#### **4.2 Compensation for net liquidity supply in the index derivatives markets**

One possible explanation for the difference in trading performance among three investor groups is that a group of investors who provide more liquidity in the KOSPI 200 derivatives market could earn higher profits than the other groups do, even if there does not exist information asymmetry. However, given that foreign investors trade more aggressively than domestic investors do in both the futures and options markets as shown in Section 2, they are likely to demand rather than supply liquidity in the derivatives market. To further examine whether the large trading profits of foreign investors can be attributed, at least partially, to liquidity provision in the market, we calculate two measures of effective spread weighted differently for each one-minute period for each investor. One is to represent the profits earned as a reward for liquidity provision and calculated as the sum of the absolute differences between mid-quote prices and actual trading prices weighted by contract sizes of passive trades. We call this the benefit from passive trades. The other is to represent the penalty paid for consuming liquidity and calculated as the sum of the absolute differences between mid-quote and trading prices weighted by contract sizes of aggressive trades. We call this the cost from aggressive trades. Then, the net compensation for supply of liquidity earned by each investor can be defined as the difference between the benefit from passive trades and the cost from aggressive trades. The two weighted effective spread measures are calculated for each minute and each investor and then aggregated by types of investors, and their averages across time are reported in Panel A of Table 8.

Panel A of Table 8 shows clear evidence that the huge profits of foreign investors are not due to liquidity provision in both the futures and options markets. In the futures market, foreign investors gain the least by trading passively and pay the most to trade aggressively among the three investor groups. As a result, they earn a negative net profit of  $-0.650$  million KRW per minute on average from liquidity provision. In contrast,

both domestic individuals and institutions earn positive compensation for net supply of liquidity. In the options market, foreign investors gain rewards from passive trades comparable to but pay costs from aggressive trades more than twice domestic individuals do. The average net profit for liquidity supply earned by foreign investors is  $-0.855$  million KRW per minute. Consistent with the results reported in Table 1 that foreign investors trade aggressively on average compared to domestic investors, the results in Table 8 indicate that foreign investors indeed pay substantial penalties for consuming market liquidity by trading at disadvantageous prices. On the other hand, domestic individuals earn net profits from supplying liquidity more than twice domestic institutions do in both the futures and options markets.

These findings imply that neither the huge trading profits of foreign investors nor the huge losses of domestic individuals result from their net supply of liquidity, and moreover, the difference in trading performance between the two investor groups becomes even greater when the outcomes of liquidity providing activity are excluded. These results also suggest that foreign investors may trade aggressively in the index derivatives market with superior information on market-wide movements in the stock market but that domestic individuals make huge losses because of the lack of such information despite their role of providing liquidity in the market.

#### **4.3 Informational advantage of foreign investors in the index derivatives markets**

Since the large trading profits earned by foreign investors can be accounted for by compensation for neither bearing high risk nor providing market liquidity, we now ask whether foreign investors have superior information about future movements in the KOSPI 200 index. If foreign investors indeed have information on directional changes in the underlying index, they would make profits by increasing the delta exposure of their derivatives trading positions when the underlying index is expected to rise in the next period. We examine this hypothesis in two ways. First, we calculate trading profits due to delta exposures by multiplying the total delta of foreign investors' trading positions each minute by the change in the KOSPI 200 index over the next minute, averaged over time, and examine what fraction of their total trading profits is attributed to informed trading. Second, we calculate foreign investors' net demand for directional changes

as the difference between buy and sell volumes for each derivative contract weighted by its delta, and investigate whether it can predict future directions of the KOSPI 200 index.

Panel B of Table 8 reports the total per-minute trading profit and the trading profit due to delta exposures for each investor group. Foreign investors make an average profit of 1.871 million KRW per minute from futures trading and earn 2.167 million KRW per minute on average due to the delta exposure of their trading positions in futures, which is 115.82% of the total trading profit. The finding that the profit due to delta exposures is greater than the total trading profit is consistent with foreign investors paying a significant penalty for liquidity consumption, shown in Panel A. Our results indicate that most of the futures trading profits earned by foreign investors can be attributed to superior information about intraday movements in the KOSPI 200 index. Meanwhile, most of the huge trading losses of domestic individuals are explained by their delta exposure in the futures market.

In the options market, on the other hand, foreign investors earn an average profit of 1.723 million KRW per minute due to delta exposures, which is statistically significant but only 28.16% of the total per-minute trading profit. Given that foreign investors trade much more frequently in the options market than in the futures market, as shown in Table 1, our results in Table 8 suggest that they may profit mostly from high frequency trading with a time horizon much shorter than a minute in the options market. Because foreign investors are not net suppliers of liquidity in the options market, their huge profits from intraday options trading may be attributed to informational advantage for changes in the underlying index over a very short horizon but this cannot be detected by our analyses of daily or per-minute trading profits in this study.

Alternatively, we construct variables of net demand for directional changes of foreign investors in both the futures and options markets and test its predictive power for future returns on the underlying index in both daily and intraday frequency. To this end, since futures have positive exposure to directional changes, we consider buy volume for futures as positive demand and sell volume as negative demand for directional changes. Thus, the difference between buy and sell volume for each contract, which is identical to the net open positions at the end of each period, indicates the net demand for directional changes. In the options market, call options have positive exposure but put options have negative exposure to directional changes,

and therefore the net open positions for a call and the opposite-signed net open positions for a put, at the end of each period, indicates the net demand for directional changes, respectively. To obtain the aggregate net demand for directional changes of foreign investors in each of the futures and options markets, we weight the net demand for each contract by its exposure to directional changes, delta, because each derivative contract has different exposure to directional changes depending on its strike price and remaining maturity. We call this the delta-weighted net demand (DWD) of foreign investors. For options, we calculate the delta of each contract based on the Black-Scholes formula and use its absolute value for put options.

To investigate whether the delta-weighted net demand of foreign investors forecasts future index returns, we estimate the following time-series regressions in either daily, 5-minute, or 1-minute frequency,

$$FRET_t = \alpha_j + \beta_{1,j}DWD_t(j) + \sum_{i=1}^5 \beta_{2,i,j}RET_t(i) + \beta_{3,j}LVOL_t(j) + \beta_{4,j}LSVOL_t(j) + \varepsilon_{t,j}, \quad (2)$$

where  $FRET_t$  is the return on the KOSPI 200,  $DWD_t(j)$  is the  $j$ -th lag of the delta-weighted net demand of foreign investors for each  $j = 1, \dots, 5$ ,  $RET_t(i)$  is the  $i$ -th lag of the return of the KOSPI 200, and  $LVOL_t(j)$  is the  $j$ -th lag of the logarithm of the total trading volume in either the futures or options market, and  $LSVOL_t(j)$  is the  $j$ -th lag of the logarithm of trading volume in the underlying KOSPI 200 index.

Similarly, we further investigate whether foreign investors have superior information about volatility of the KOSPI 200. If foreign investors can predict volatility in the underlying index, their net demand for volatility will be positively related to the future volatility of the index. Following Ni, Pan, and Poteshman (2008) and Chang, Hsieh, and Wang (2010), we construct the aggregate demand for volatility of the group of foreign investors in the options market and test its predictive power for future volatility. Since both call and put options have positive exposure to volatility, we consider buy volume for each option contract as positive demand and sell volume as negative demand for volatility, regardless of option types. The difference between buy and sell volume for each contract, which means the net open positions at the end of each period, indicates the net demand for volatility. To obtain the aggregate net demand for volatility of foreign investors in the options market, the net demand for each contract is weighted by its exposure to volatility, vega. We call this the vega-weighted net demand (VWD) of foreign investors. We calculate the

vega of each contract based on the Black-Scholes formula.

To investigate whether the vega-weighted net demand of foreign investors forecasts future volatility of the KOSPI 200, we estimate the following predictive regressions in either daily or 5-minute frequency,

$$\begin{aligned}
 FV_t = & \alpha_j + \beta_{1,j}VWD_t(j) + \sum_{i=1}^5 \beta_{2,i,j}RV_t(i) + \beta_{3,j}IV_t(1) + \beta_{4,j}ADWD_t(j) \\
 & + \beta_{5,j}LVOL_t(j) + \beta_{6,j}LSVOL_t(j) + \varepsilon_j ,
 \end{aligned} \tag{3}$$

where  $FV_t$  is the realized volatility of the KOSPI 200,  $VWD_t(j)$  is the  $j$ -th lag of the vega-weighted net demand of foreign investors for each  $j = 1, \dots, 5$ ,  $RV_t(i)$  is the  $i$ -th lag of the realized volatility of the KOSPI 200 for  $i = 1, \dots, 5$ ,  $IV_t(1)$  is the square-root of the VKOSPI in the preceding period,  $ADWD_t(j)$  is the  $j$ -th lag of the absolute value of DWD, and  $LVOL_t(j)$  is the  $j$ -th lag of the logarithm of the total trading volume in the options market, and  $LSVOL_t(j)$  is the  $j$ -th lag of the logarithm of trading volume in the KOSPI 200 index.

Table 9 reports the estimated results of the predictive regressions in Equations (2) and (3). Panels A and B show the results for the futures and options markets, respectively. In Panel A, the daily DWD of foreign investors in the futures market has a positive coefficient for predicting the next day stock returns ( $j = 1$ ), but the predictive power is marginally significant. However, the daily DWD generally has no significant predictive power for longer horizon future returns ( $j = 2, \dots, 5$ ). This weak evidence is consistent with unstable overnight performance of foreign investors. In contrast, in intraday frequency, the 5-minute DWD of foreign investors in the futures market have positive and significant coefficients except for  $j = 4$  and the estimated coefficient on DWD(1) is particularly large. The 1-minute DWD also significantly predict future market returns. These results show that foreign investors may have short-term information about intraday directional changes in the underlying index, although we find only weak evidence in the futures market for long-term information about overnight changes in the KOSPI 200.

Panel B of Table 9 reports the estimated results of the predictive regressions in Equations (2) and (3) in the options market. The coefficients on daily DWD over past five days are all positive, whereas they are statistically insignificant at the 5% significance level. The estimation results based on the 5-minute net

demand provide clearer evidence. The slope on DWD in the preceding 5-minute period ( $j = 1$ ) is significant at the 1% significance level, although its size is much smaller than that estimated in the futures market of Panel A. The predictive power of the 5-minute DWD becomes insignificant for longer forecast horizons ( $j = 2, \dots, 5$ ). Meanwhile, the estimated coefficients on 1-minute DWD do not show a consistent pattern, while DWD(2) and DWD(5) have positive and significant coefficients. These results from predictive regressions supplement our previous finding that delta exposures of foreign investors cannot fully explain the intraday performance in the options market of foreign investors, shown in Table 8. Foreign investors seem to have information about intraday changes in the underlying stock index and they clearly exploit this information in both the futures and options markets. Nevertheless, our results based on the 5-minute or 1-minute frequency analyses still cannot fully account for their outstanding performance from intraday trading in the options market. Further analyses for high frequency trading may help to understand their unexplained performance in future studies.

On the other hand, the estimated results of the predictive regressions in Equation (3) show the evidence that foreign investors may have some informational advantage about daily stock market volatility as well. The VWD over the past four to two days is positively related to future volatility, and moreover, the predictive relation is statistically significant for two- and three-day-ahead volatility at the 1% significance level. These results indicate that superior information about future volatility in the underlying index can partially explain the overnight performance of foreign investors. However, the 5-minute VWD has no predictive power at all, and the estimated coefficients are even negative. Therefore, the great intraday performance of foreign investors cannot be explained by volatility information advantage.

Our empirical findings can be summarized as follows. We find only weak evidence that foreign investors' net demand for daily changes in the underlying index returns can marginally predict the next-day return in the futures market. This implies that the outperformance in overnight futures trading of foreign investors can be only partially attributed to superior information about overnight directional changes in the underlying index. In the options market, however, not information about directional changes but information about volatility can partially explain their overnight trading performance. On the contrary, the

net demand for directions in 5- or 1-minute-ahead index returns has generally significant predictive power, in both the futures and options markets. This supports that a main source behind the substantial intraday trading profits may be short-term information about intraday changes in the underlying stock index, although it seems to be insufficient to fully explain the huge profits from options trading.

## **5. Conclusion**

This study examines whether foreign investors have an edge over domestic investors in index derivatives market using the unique data on the complete trading history of the KOSPI 200 index futures and options. Unlike the previous research, we focus on the market index rather than firm-level prices. Since it is known that derivatives markets are a habitat for informed investors (Easley, O'Hara, and Srinivas, 1998), we expect that our experiment will have more power than the research based on stock market data.

Our empirical results are summarized as follows. Foreign investors make huge profits in the KOSPI 200 index futures and options markets, while domestic individuals lose almost the same amount as that foreigners earn. Domestic institutions only earn a small gain. The intraday and overnight trading profits of foreign investors are similar in magnitude. However, the intraday trading profits are consistently earned over time and the overnight trading profits are concentrated on days of stock market crashes. The risk-adjusted performance of foreign investors is significantly positive for intraday futures trading and for both intraday and overnight options trading.

We also find that foreign investors in the KOSPI 200 derivatives market do not supply but demand liquidity on average, and thus they pay substantial penalties for demanding liquidity by trading at disadvantageous prices. This indicates that the huge intraday trading profits of foreign investors cannot be accounted for by compensation for liquidity provision. We finally examine whether the delta- and vega-weighted net demand of foreign investors can predict future returns and volatility, respectively, on the underlying index, and find evidence supporting that foreign investors have short-term information about intraday changes in the KOSPI 200 and a main source of their intraday trading profits is the information

advantage. Further analyses on high frequency trading in the same market may help to fully understand the outperformance of foreign investors in future works.

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**Table 1. Trading activities of domestic and foreign investors in the KOSPI 200 index derivatives markets**

This table shows the summarized information on trading activities of domestic individuals, domestic institutions, and foreign investors in the KOSPI 200 futures and options markets. All variables are constructed in daily frequency, and the time-series mean of each variable is reported. Trading volumes and absolute open interests are in billion KRW, and those per account are in million KRW. The sample period is January 4, 2010 to June 30, 2014 (1,115 trading days).

	Futures				Options			
	Domestic individuals	Domestic institutions	Foreigners	Total	Domestic individuals	Domestic institutions	Foreigners	Total
Number of accounts	6423.26	1594.34	412.04	8429.64	23741.18	608.71	237.30	24587.19
Number of trades	102927.20	71747.53	83682.27	258357.00	791386.93	348615.10	807446.06	1947448.09
Number of trades per account	16.02	45.00	203.09	264.11	33.33	572.71	3402.70	4008.74
Trading volume	20784.08	22447.83	23620.47	66852.38	829.44	443.92	1254.49	2527.85
(% in total volume)	31.09%	33.58%	35.33%		32.81%	17.56%	49.63%	
Trading volume per account	3235.75	14079.70	57325.67	7930.63	34.94	729.28	5286.51	102.81
Open interest	2513.21	5737.3	12961.65	21212.16	348.96	168.06	779.04	1296.06
(% in total open interest)	11.85%	27.05%	61.10%		26.92%	12.97%	60.11%	
Open interest per account	391.27	3598.54	31457.26	2516.38	14.70	276.09	3282.93	52.71
Volume of trades initiation	8901.94	9649.38	14874.87	33426.19	281.86	177.08	804.99	1263.93
(% in all trades)	42.83%	42.99%	62.97%	50.00%	33.98%	39.89%	64.17%	50.00%
Volume of trades with individuals	6577.94	6759.89	7446.25	20784.08	226.84	129.87	472.74	829.45
(% in all trades)	31.65%	30.11%	31.52%	31.09%	27.35%	29.26%	37.68%	32.81%
Volume of trades with institutions	6759.89	8110.38	7577.56	22447.83	129.87	86.9	227.16	443.93
(% in all trades)	32.52%	36.13%	32.08%	33.58%	15.66%	19.58%	18.11%	17.56%
Volume of trades with foreigners	7446.25	7577.56	8596.66	23620.47	472.74	227.16	554.58	1254.48
(% in all trades)	35.83%	33.76%	36.39%	35.33%	57.00%	51.17%	44.21%	49.63%

**Table 2. Trading profits of domestic and foreign investors in the KOSPI 200 index derivatives markets**

This table shows the average trading profits of domestic individuals, domestic institutions, and foreign investors in the KOSPI 200 futures and options markets. The total trading profit (PRF) is calculated as the sum of cash flows from trading during a day and the daily change in the market value of unsettled positions. The intraday trading profit (ITPRF) is defined as the total positions that are newly established and liquidated within a day multiplied by the difference between the average buying and selling prices during the day. The overnight trading profit (OTPRF) is defined as the difference between PRF and ITPRF. Panel A reports the average of daily trading profits aggregated by type of investors. Panel B reports the average profits of each investor group from trading with other groups. Trading profits are in billion KRW, and numbers in parentheses are heteroscedasticity-consistent standard errors of means. The sample period is January 4, 2010 to June 30, 2014 (1,115 trading days).

	Futures			Options		
	Domestic individuals	Domestic institutions	Foreigners	Domestic individuals	Domestic institutions	Foreigners
Panel A: Daily average trading profits						
Total trading profit	-1.027	0.072	0.955	-2.334	-0.016	2.349
(PRF)	(0.190)	(0.531)	(0.601)	(0.590)	(0.336)	(0.499)
Intraday trading profit	-0.072	0.146	0.445	-0.287	0.176	1.334
(ITPRF)	(0.046)	(0.034)	(0.039)	(0.047)	(0.043)	(0.045)
Overnight trading profit	-0.956	-0.074	0.510	-2.047	-0.192	1.015
(OTPRF)	(0.196)	(0.527)	(0.598)	(0.598)	(0.326)	(0.481)
Panel B: Daily average profits from trading with other groups						
Domestic institutions	-0.409			-0.423		
	(0.105)			(0.142)		
Foreigners	-0.618	-0.337		-1.912	-0.437	
	(0.147)	(0.497)		(0.515)	(0.223)	

**Table 3. Trading profits by option moneyness in the KOSPI 200 options market**

This table shows trading activity and profits of domestic individuals, domestic institutions, and foreign investors for various options classified by option types and moneyness in the KOSPI 200 options markets. A call (put) option is classified as Deep ITM if its strike-to-spot (spot-to-strike) ratio is less than 0.93, ITM if the ratio is between 0.93 and 0.97, ATM if the ratio is between 0.97 and 1.03, OTM if the ratio is between 1.03 and 1.07, and Deep OTM if the ratio is larger than 1.07, respectively, where all these intervals include the lower bound but exclude the upper bound. Panel A reports the aggregate trading volume, Panel B reports the aggregate absolute value of open interest, Panel C reports the total trading profit (PRF), Panel D reports the intraday trading profit (ITPRF), and Panel E reports the overnight trading profit (OTPRF). All variables are constructed in daily frequency, and the time-series mean of each variable is reported. Trading volumes and absolute open interests are in billion KRW, and trading profits are in million KRW. Nnumbers in parentheses are heteroscedasticity-consistent standard errors of means. The sample period is January 4, 2010 to June 30, 2014 (1,115 trading days).

	Domestic individuals		Domestic institutions		Foreigners	
	Call	Put	Call	Put	Call	Put
Panel A. Average trading volume						
Deep ITM	2.207 (0.088)	2.933 (0.782)	0.691 (0.093)	0.605 (0.095)	3.948 (0.227)	4.319 (0.903)
ITM	6.682 (0.491)	7.670 (0.368)	1.414 (0.161)	1.079 (0.087)	11.371 (0.808)	11.872 (0.578)
ATM	300.118 (5.050)	266.906 (4.892)	150.132 (4.096)	125.327 (3.656)	418.816 (5.919)	415.904 (5.957)
OTM	89.906 (3.192)	101.913 (3.727)	66.190 (2.109)	60.723 (3.025)	130.218 (4.220)	174.290 (5.896)
Deep OTM	14.643 (1.993)	36.463 (2.787)	12.293 (1.291)	25.470 (2.268)	21.141 (2.600)	62.608 (4.817)
Panel B. Average absolute value of open interest						
Deep ITM	24.840 (0.511)	23.890 (2.255)	11.524 (0.386)	10.486 (1.784)	86.132 (2.707)	98.952 (13.256)
ITM	23.740 (0.840)	23.036 (0.807)	13.349 (0.814)	9.602 (0.609)	84.750 (2.669)	70.242 (2.909)
ATM	86.673 (1.394)	72.341 (1.211)	50.277 (1.056)	38.432 (0.921)	153.856 (2.882)	142.439 (3.108)
OTM	31.277 (0.499)	34.048 (0.699)	12.266 (0.218)	12.505 (0.248)	39.898 (0.768)	52.362 (1.241)
Deep OTM	8.748 (0.440)	20.369 (0.686)	3.194 (0.178)	6.426 (0.214)	14.531 (0.888)	35.879 (1.214)
Panel C. Total trading profits (PRF)						
Deep ITM	6.833 (51.826)	95.963 (123.298)	-27.495 (26.569)	111.485 (132.402)	20.662 (63.220)	-207.448 (128.895)
ITM	22.946 (51.770)	-159.342 (110.017)	16.313 (46.313)	-106.520 (88.083)	-39.259 (61.678)	265.862 (119.725)
ATM	-869.146 (129.226)	-922.293 (333.557)	-67.885 (169.470)	-136.071 (243.842)	937.031 (166.205)	1058.364 (332.558)
OTM	-271.784 (73.562)	-102.841 (160.370)	101.860 (35.999)	-66.298 (49.303)	169.924 (91.611)	169.139 (167.198)
Deep OTM	-66.453 (33.748)	-67.563 (112.338)	66.887 (23.229)	91.926 (27.800)	-0.434 (45.430)	-24.363 (125.341)

Continued	Domestic individuals		Domestic institutions		Foreigners	
	Call	Put	Call	Put	Call	Put
Panel D. Intraday trading profits (ITPRF)						
Deep ITM	-0.728 (0.873)	0.529 (2.397)	-13.449 (13.968)	-5.820 (7.931)	10.495 (9.694)	7.819 (6.137)
ITM	0.436 (5.510)	5.188 (2.171)	-2.524 (2.800)	-3.703 (2.905)	11.299 (3.129)	15.047 (4.402)
ATM	-209.589 (59.094)	-123.746 (53.923)	148.029 (30.533)	51.681 (23.797)	400.197 (23.470)	381.748 (29.254)
OTM	31.350 (17.478)	-4.216 (18.767)	12.191 (9.553)	-6.205 (12.322)	171.499 (10.122)	244.704 (16.130)
Deep OTM	7.706 (9.421)	6.523 (10.787)	-1.784 (6.893)	-2.578 (7.794)	26.059 (5.506)	65.283 (9.534)
Panel E. Overnight trading profits (OTPRF)						
Deep ITM	7.560 (51.850)	95.434 (122.500)	-14.046 (19.786)	117.305 (131.100)	10.167 (61.293)	-215.267 (129.294)
ITM	22.510 (51.917)	-164.530 (110.067)	18.838 (46.102)	-102.817 (88.000)	-50.559 (61.603)	250.814 (118.317)
ATM	-659.557 (150.116)	-798.546 (348.302)	-215.913 (177.537)	-187.752 (247.575)	536.833 (161.156)	676.615 (318.941)
OTM	-303.134 (81.256)	-98.625 (170.573)	89.669 (34.163)	-60.093 (49.867)	-1.574 (89.223)	-75.566 (163.763)
Deep OTM	-74.159 (31.939)	-74.086 (118.012)	68.671 (20.339)	94.503 (24.704)	-26.493 (45.365)	-89.646 (124.127)

**Table 4. Trading profits of foreign investors and increase in options multiplier in the KOSPI 200 index derivatives market**

This table shows trading activity and profits of foreign investors during sub-periods before and after the increase in the contract multiplier in the KOSPI 200 index derivatives markets. We divide the sample period in three sub-periods, the pre-increase period of January 4, 2010 to March 8, 2012 (545 days), the transition period of March 9 to June 14 in 2012 (66 days), and the post-increase period of June 15, 2012 to June 30, 2014 (504 days). The first row shows the aggregate trading volume and the second row shows the aggregate absolute value of open interest of foreign investors. The total trading profit (PRF) is calculated as the sum of cash flows from trading during a day and the daily change in the market value of unsettled positions. The intraday trading profit (ITPRF) is defined as the total positions that are newly established and liquidated within a day multiplied by the difference between the average buying and selling prices during the day. The overnight trading profit (OTPRF) is defined as the difference between PRF and ITPRF. All variables are constructed in daily frequency, and the time-series mean of each variable is reported in a billion KRW. The numbers in parentheses are heteroscedasticity-consistent standard errors of means.

	Futures			Options		
	Pre-increase	Transition	Post-increase	Pre-increase	Transition	Post-increase
Trading volume	25123.950 (360.123)	24670.300 (774.829)	21857.190 (282.999)	1359.520 (26.222)	1307.500 (59.209)	1133.970 (18.375)
Open interest	13472.710 (193.050)	12653.980 (618.680)	12449.310 (161.395)	1027.190 (29.325)	815.195 (47.337)	505.967 (8.105)
Total trading profit (PRF)	0.746 (0.725)	5.726 (5.140)	0.558 (0.835)	3.100 (0.985)	2.373 (1.336)	1.534 (0.227)
Intraday trading profit (ITPRF)	0.628 (0.067)	0.508 (0.109)	0.240 (0.041)	1.454 (0.071)	1.092 (0.088)	1.237 (0.063)
Overnight trading profit (OTPRF)	0.117 (0.718)	5.218 (5.115)	0.318 (0.837)	1.647 (0.950)	1.281 (1.305)	0.298 (0.213)

**Table 5. Pricing tests on excess option returns**

This table shows the estimated results of the following time-series regressions of daily excess option returns on five risk factors:

$$r_{i,t} - r_{f,t} = \text{Alpha}_i + \beta_{i,1}\text{MKT}_t + \beta_{i,2}\text{SMB}_t + \beta_{i,3}\text{HML}_t + \beta_{i,4}\text{ZSR}_t + \beta_{i,5}\text{VSR}_t + \varepsilon_{i,t}$$

where  $r_i$  and  $r_f$  represent a daily rate of returns on test portfolio  $i$  and the 91-day CD, respectively, and MKT, SMB, HML are the Fama–French (1993) three factors constructed using the Korean stock market data, ZSR is the return on the at-the-money zero-beta straddle position in excess of the 91-day CD rate, and VSR is the variance swap return inferred from the volatility index following Daniel and Moskowitz (2016). We construct test portfolios of options classified by option types and moneyness and calculate daily equal-weighted returns for each test portfolio. A call (put) option is classified as Deep ITM if its strike-to-spot (spot-to-strike) ratio is less than 0.93, ITM if the ratio is between 0.93 and 0.97, ATM if the ratio is between 0.97 and 1.03, OTM if the ratio is between 1.03 and 1.07, and Deep OTM if the ratio is larger than 1.07, respectively, where all these intervals include the lower bound but exclude the upper bound. Panel A (C) reports the results on five moneyness portfolios of call (put) options, and Panel B (D) reports the same results with call (put) options of the nearest maturity only. All returns are annualized in decimal form. The  $t$ -values are adjusted using Newey–West (1987) standard errors with 10 lags (two weeks). The sample period is January 4, 2010 to June 30, 2014 (1,115 trading days).

	Deep ITM		ITM		ATM		OTM		Deep OTM	
	Coeff.	$t$ -value	Coeff.	$t$ -value	Coeff.	$t$ -value	Coeff.	$t$ -value	Coeff.	$t$ -value
Panel A. All Call options										
Alpha	0.371	1.54	-0.217	-0.63	-0.195	-0.15	-1.681	-1.46	-0.821	-0.45
MKT	8.326	58.44	11.619	62.43	23.072	31.78	28.789	46.08	24.761	26.32
SMB	-0.257	-1.53	-1.173	-5.32	-3.221	-3.75	-5.156	-6.97	-6.874	-5.99
HML	0.054	0.33	-0.054	-0.24	-0.159	-0.18	-0.622	-0.81	-0.721	-0.60
ZSR	-0.053	-2.70	-0.080	-2.94	0.422	3.96	1.132	12.34	1.747	12.12
VSR	0.048	10.45	0.073	12.96	0.182	8.34	0.197	10.47	0.130	4.68
Adj R <sup>2</sup>	87.62%		87.68%		62.52%		78.29%		62.39%	
Panel B. Call options with nearest maturity										
Alpha	0.212	0.78	-0.115	-0.26	1.045	0.26	-4.369	-1.63	-0.546	-0.16
MKT	9.724	59.96	16.394	66.95	43.131	19.77	46.801	32.29	24.211	14.09
SMB	-0.380	-1.99	-1.934	-6.67	-6.123	-2.37	-8.914	-5.19	-9.427	-4.42
HML	-0.062	-0.34	-0.308	-1.04	-0.303	-0.11	-0.837	-0.47	1.060	0.47
ZSR	-0.035	-1.57	-0.159	-4.42	1.428	4.46	2.935	13.79	3.004	11.15
VSR	0.041	8.15	0.103	12.49	0.328	5.00	0.259	5.92	0.016	0.31
Adj R <sup>2</sup>	89.08%		89.62%		38.71%		64.61%		39.48%	
Panel C. All put options										
Alpha	0.347	0.94	-0.115	-0.29	0.410	0.39	-1.902	-1.39	-2.401	-1.83
MKT	-8.173	-43.15	-12.368	-57.86	-19.521	-34.30	-22.702	-30.55	-22.494	-29.02
SMB	0.963	4.17	1.138	4.50	2.380	3.53	1.773	2.02	-0.035	-0.04
HML	0.012	0.05	-0.005	-0.02	0.179	0.26	0.501	0.55	0.452	0.52
ZSR	0.118	4.07	0.224	7.14	1.126	13.47	2.123	19.46	2.369	22.19
VSR	-0.033	-5.84	-0.024	-3.70	-0.078	-4.54	-0.140	-6.27	-0.127	-5.12
Adj R <sup>2</sup>	83.04%		88.24%		76.22%		74.61%		77.24%	
Panel D. Put options with nearest maturity										
Alpha	0.213	0.50	-0.255	-0.51	1.010	0.36	-7.660	-2.11	-8.839	-3.79
MKT	-9.323	-43.77	-16.733	-61.80	-32.532	-21.28	-33.424	-16.77	-25.275	-18.12
SMB	1.157	4.37	1.970	6.15	4.805	2.65	1.723	0.73	-0.364	-0.22
HML	-0.045	-0.16	0.406	1.23	0.511	0.27	0.219	0.09	0.672	0.43
ZSR	0.131	3.92	0.284	7.14	2.309	10.28	3.915	13.38	3.285	17.27
VSR	-0.034	-5.38	-0.031	-3.83	-0.108	-2.35	-0.009	-0.13	-0.102	-2.33
Adj R <sup>2</sup>	84.56%		89.67%		58.35%		55.62%		63.25%	

**Table 6. Risk-adjusted performance of investor groups in the KOSPI 200 futures market**

This table shows the estimated results of the following time-series regressions of daily excess returns from futures trading by domestic individuals, domestic institutions, and foreign investors on five risk factors:

$$r_{i,t} - r_{f,t} = \text{Alpha}_i + \beta_{i,1}\text{MKT}_t + \beta_{i,2}\text{SMB}_t + \beta_{i,3}\text{HML}_t + \beta_{i,4}\text{ZSR}_t + \beta_{i,5}\text{VSR}_t + \varepsilon_{i,t}$$

where  $r_i$  and  $r_f$  represent a daily rate of returns on the futures portfolio held by each investor group and the 91-day CD, respectively, and MKT, SMB, HML are the Fama–French (1993) three factors constructed using the Korean stock market data, ZSR is the return on the at-the-money zero-beta straddle position in excess of the 91-day CD rate, and VSR is the variance swap return inferred from the volatility index following Daniel and Moskowitz (2016). Daily returns earned by each investor group are calculated as the daily trading profits divided by the sum of realized cash outflows during a day, the value of long positions not closed by the end of the previous day, and the value of short positions not closed at the end of a day. Panel A reports the results of the total trading returns, and Panel B and Panel C report the results of the intraday and overnight trading returns, respectively. All returns are annualized in decimal form. The  $t$ -values are adjusted using Newey–West (1987) standard errors with 10 lags (two weeks). The sample period is January 4, 2010 to June 30, 2014 (1,115 trading days).

	Domestic individuals		Domestic institutions		Foreigners	
	Coeff.	$t$ -value	Coeff.	$t$ -value	Coeff.	$t$ -value
Panel A. Total returns from futures trading						
Alpha	-0.227	-7.02	0.001	0.01	0.064	1.17
MKT	0.246	14.01	0.405	8.95	-0.365	-12.33
SMB	-0.027	-1.32	0.037	0.69	-0.017	-0.50
HML	-0.036	-1.67	0.080	1.44	-0.042	-1.15
ZSR	-0.014	-5.52	-0.054	-8.19	0.044	10.14
VSR	0.003	6.11	0.012	8.61	-0.009	-9.87
Adj R <sup>2</sup>		28.05%		14.76%		24.71%
Panel B. Returns from intraday futures trading						
Alpha	-0.036	-3.32	0.041	4.97	0.075	9.41
MKT	-0.007	-1.24	0.013	2.83	-0.016	-3.73
SMB	-0.002	-0.28	0.006	1.08	-0.017	-3.26
HML	-0.001	-0.19	0.006	1.19	-0.005	-1.01
ZSR	0.007	7.79	-0.002	-2.83	0.001	0.83
VSR	0.000	-2.82	0.000	0.17	0.000	0.33
Adj R <sup>2</sup>		6.42%		8.31%		2.61%
Panel C. Returns from overnight futures trading						
Alpha	-0.883	-6.73	-0.144	-0.75	0.106	1.08
MKT	1.044	14.68	1.042	10.04	-0.667	-12.48
SMB	-0.073	-0.87	0.146	1.19	-0.030	-0.48
HML	-0.093	-1.07	0.212	1.67	-0.073	-1.11
ZSR	-0.071	-6.82	-0.155	-10.20	0.083	10.55
VSR	0.011	5.01	0.033	10.64	-0.017	-10.38
Adj R <sup>2</sup>		32.65%		18.73%		25.34%

**Table 7. Risk-adjusted performance of investor groups in the KOSPI 200 options market**

This table shows the estimated results of the following time-series regressions of daily excess returns from options trading by domestic individuals, domestic institutions, and foreign investors on five risk factors:

$$r_{i,t} - r_{f,t} = \text{Alpha}_i + \beta_{i,1}\text{MKT}_t + \beta_{i,2}\text{SMB}_t + \beta_{i,3}\text{HML}_t + \beta_{i,4}\text{ZSR}_t + \beta_{i,5}\text{VSR}_t + \varepsilon_{i,t}$$

where  $r_i$  and  $r_f$  represent a daily rate of returns on the futures portfolio held by each investor group and the 91-day CD, respectively, and MKT, SMB, HML are the Fama–French (1993) three factors constructed using the Korean stock market data, ZSR is the return on the at-the-money zero-beta straddle position in excess of the 91-day CD rate, and VSR is the variance swap return inferred from the volatility index following Daniel and Moskowitz (2016). Daily returns earned by each investor group are calculated as the daily trading profits divided by the sum of realized cash outflows during a day, the value of long positions not closed by the end of the previous day, and the value of short positions not closed at the end of a day. Panel A reports the results of the total trading returns, and Panel B and Panel C report the results of the intraday and overnight trading returns, respectively. All returns are annualized in decimal form. The  $t$ -values are adjusted using Newey–West (1987) standard errors with 10 lags (two weeks). The sample period is January 4, 2010 to June 30, 2014 (1,115 trading days).

	Domestic individuals		Domestic institutions		Foreigners	
	Coeff.	$t$ -value	Coeff.	$t$ -value	Coeff.	$t$ -value
Panel A. Total returns from options trading						
Alpha	-0.524	-8.10	-0.186	-1.61	0.293	7.24
MKT	0.480	13.67	-0.422	-6.72	-0.158	-7.22
SMB	0.165	3.98	-0.281	-3.78	0.011	0.43
HML	-0.030	-0.70	0.024	0.31	0.011	0.40
ZSR	-0.089	-17.22	0.097	10.57	0.029	9.10
VSR	-0.002	-2.35	-0.007	-3.58	0.001	1.92
Adjusted R <sup>2</sup>		57.70%		18.78%		30.86%
Panel B. Returns from intraday options trading						
Alpha	-0.213	-8.88	0.124	2.68	0.548	41.54
MKT	0.050	3.87	0.038	1.51	0.021	2.92
SMB	-0.069	-4.48	0.054	1.82	0.016	1.85
HML	-0.010	-0.62	0.027	0.88	-0.003	-0.31
ZSR	0.023	12.02	0.034	9.15	-0.001	-1.05
VSR	0.000	-0.02	-0.002	-3.16	0.001	3.26
Adjusted R <sup>2</sup>		19.29%		7.34%		0.78%
Panel C. Returns from overnight options trading						
Alpha	-0.801	-6.77	-0.346	-1.43	0.175	2.51
MKT	0.870	13.55	-0.848	-6.44	-0.288	-7.63
SMB	0.328	4.31	-0.555	-3.56	0.019	0.42
HML	-0.074	-0.94	0.026	0.16	0.044	0.96
ZSR	-0.185	-19.64	0.154	7.95	0.060	10.78
VSR	-0.003	-1.46	-0.004	-1.08	0.000	-0.04
Adjusted R <sup>2</sup>		59.73%		16.93%		31.13%

**Table 8. Decomposing per-minute trading profits in the KOSPI 200 index derivatives markets**

This table shows the average trading profits per minute due to net supply of liquidity and due to delta exposures, earned by domestic individuals, domestic institutions, and foreign investors. Panel A reports the average per-minute profits earned as compensation for liquidity provision. The benefit from passive trades is calculated as the sum of the absolute differences between mid-quote and trading prices weighted by contract sizes of trades initiated by the counterparty. The cost from aggressive trades is calculated as the sum of the absolute differences between mid-quote and trading prices weighted by contract sizes of trades initiated by each group itself. Then, the difference between them indicates the net profit earned as a reward for liquidity provision in the market. Panel B reports the total per-minute trading profit and the trading profit due to delta exposures for each investor group. The total per-minute profits are marked to market using the last transaction price for each minute. The profits due to delta exposures indicate the products between the aggregate delta in the previous period and the change in the underlying stock index. All variables are constructed in 1-minute frequency and the time-series mean of each variable is reported in a million KRW. The numbers in parentheses are heteroscedasticity-consistent standard errors. The sample period is January 4, 2010 to June 30, 2014 (1,115 trading days) and only intraday observations of trades between 9:00 to 14:50 are included in the sample.

	Futures			Options		
	Domestic individuals	Domestic institutions	Foreigners	Domestic individuals	Domestic institutions	Foreigners
<b>Panel A. Profits due to net supply of liquidity</b>						
Benefit from passive trades	1.660 (0.003)	1.268 (0.003)	0.959 (0.002)	1.689 (0.003)	0.651 (0.001)	1.366 (0.003)
Cost from aggressive trades	1.217 (0.002)	1.061 (0.002)	1.609 (0.002)	1.091 (0.002)	0.394 (0.001)	2.221 (0.004)
Difference	0.443 (0.001)	0.207 (0.001)	-0.650 (0.001)	0.598 (0.001)	0.257 (0.001)	-0.855 (0.002)
<b>Panel B. Profits due to delta exposures</b>						
Total per-minute profit	-2.209 (0.366)	0.338 (1.095)	1.871 (1.207)	-5.776 (0.986)	-0.344 (0.841)	6.119 (0.919)
Profit due to delta exposures	-2.175 (0.343)	0.008 (1.047)	2.167 (1.142)	-2.331 (0.696)	0.608 (0.453)	1.723 (0.523)
(% of total profit)	98.46%	2.37%	115.82%	40.36%	-176.74%	28.16%

**Table 9. Predictive regressions on delta- and vega-weighted demand of foreign investors**

This table reports the estimated coefficients on the delta- and vega-weighted net demand of foreign investors from the following predictive regressions of future returns and volatility, at either daily, 5-minute, or 1-minute horizons,

$$FRET = \alpha_j + \beta_{1,j}DWD(j) + \sum_{i=1}^5 \beta_{2,i,j}RET(i) + \beta_{3,j}LVOL(j) + \beta_{4,j}LSVOL(j) + \varepsilon_j ,$$

$$FV = \alpha_j + \beta_{1,j}VWD(j) + \sum_{i=1}^5 \beta_{2,i,j}RV(i) + \beta_{3,j}IV(1) + \beta_{4,j}ADWD(j) + \beta_{5,j}LVOL(j) + \beta_{6,j}LSVOL(j) + \varepsilon_j ,$$

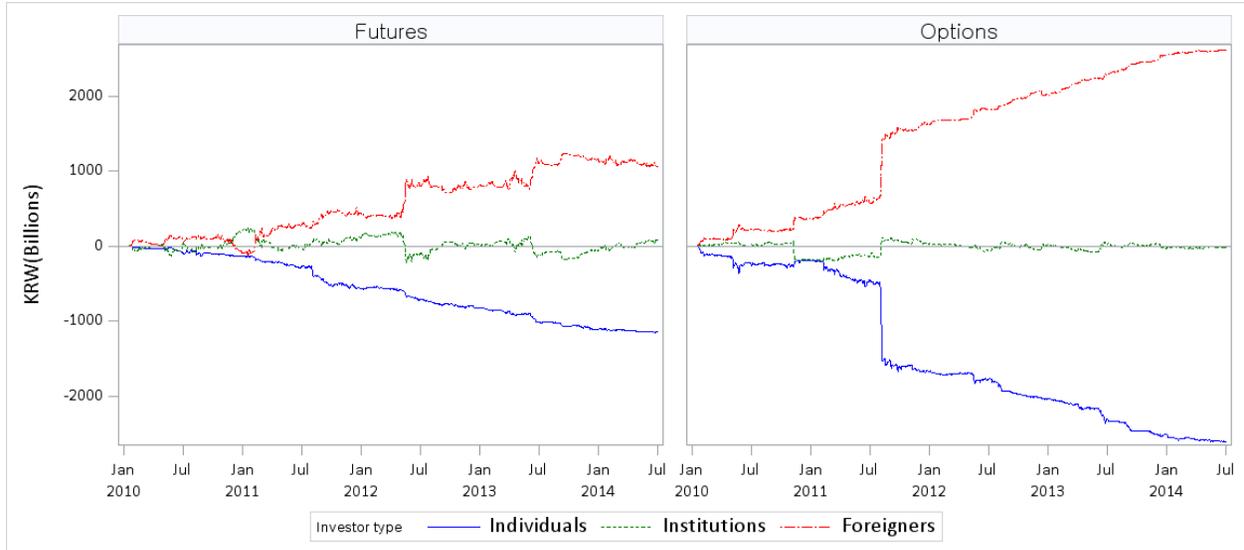
where  $FRET$  is the return on the KOSPI 200 and  $FV$  is the realized volatility of the KOSPI 200.  $DWD(j)$  and  $VWD(j)$  are the  $j$ -th lags of the delta- and vega-weighted net demands of foreign investors, respectively, for  $j = 1, \dots, 5$ .  $RET(i)$  is the  $i$ -th lag of the return of the KOSPI 200 and  $RV(i)$  is the  $i$ -th lag of the realized volatility of the KOSPI 200 for  $i = 1, \dots, 5$ .  $IV(1)$  is the lag of the square-root of the VKOSPI, and  $ADWD(j)$  is the  $j$ -th lag of the absolute value of DWD.  $LVOL(j)$  is the  $j$ -th lag of the logarithm of the total trading volume in either the futures or options market and  $LSVOL(j)$  is the  $j$ -th lag of the logarithm of trading volume in the KOSPI 200 index. Panels A and B show the estimation results for futures and options, respectively. The  $t$ -values are adjusted using Newey–West (1987) standard errors with 10 lags. The sample period is January 4, 2010 to June 30, 2014 (1,115 trading days).

	$j = 1$		$j = 2$		$j = 3$		$j = 4$		$j = 5$	
	Coeff.	$t$ -value								
Panel A. Futures										
DWD (Daily)	0.081	1.87	0.058	1.35	0.030	0.70	-0.050	-1.16	0.025	0.58
DWD (5-minute)	7.438	21.28	1.037	2.95	0.797	2.27	0.427	1.23	0.838	3.23
DWD (1-minute)	9.058	27.04	4.628	13.70	1.583	4.68	1.014	3.00	0.579	1.72
Panel B. Options										
DWD (Daily)	0.044	0.99	0.029	0.66	0.087	1.97	0.044	1.01	0.021	0.47
DWD (5-minute)	0.316	3.31	0.028	0.29	0.010	0.10	0.080	0.84	-0.075	-0.86
DWD (1-minute)	0.048	0.71	0.238	3.49	-0.198	-2.91	-0.012	-0.18	0.170	2.51
VWD (Daily)	-4.028	-0.68	16.136	2.72	17.156	2.88	5.499	0.92	-0.430	-0.07
VWD (5-minute)	-3.027	-0.62	-0.142	-0.03	-3.296	-0.67	-13.586	-2.79	-12.889	-3.02

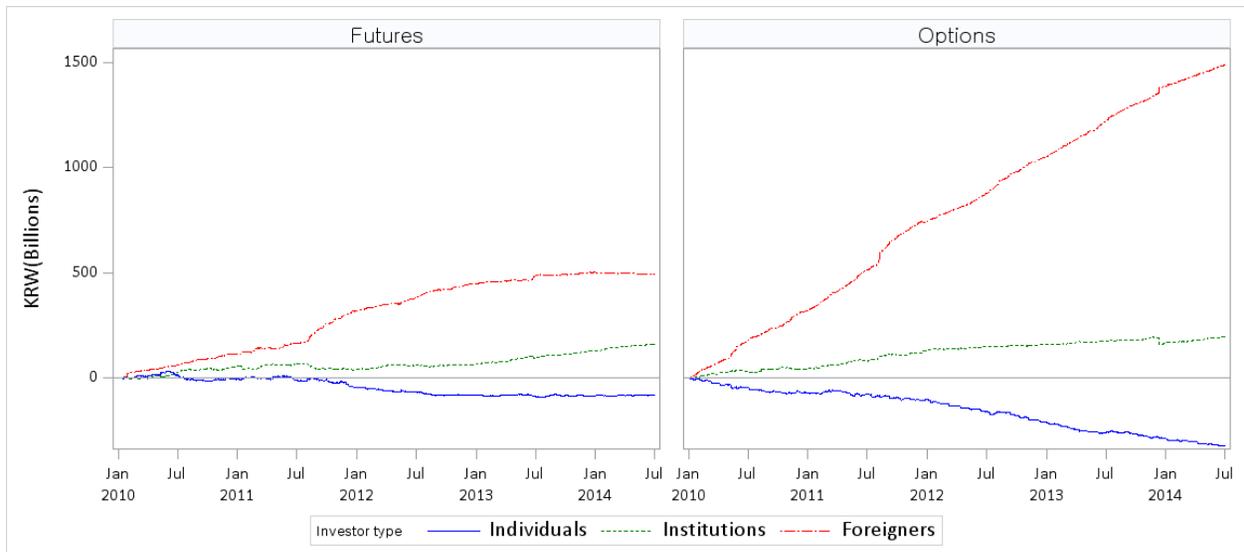
### Figure 1. Cumulative trading profits in the KOSPI 200 index derivatives markets

This figure shows the time trend of the cumulative trading profits in the KOSPI 200 index derivatives markets over the sample period from January 4, 2010 to June 30, 2014 (1,115 trading days). The unit of the trading profits is a billion KRW. The solid, dashed, dash-dot lines indicate the cumulative trading profits of domestic individuals, domestic institutions, and foreigners, respectively.

Panel A. Total trading profits



Panel B. Intraday trading profits



Panel C. Overnight trading profits

