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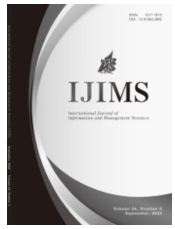
International Journal of
Information
and
Management
Sciences

International Journal of
Information and Management Sciences

36 (2025), 315-328. DOI:10.6186/IJIMS.202509_36(4).0004



The Influence of Lottery Effect on the Holding Period Returns of Futures around Expiration Date

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Keywords

Index Futures; Gambling Truncation; Lottery Effect

Abstract

We have analyzed influences on returns of futures from investors' gambling transactions in the paper. We have discovered from group testing and regression analysis that there is no obvious lottery effect in the futures market before the expiration date but significant lottery effects occur in the futures market on the expiration date and are particularly obvious in the next-month futures market. Besides, we have also discovered that the performance of futures index would be worse (better) than that of spot index on the expiration date if the market returns surge (crash) on the day before expiration of futures contracts. Lastly, our empirical results have demonstrated that the returns of futures are lower (higher) than spot returns on the expiration date when the market risks are higher (lower).

1. Introduction

The so-called lottery effect in the financial market refers to the phenomenon that investors expect a rising probability of surge in financial markets, so purchase financial assets in the mind of buying lotteries, and this further influences asset prices. Such gambling transactions often result in high asset prices and low holding returns.

In most literature researches on lottery effects, skewness coefficient is normally used to measure lottery features of financial assets[†]. When the skewness coefficient of returns on a financial asset is high, market investors' expect a rising probability of surge and have an increasing demand to purchase the financial asset, therefore, the asset is overbought at a higher price and a lower return. In relevant literature, for example: Barberis & Huang (2008) proved that the price of a financial asset was high when its skewness coefficient was high with the computable general equilibrium (CGE) model; Boyer & Vorkink (2014) discovered that the holding returns of options had reverse relationships with the skewness coefficients of returns;

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[†]A lottery feature means the low probability of winning a lottery and considerably high winnings once it is a winning lottery.

Boyer et al. (2010) discovered that investors in the stock market were willing to pay more for stocks with higher skewness coefficients; Green & Hwang (2012) took IPO price data as the research objects and discovered that the probability of excess returns on an IPO within one to five years after its issuance was negative when its expected skewness coefficient of returns was high.

Different from the foregoing literature in which the skewness coefficient is used to measure the lottery features of financial assets, relevant researches on lottery effect from other indexes are only available in a small part of literature. In relevant literature, for example: Bali et al. (2011) used the MAX index to measure the degrees of lottery features. The so-called MAX index refers to the highest daily returns for some time past, and Bali et al. (2011) discovered that the stocks with higher lottery features had lower returns through quantifying the lottery features with the MAX index. On the other hand, Conrad et al. (2014) measured the lottery features of financial commodities at the probability of high returns (the probability in which that the returns would be over 100%) in the coming year, and discovered that companies with higher lottery features were exposed to higher probability of bankruptcy. Lastly, Ang et al. (2006) discovered that stocks with higher idiosyncratic volatility could easily attract investors' gambling preferences, quantified the lottery features of financial commodities with idiosyncratic volatility, and discovered that stocks with higher idiosyncratic volatility had lower future returns, and their results proved the negative correlation between lottery features and holding returns.

Liu et al. (2020) discovered that the stock price of a company would be influenced by lottery effects before its earnings announcement and their research results showed that lottery effects occurred with events, therefore, investors conducted gambling transactions through financial commodities before financial events occurred, and such transactions indeed had significant influences on prices of financial commodities. The event date which draws the most attention in the futures market is the futures expiration date. In practice, bullish and bearish investors can increase investment profit through purchasing and selling futures, and they fight with each other till the expiration date, so the futures expiration date is also regarded as the Bull-Bear great match. In theory, the price behaviors of futures on the expiration date contain a massive amount of market information, for example: Samuelson (1965) and Galloway & Kolb (1996) discovered that futures could reflect much information of spot prices near expiration, as a result, futures prices near the expiration date would be highly volatile. In the research, we have regarded the futures expiration date as the event date and verified whether investors' gambling transactions influence the returns of futures on the expiration date. Intuitively, highly-volatile financial assets are preferred in gambling investment, and Samuelson (1965) discovered that the volatility of futures rose near the expiration date, and a higher volatility easily enhanced investors' gambling preferences (See details in Hsu & Chen 2017), therefore, investors preferred conducting gambling transactions near the futures expiration. On the other hand, according to the research of Bali et al. (2011), financial assets with higher lottery features could easily arouse investors' gambling investment demands. Thus, when the lottery features of futures go up, investors intend to make gambling transactions by holding long futures, and the rising volatility near expiration particularly strengthens their gambling preferences and make them have higher gambling transaction demands, resulting in higher futures prices and lower holding returns on the expiration date.

In the research, we have taken Taiwan stock index futures as the research objects, and measured the lottery features of futures with the MAX index by referring to the research methods of Bali et al. (2011). We have discovered that there is no significant lottery effect in the futures market before the expiration date through out-of-sample group testing and random group testing. On the other hand, through the out-of-sample group testing, within-sample group testing and regression analysis, we have discovered that the returns of futures have had significant negative correlation with the MAX index in the futures market on the expiration date, demonstrating there are indeed lottery effects in the futures market, and the significance of lottery effects is especially obvious for the hedged next-month futures.

There are four chapters in the paper, it is the Introduction in the chapter, and the other chapters are prepared as below: Chapter II introduces empirical data, Chapter III explains research methods and discusses empirical results, and Chapter IV is conclusion.

2. Empirical Data

In the research, we have verified whether there is a high probability for lottery effects in the futures market near the expiration date. We have regarded Taiwan stock index futures as the research objects during the sample period from Sept 15, 1998 to Sept 15, 2020. All the data required for this study are obtained from the Taiwan Economic Journal (TEJ) database. As the expiration date of Taiwan stock index futures is fixed on the third Wednesday every month (Hereinafter referred to as the m day or the expiration date of futures market), we have collected and analyzed the daily returns of current-month and next-month futures on the third Wednesday every month. To make a contrast analysis, we have also collected the daily returns of futures on the day before expiration (The third Tuesday every month, hereinafter referred to as the $m-1$ day). Relevant descriptive statistics are shown in Table 1 and Table 2. In the tables, "Unhedged" denotes the naked futures position. As the returns of futures are highly influenced by the spot returns, we have also collected the spread returns with the returns of futures minus the spot returns, and named the spread returns as the hedged returns used to observe whether the returns of futures are influenced by lottery effects or not after excluding influences from spot goods.

In Table 1, we have displayed the descriptive statistics of current-month futures. Firstly, we observed that the average rate of returns of unhedged futures on the $m-1$ day was 0.1337% and decreased to 0.0346% on the m day. On the other hand, the average rate of returns of hedged futures on the $m-1$ day was 0.0591% and decreased to -0.0561% on the m day. Their returns saw the same decline trend from the $m-1$ day to the m day, the unhedged futures had positive returns on the two days, but the hedged ones presented the price reverse from positive to negative returns, indicating that the average performance of futures on the $m-1$ day was better than that of spot goods, but the average returns of futures on the m day were lower than the spot returns. Besides, we have also discovered that the standard deviations of the unhedged futures on the two days were 1.5204% and 1.6861% respectively, higher than those of the hedged ones which were 0.4428% and 0.8348% respectively. The data have reflected that the unhedged futures were exposed to higher risks than the hedged ones. Lastly, the standard deviations of both the unhedged and hedged futures on the m day were higher than those on the $m-1$ day, showing that the volatility of futures on the expiration date were higher than that on the day before expiration.

Table 1. *The Descriptive Statistics of Current-Month Futures*

		Mean	Std.	Q1	Median	Q3
Unhedged	$m-1$	0.1337	1.5204	-0.5229	0.1283	0.6206
	m	0.0346	1.6861	-0.6150	0.1572	0.8553
Hedged	$m-1$	0.0591	0.4428	-0.1443	0.0286	0.2032
	m	-0.0561	0.8348	-0.3022	0.0118	0.2548
The data units in the table are in percentage (%).						

The descriptive statistics of next-month futures are shown in Table 2. Similar with Table 1, the returns of unhedged next-month futures on the $m-1$ day and the m day were positive and declined from the $m-1$ day to the m day. The hedged futures also showed the decline trend and price reserve phenomenon. Moreover, the standard deviations of the hedged futures on the two days were lower than those of the unhedged ones. Lastly, we have observed that the standard deviations of the hedged next-month futures (0.2557% and 0.2751% respectively) on the two days were lower than those of the hedged current-month ones (0.4428% and 0.8348% respectively), demonstrating that the hedge effects of next-month futures are better than those of current-month ones near the expiration date.

Table 2. *The Descriptive Statistics of Next-Month Futures*

		Mean	Std.	Q1	Median	Q3
Unhedged	$m-1$	0.0897	1.6214	-0.5636	0.0938	0.6140
	m	0.0227	1.6034	-0.6476	0.0840	0.7429
Hedged	$m-1$	0.0152	0.2557	-0.1447	0.0395	-0.013
	m	-0.0680	0.2751	-0.1162	-0.0352	0.0128
The data units in the table are in percentage (%).						

3. Research Methods and Result Analysis

In the chapter, we have verified whether the returns of Taiwan stock index futures on the $m-1$ day and on the m day would be influenced by lottery effects. Samuelson (1965) and Galloway & Kolb (1996) discovered that futures could reflect a massive amount of information on spot prices near expiration, resulting in higher volatility of futures prices near the expiration date. On the other hand, Hsu & Chen (2017) discovered that highly-volatile financial assets could easily arouse investors' gambling preferences. By combining the results in the foregoing three literature, we could infer that investors would have higher gambling preferences for futures near the expiration date, that is to say, they would intend to conduct gambling transactions through futures. What's more, Bali et al. (2011) quantified the lottery features of financial assets with the *MAX* index, and discovered that investors preferred purchasing financial assets in the mind of buying lotteries when they found that such financial assets had high lottery features, resulting in increased gambling transaction demands. By combining the foregoing literature, we have drawn the following inference: when the lottery features of futures go up, investors intend to deal with gambling transactions by holding long futures, and the rising volatility near the expiration date further enhances investors' gambling preferences (See details in Hsu and Chen (2017)) and increases their gambling transaction demands, resulting in high futures prices and low holding returns of futures on the expiration date, so lottery effects easily occurs to futures near the expiration date. Based on the foregoing inference, we have proposed the following hypothesis:

Hypothesis: In the futures market, as the contract approaches its expiration date, traders are more likely to exhibit a lottery-seeking behavior, disproportionately allocating trades to contracts with low probability but high potential payoffs.

3.1 Within-sample group testing

By referring to the researches made by Bali et. al. (2011) and Liu et. al. (2020), the MAX index is used as the proxy of lottery effects in the research. The index is defined as below:

$$MAX_{i,t} = Max\{R^f_{i,t-j} | i{=}1{,}2,\ \mathrm{j{=}0,1,\ldots,4}\} \tag{3.1}$$

where, $R^f_{1,t-j}$ $(R^f_{2,t-j})$ is the return of current-month (next-month) futures on the $t-j$ day. It is known from the definition in Eq. (3.1) that $MAX_{1,t}$ $(MAX_{2,t})$ is the highest returns of current-month (next-month) futures during the past five days. Bali et. al. (2011) discovered that investors intended to purchase financial assets in the mind of buying lotteries when the MAX index was high. Accordingly, it is hypothesized that investors exhibit increasing demand for gambling-motivated trades in current-month (next-month) futures as $MAX_{1,t}$ $(MAX_{2,t})$ increases. In the paper, we have analyzed whether that the returns of current-month and next-month futures near the m day (the third Wednesday every month) would be influenced by lottery effects. We used $MAX_{1,t}$ and $(MAX_{2,t})$ as proxies while analyzing the current-month (next-month) futures to measure the degrees of their lottery feature.

Firstly, we grouped the data of current-month futures by the $MAX_{1,t}$ value:

$$MAXL_1 = \{R^f_{1,m-i} | MAX_{1,m-2} < Percentile_{0.33}, m \in maturity\ date,\ i = \ 0\ or\ 1\} \tag{3.2}$$

$$MAXH_1 = \{R^f_{1,m-i} | MAX_{1,m-2} > Percentile_{0.67}, m \in maturity\ date, i = \ 0\ or\ 1\} \tag{3.3}$$

As shown in Formulae (3.2) and (3.3), we have judged the lottery features of current-month futures contracts near expiration with the MAX index on the $m-2$ day (Two days before expiration i.e. the third Monday every month). When the MAX index was below (above) 33% (67%) percentile rank, it was identified that the lottery features were low (high). Therefore, $MAXL_1(MAXH_1)$ collects the returns of current-month futures on the $m-1$ day and on the m day when the lottery feature is relatively low (high). We have calculated the average returns of futures on the $m-1$ day and on the m day when the MAX indexes were high and low, and verified whether the MAX index was correlated to returns of futures with results as shown in Table 3. Firstly, we observed the empirical results on the $m-1$ day. As shown in the table, the average rate of returns of unhedged futures was -0.0011% when the MAX index was low $(MAXL_1)$, and that was 0.3109% when the MAX index was high $(MAXH_1)$, and their difference $(MAXH_1 - MAXL_1)$ was 0.3120%. Data have displayed that the returns of unhedged futures are high at a high MAX index, representing the positive correlation between the returns and the MAX index, but such correlation is not significant demonstrated by the t - value at 1.2555. Then, we observed the hedged futures (excluding influences from spot goods,) and results showed that the rate of returns of futures was -0.0036% when the MAX index was low and 0.0013%

when it was high and their difference was significant on the confidence level of 95%. The foregoing results showed that the returns of futures were not low but high when their lottery features were high on the $m-1$ day, manifesting that there is no lottery effect in the futures market on the day before expiration.

The lower half of Table 3 shows the average returns and verification results on the m day. The empirical results showed that the rate of returns of unhedged futures was -0.0771% at low lottery features and -0.1586% at high lottery features. Results have shown that the higher the lottery features are, the lower the returns are, and represented that lottery effects exist in the futures market on the m day but are not significant as the t value is -0.081. Similar results are for the hedged futures. The rate of returns of hedged futures was -0.1048% at low lottery features and -0.1407% at high lottery features, showing that the higher the lottery features are, the lower the returns are, but the lottery effects are insignificant based on the t- value.

According to the hypothesis of the paper, we expect that lottery effects would occur at a high probability in the futures market near the futures expiration date. In Table 3, we could observe that no lottery effect occurred to current-month futures on the day before expiration, and lottery effects occurred on the expiration date but were insignificant. Though the hypothesis is supported by data, the empirical results on the expiration date lack significant evidences to support the existence of lottery effects. The prices of current-month futures before the expiration are easily manipulated by investors (See details in Zhang (2022)), as a consequence, we might fail to find sufficient evidences in the data regarding current-month futures to support the hypothesis of the paper. As the prices of next-month futures are not susceptible to human manipulation upon expiration of current-month futures, we will use the data of next-month futures to verify whether a lottery effect occurs in the futures market at a high probability near expiration of current-month futures.

Table 3. *Within-Sample Group Test of Current-Month Futures*

	$m-1$	
	Unhedged	Hedged
$MAXL_1$	-0.0011	-0.0036
$MAXH_1$	0.3109	0.1300
$MAXH_1 - MAXL_1$	0.3120 (1.2555)	0.1336** (1.7878)
	m	
	Unhedged	Hedged
$MAXL_1$	-0.0771	-0.1048
$MAXH_1$	-0.1586	-0.1407
$MAXH_1 - MAXL_1$	-0.0815 (-0.2888)	-0.0358 (-0.2566)

**indicates a confidence level of 95%

Similar with Table 3, we grouped the data of next-month futures by $MAX_{2,t}$ value:

$$MAXL_2 = \{R^f_{2,m-i} | MAX_{2,m-2} < Percentile_{0.33}, m \in maturity\ date,\ i = 0\ or\ 1\} \quad (3.4)$$

$$MAXH_2 = \{R^f_{2,m-i} | MAX_{2,m-2} > Percentile_{0.67}, m \in matureity\ date, i = 0\ or\ 1\} \quad (3.5)$$

$MAXL_2$ in Eq. (3.4) are the collected returns of next-month futures on the $m-1$ day and on the m day at a low MAX index; correspondingly, $MAXH_2$ in Eq. (3.5) are the collected returns of next-month futures on the $m-1$ day and on the m day at a high MAX index. We have calculated the average returns of futures on the $m-1$ day and on the m day, respectively, at both high and low MAX indexes and verified whether the MAX index values influence the returns with results as shown in Table 4.

The upper half of Table 4 shows the empirical results on the $m-1$ day. The rate of returns of unhedged futures was -0.0761% at a low MAX index and went up to 0.2288% at a high MAXindex, their difference was 0.2288 and insignificant according to the t-value. On the other hand, the returns of hedged futures have positive correlation with the MAX indexes; as shown in the Table, the rate of returns of hedged futures was -0.0150% at a low MAXindex and rose to 0.0308% at a high MAX index, their difference was 0.0459% but insignificant. Similar with Table 3, the returns of next-month futures on the $m-1$ day are positively correlated to the MAX indexes, showing that no lottery effect occurs to the next-month futures on the $m-1$ day either.

The lower half of Table 4 shows the empirical results of next-month futures on the m day. As shown in the Table, the rate of returns of unhedged futures was -0.0134% at a low MAX index and went down to -0.1896% at a high MAX index, but their difference was insignificant. On the other hand, the rate of returns of hedged futures was -0.0429% at a low MAX index and declined to -0.1851% at a high MAX index, and there was a significant difference between them according to t-value, and the data have proved that significant lottery effects occur on the m day.

By integrating Table 3 and Table 4, we have the following observation results:

Observation I: No lottery effect occurs to current-month or next-month futures on the day before expiration of current-month futures.

Observation II: Lottery effects occur in the current-month futures market on the expiration date, but are insignificant.

Observation III: Lottery effects occur in the next-month futures market on the expiration date of current-month futures, especially the hedged futures witness significant lottery effects.

Based on the foregoing observation results, we have discovered that no obvious lottery effect occurs in the futures market on the day before expiration of current-month futures, but lottery effects occur in the futures market on the expiration date, and are significant especially for the hedged next-month futures. These results support the hypothesis of the paper: a lottery effect occurs to the futures market at a high probability near the expiration date.

Table 4. *Within-Sample Group Test of Next-Month Futures*

	$m-1$	
	Unhedged	Hedged
$MAXL_2$	-0.0761	-0.0150
$MAXH_2$	0.1527	0.0308
$MAXH_2 - MAXL_2$	0.2288 (0.8442)	0.0459 (0.4369)
	m	
	Unhedged	Hedged
$MAXL_2$	-0.0134	-0.0429
$MAXH_2$	-0.1896	-0.1851
$MAXH_2 - MAXL_2$	-0.1762 (-0.6605)	-0.1422** (-1.6710)

**indicates a confidence level of 95%

3.2 Random grouping test

Table 4 shows that significant lottery effects occur to the hedged next-month futures on the m day, but no lottery effect occurs on the $m-1$ day. Then, we want to verify whether any lottery effect occurs on a transaction day far from the m day. To prove that lottery effects of the futures market indeed are related to the proximity to the expiration date, we have randomly selected a transaction date from the three to ten transaction days before the expiration date every month during the sample period. Let t_i be the random transaction date in the i month and collected all the MAX indexes $\left\{ MAX_{t_j} \middle| \forall j \right\}$ on the sampling day. Then, we judged whether the MAX indexes on the sampling day were less than $Percentile_{0.33}$, and collected the returns of futures one and two days after t_i in the set of $MAXL_R$ if conditions were met; collected the returns of futures one and two days after t_i in the set of $MAXH_R$ if the indexes were higher than $Percentile_{0.67}$. To put it simple, $MAXL_R$ is the set of lower MAX indexes among the randomly-selected data and $MAXH_R$ the set of higher MAX indexes. We have calculated the average returns of the hedged futures in the two sets and verified their differences.

Table 5 shows the empirical results of hedged current-month futures. The empirical results showed the average rate of returns was 0.0039% at a low index and 0.0397% at a high index on the day after random sampling, the positive correlation between the MAX indexes and returns of futures has indicated that there is no lottery effect. On the second day after random sampling, the average rate of returns was 0.0630% at a low index and -0.0081% at a high index, namely, the higher the lottery features of futures are, the lower the returns of futures are, thus, lottery effects exist in the futures market but are insignificant based on the t-value.

Table 5. *Random Grouping Test of Hedged Current-Month Futures*

	The day after random sampling	The second day after random sampling
$MAXL_R$	0.0039	0.0630
$MAXH_R$	0.0397	-0.0081
$MAXH_R - MAXL_R$	0.0357 (0.5154)	-0.0712 (-1.2520)

Table 6 shows the random sample verification results of hedge next-month futures. The empirical results showed the average rate of returns was -0.0186% at a low MAX index and up to 0.0472% at a high MAX index on the day after random sampling, the higher the lottery features of futures are, the higher the returns of futures are, showing that there is no obvious lottery effect in the futures market. On the other hand, on the second day after random sampling, the average rate of returns was 0.0694% at a low MAX index and down to -0.0106% at a high MAX index. Though data have shown that the higher the lottery features of futures are, the lower the returns of futures are, and lottery effects exist in the futures market but are insignificant based on the t- test results.

Table 6. *Random Grouping Test of Hedged Next-Month Futures*

	The day after random sampling	The second day after random sampling
$MAXL_R$	-0.0186	0.0694
$MAXH_R$	0.0472	-0.0106
$MAXH_R - MAXL_R$	0.0658 (0.9650)	-0.0801 (-1.3707)

Through the hedged next-month futures, we have discovered that significant lottery effects only occur in the futures market on the expiration date, and there is no obvious lottery effect on the day before expiration or much earlier transaction days. These empirical results all support the hypothesis of the paper: a lottery effect occurs to the futures market at a high probability near the expiration date.

3.3 Out-of-sample group testing

By looking through the data of next-month futures in the first section of the chapter, we have found significant evidences to prove that lottery effects occur to futures on the expiration date (of current-month futures). In the section, we have further verified the hedged next-month futures through out-of-sample group testing to confirm that the lottery effects in the futures market on the expiration date are reliable.

To begin with, we have revised Eq. (3.4) and (3.5) as below:

$$MAXL_2 = \{R^f_{2,m-i} \mid MAX_{2,m-2} < Percentile_{0.33}\{ MAX_{2,m-j} \mid j = 3,4,\dots,22\}, i = -1, 0\} \quad (6)$$

$$MAXH_2 = \{R^f_{2,m-i} \mid MAX_{2,m-2} > Percentile_{0.67}\{ MAX_{2,m-j} \mid j = 3,4,\dots,22\}, i = -1, 0\} \quad (7)$$

In Eq. (3.4) and (3.5), we have collected all the MAX indexes of samples on the second day before the m day in the set: $\{MAX_{2,m-2} | m\ maturity\ date\}$, and took the set percentiles 33%(67%) as the threshold values to judge whether the lottery features of futures are low (high). The threshold values need to be determined by all sample information, consequently, the lottery effects discovered in the first section are only the within-sample results. In Eq. (3.6) and (3.7), we have only collected the MAX indexes in the first twenty days before the $m-2$ day in the set: $\{MAX_{2,m-j} | j = 3,4, \dots ,22\}$, and took the set percentiles 33%(67%) to judge whether the data on the m date and the day before should be collected in $MAXL_2(MAXH_2)$. In this sense, only the data before the $m-i$ days are required to judge whether it is necessary to put $R^f_{2,m-i}$ into Set $MAXL_2$ or Set $MAXH_2$, and data at low and high MAX indexes are collected respectively in the out-of-sample way in Eq. (3.6) and (3.7).

We conducted out-of-sample grouping with Eq. (3.6) and (3.7) with the group verification results as shown in Table 7. The data in Table 7 showed that the rate of returns was 0.0133% at a low MAX index and 0.0131% at a high MAX index on the $m-1$ day, and there was no significant difference between them. On the other hand, on the m day, the average rates of returns were -0.0267% and -0.1735% respectively at low and high indexes, and the rate of returns decreased by -0.1468% at a high MAX index compared with that at a low MAX index, and the t-value also demonstrated a significant difference. Through out-of-sample group testing, we have re-confirmed that significant lottery effects occur in the futures market on the expiration date, and no significant lottery occurs on the day before expiration, and these results support the hypothesis of the paper.

Table 7. *Out of Sample Group Test of Next-Month Hedged Futures*

	$m-1$	m
$MAXL_2$	0.0133	-0.0267
$MAXH_2$	0.0131	-0.1735
$MAXL_2 - MAXH_2$	-0.0002 (-0.0018)	-0.1468** (-1.8315)

3.4 Regression Analysis

In the last section, we have verified the lottery effects of the futures market on the expiration date in regression analysis in order to strengthen the robustness of empirical results. In the regression analysis, we considered the returns of hedged next-month futures as the explained variable and the MAX index as the explanatory variable, and also added the market risk factors as explanatory variable in order to explain whether the explanatory power of the MAX index on returns of futures is related to any market risk factors in the regression model as below:

$$R^f_{2,m} = \alpha + \beta_1 * MAX_{2,m-1} + \beta_2 * RM_{m-1} + \beta_3 * ILLIQ_{m-1} + \beta_4 * MOM_{m-1} + \beta_5 * VOL_{m-1} + \varepsilon_{m-1} \quad (3.8)$$

Where, $R^f_{2,m}$ is the returns of hedged next-month futures on the m day (the third Wednesday every month); $MAX_{2,m-1}$ the MAX index on the $m-1$ day; RM_{m-1} the market returns; $ILLIQ_{m-1} = |R^f_{2,m-1}| -/$ trading volume, to measure the liquidity of the next-month futures market; $MOM_{m-1}$the cumulative returns of hedged next-month futures in the past five days to measure its momentum; VOL_{m-1} the volatility of spot index to measure the market risks. The regression coefficient estimation results are in Table 8. When the explanatory variable was only the MAX index, the regression coefficient was -0.0840, and significantly smaller than 0 on the confidence level of 99% based on the t- test. The data have shown that returns of futures have significant negative correlation with the MAX index and there are significant lottery effects in the futures market on the expiration date. Then, we used the market returns as the single explanatory variable, then the regression coefficient was -0.0731 and significantly smaller than 0 based on the t- test, illustrating that the performance of futures index would be worse (better) than the spot index on the expiration date if the market returns surged (crashed) on the day before expiration.

Then, $ILLIQ_{m-1}$ was used as the single explanatory variable to carry out simple linear regression, and the regression coefficient was -0.0731 and not significantly smaller than 0 based on the verification results, showing that the returns of next-month futures had no significant correlation with liquidity. On the other hand, when MOM_{m-1} was used as the explanatory variable, the regression coefficient was -0.1797 and significantly negative based on the verification result, stating that the hedged futures would easily see price reverse crash (surge) on the expiration date if they kept surging (crashing) before the expiration date. Last, when VOL_{m-1} was used as the single explanatory variable, the regression coefficient was -0.1711 and significantly negative based on the verification result, declaring that the returns of futures were lower (higher) than spot returns when the market risks were high (low) before expiration.

Then, we added the MAX index to the foregoing 4 market factors for bi-variate regression with results as shown in Rows 6 to 9 in Table 8. The data have shown that the MAX index still has significant negative correlation with the returns of futures after separately controlling the 4 market factors. The results have proved that there are indeed significant lottery effects in the futures market on the expiration date.

Lastly, we used the 4 market factors and the MAX index as explanatory variables simultaneously for multi-regression with results as shown in Row 10 in Table 8. The regression results have shown that the MAX index coefficient has no significant explanatory power any more, but the market returns, market volatility and momentum of hedged futures do, and demonstrated that the influences of MAX index on the returns of futures on the expiration date are mainly from market risk factors.

Table 8. *The Regression Coefficient Estimation Results of Next-Month Hedged Futures*

$MAX_{2,m-1}$	RM_{m-1}	$ILLIQ_{m-1}$	MOM_{m-1}	VOL_{m-1}
-0.0840*** (-3.99474)				
	-0.0731*** (-3.203)			
		-0.03319 (-0.13196)		
			-0.1797*** (-3.357)	
				-0.1711*** (-3.212)
-0.0686*** (-3.072)	-0.0473** (-1.9740)			
-0.0878*** (-4.0661)		0.1971 (0.7855)		
-0.0685*** (-3.123)			-0.1261** (-2.278)	
-0.06753** (-2.541)				-0.0677 (-1.018)
0.0013 (0.0388)	-0.05545** (-2.2899)	-0.06217 (-0.2407)	-0.18265** (-3.0292)	-0.1791** (-2.3979)

4. Conclusion

High volatility of futures near expiration easily arouse investors' gambling preferences for futures, so we have inferred that investors would have higher gambling transaction demands near the expiration date, meaning that they would conduct gambling transactions through futures at a high probability. Therefore, when the lottery features of futures go up, investors intend to make gambling transactions by holding long futures, and the rising volatility near the expiration date particularly strengthens their gambling preferences and make them have higher gambling transaction demands, resulting in higher futures prices and lower holding returns on the expiration date, hence, lottery effects easily occur to futures near the expiration date.

We have measured the lottery features of futures with the MAX index and verified whether a lottery effect occurs in the futures market at a high probability near the expiration date. We have discovered that there is no significant lottery effect in the futures market before the expiration date through out-of-sample and random group testing. On the other hand, through out-of-sample group testing, within-sample group testing and regression analysis, we have also discovered that significant lottery effects occur in the futures market on the expiration date and the significance of such lottery effects is particularly obvious for next-month hedged futures. Lastly, through regression analysis, we have discovered: (1) if the market returns surge (crash) on the day before expiration of futures, the performance of futures is worse (better) than that of spot goods on the expiration date; (2) if they surge (crash) on the day before expiration, the hedged futures easily witness reverse crash (surge) on the expiration date; (3) when market risks are higher (lower), the returns of futures are lower (higher) than the spot returns on the expiration date.

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(Received July 2025; accepted December 2025)