Mispricing of SET50 Index Futures Calendar Spreads: Evidence from the Thailand Futures Exchange

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and

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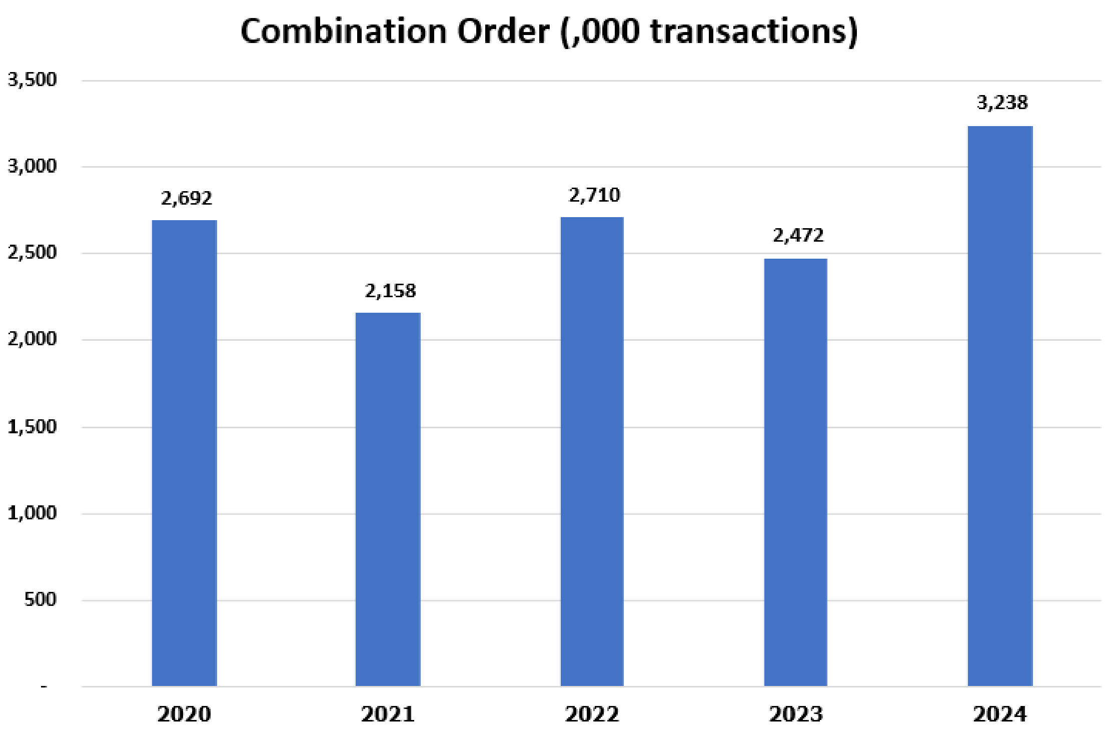
Introduction

The mispricing of futures contracts, including index futures, has been a topic of considerable academic attention. However, research focusing specifically on calendar spreads, particularly in the context of emerging markets like Thailand, remains sparse. Calendar spreads are often perceived as low-risk positions due to their lower volatility compared to outright futures contracts. This may explain the relative lack of attention given to their mispricing in academic literature.

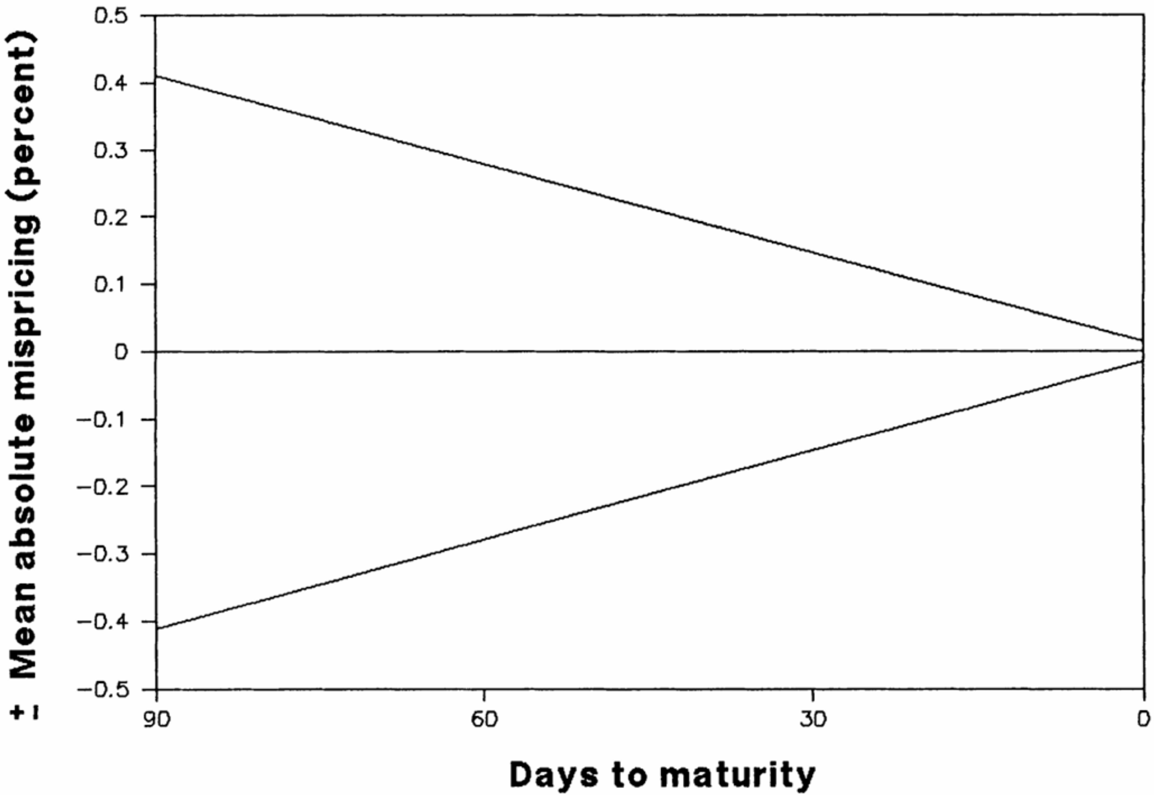
In 2020, the Thailand Futures Exchange (TFEX) introduced combination orders, allowing investors to execute calendar spread trades more efficiently. This feature, which enables the simultaneous execution of long and short positions in near and deferred contracts, has become increasingly popular as the capital market continues to develop. Calendar spreads are typically used by investors wishing to roll over contracts from the near to the deferred month. Although calendar spreads are often regarded as relatively low-risk, the potential for mispricing—when the spread deviates from its theoretical value—raises important questions for investors. Specifically, it prompts the question of whether rollovers incur additional costs or, conversely, offer opportunities for gain due to mispricing. For example, an investor with a long position may roll over into a deferred contract while the theoretical price suggests the deferred contract should trade at a discount to the current futures price. However, if the market is in contango—where the deferred contract trades at a premium—this could result in a disadvantageous transaction. The investor would effectively close the short leg of the spread below its theoretical value and buy the deferred contract at a higher price, increasing the cost of maintaining the position. While the opposite scenario may offer a benefit, such pricing anomalies introduce risks that are not fully captured by standard futures pricing models, particularly during the rollover period.

Figure 1 : Combination Order Volume Yearly



According to MacKinlay and Ramaswamy (1988), the mispricing of futures contracts, as indicated by deviations from the cost-of-carry model adjusted for transaction costs, should diminish as the contract maturity date approaches. The rationale is that the closer the maturity, the lower the risk of unexpected dividends or interest rate changes—both of which are integral components of the cost-of-carry equation. However, observations of the SET50 Index futures market in Thailand suggest that these theoretical expectations may always not hold true especially during rollover period which Slivka study suggest that around 15 days before maturity is when market tend to have excess volatility from rollover effect.

Figure 2 : MacKinlay and Ramaswamy (1988) Mispricing bound from theoretical price shrinks as time to maturity approaches



This discrepancy between theory and market practice has significant implications for investors, especially in the context of rollover decisions. For a long-position investor looking to roll over their position to a deferred contract, the cost of a mispriced calendar spread can result in suboptimal execution. For instance, if the calendar spread is priced lower than its theoretical value, the long party is at a disadvantage, as they would close out their near-term position at a lower price while opening the deferred position at a higher price. This mispricing, combined with transaction costs such as bid-ask spreads and broker fees, can lead to additional costs for investors. On the other hand, a mispriced spread can be beneficial for short-position holders, who would be able to close their near-term position at a lower price and open a short position at a higher price, thereby increasing their profits.

The difference between near and far contracts is widely known as the roll yield, a significant research field typically focused on commodity futures. Studies such as Casassus (2005), Peter Prins, and Gome (2015) examine roll returns in futures contracts across various markets and commodities. Roll yield is often emphasized in commodities due to the presence of convenient yield—reflecting the real economic value tied to production and storage costs, adding layers of complexity to the analysis. In contrast, index futures, being purely financial assets, lack these physical elements. However, I believe that convenient yield could still be a significant factor in financial assets like index futures. The need for investors to roll over positions and the deviation from theoretical prices may implicitly suggest a form of convenient yield for index futures, as investors may be willing to accept higher or lower prices based on their expectations of future market direction.

This study aims to investigate the mispricing of SET50 Index futures calendar spreads on the Thailand Futures Exchange, providing empirical evidence on how these spreads deviate from theoretical pricing models and exploring the implications for investors' rollover strategies. The Thailand Futures Exchange is largely dominated by foreign and local retail investors (See figure 3), which is evident from the volume of contracts traded by these participants. As several studies have explored the influence of large traders on financial markets, notable examples include Jarrow, Fung, and Tsai (2018), who investigate market manipulation by large traders in derivatives markets, and Gastineau and Jarrow (1991), who examine the broader impact of large traders on market dynamics. These studies provide evidence that large traders can exert significant influence on prices, particularly through strategic trading or manipulation, which in turn affects market efficiency and pricing behavior. In contrast to other studies—such as Brailsford and Hodgson (1997), Frino and McKenzie (2002), and Carchano (2009)—that primarily examine open interest and volume in near and far contracts, this research will also consider the role of institutional and foreign investor activity, adding an additional layer to the understanding of calendar spread mispricing. This aspect of the study aims to provide further insights into how market dynamics might contribute to mispricing, making it an interesting and potentially novel contribution to the existing literature.

Figure 3 : SET50 Average Daily Contracts Turnover by Investor Type (2019 - 2024)

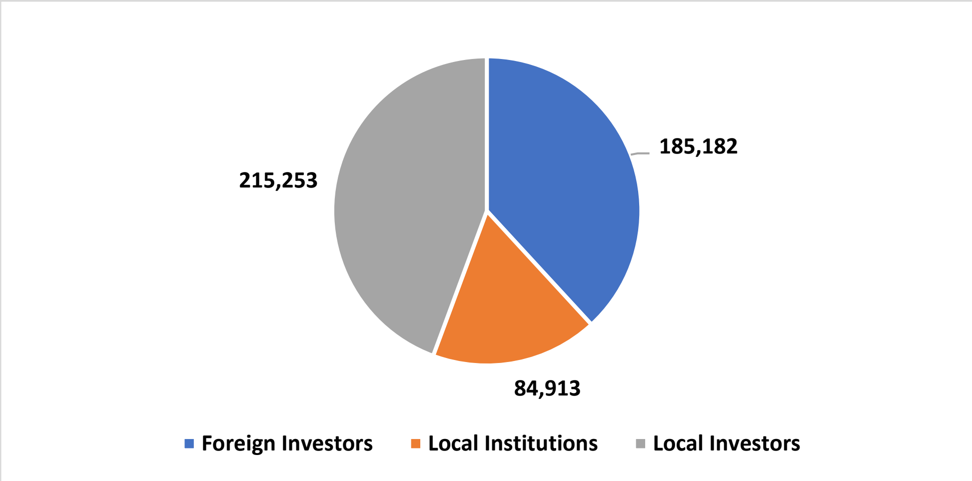
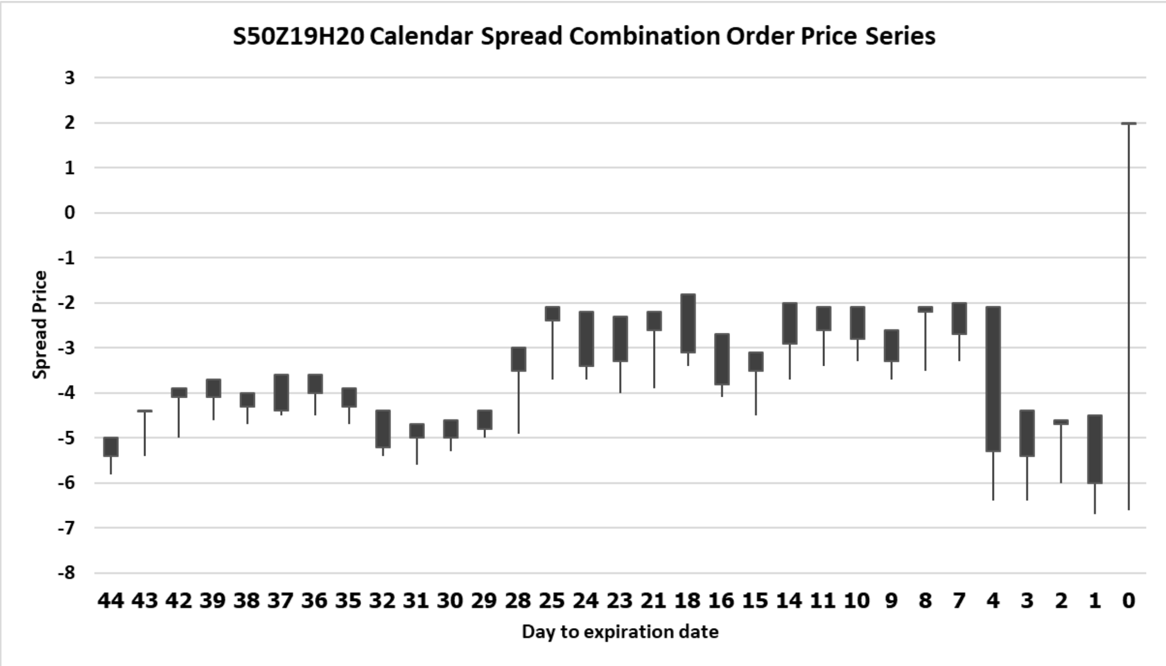
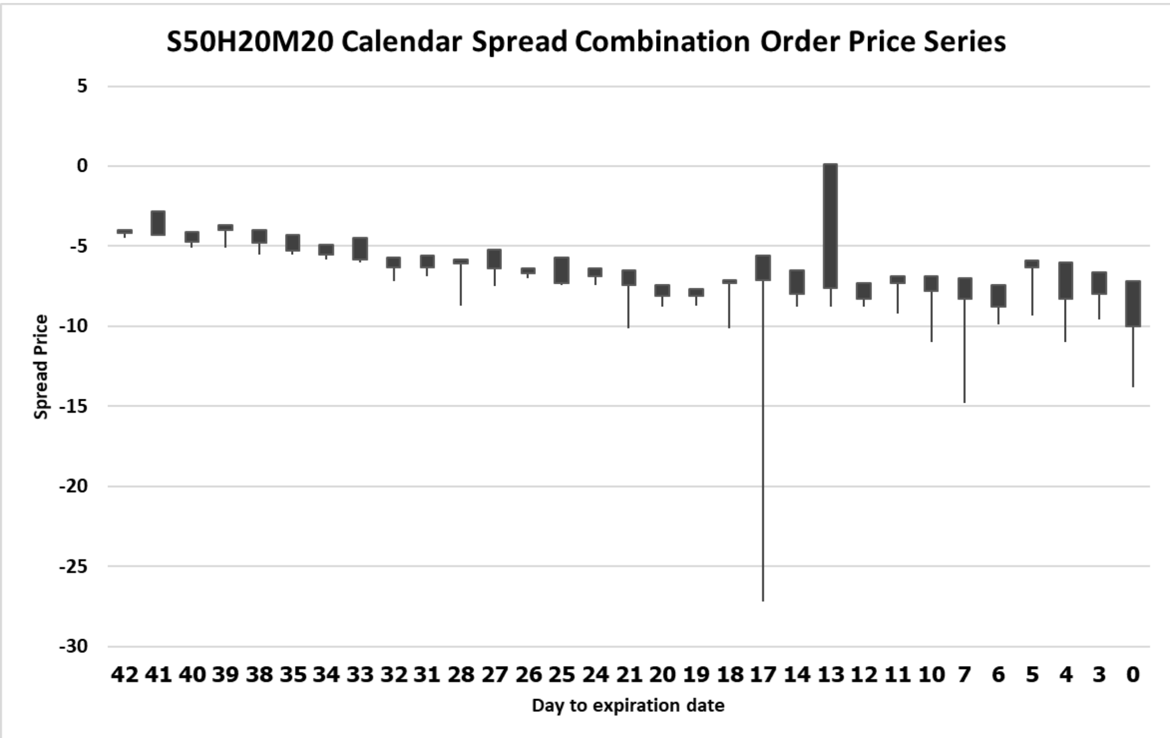


Figure 3 presents the average daily number of SET50 futures contracts traded—both long and short—by each investor type, as classified by the Thailand Futures Exchange. The data spans from 2019 to 2024, and the values reflect the number of contracts involved on both sides of the outright transaction (i.e., long and short positions), averaged on a daily basis.

Additionally, the concept of roll yield, which influences the cost of investors' rollover strategies, is central to this research. Roll yield refers to the difference between the price of a shorter-dated futures contract and that of a deferred futures contract. When mispricing in futures contracts becomes pronounced, the roll yield may deviate significantly from what is predicted by the cost-of-carry model. Such deviations can introduce excess volatility and risk into the market. For example, mutual funds or institutional investors that utilize derivatives to replicate the performance of an underlying asset may experience substantial tracking errors if roll yield fluctuates unexpectedly. Therefore, understanding the mispricing behavior of calendar spreads is essential—not only for anticipating potential costs—but also for promoting greater awareness of the risks inherent in rollover strategies. One important aspect to investigate is the potential correlation between the time to expiration and the direction of mispricing. If a negative correlation exists between these variables, it could have significant implications for investors' decisions regarding rollover strategies. Specifically, if mispricing tends to favor the long rollover in certain conditions or the short rollover in others, it could provide investors with strategic advantages depending on the expiration timeline. Understanding this dynamic contributes to the broader literature on market efficiency and liquidity, particularly during contract rollovers when trading activity intensifies. If consistent patterns of mispricing emerge near expiration, they may reflect structural frictions or temporary inefficiencies in the market—such as shifts in order flow, limited arbitrage, or constraints on liquidity provision—rather than rational pricing behavior. Identifying these anomalies may offer insights into how rollover mechanisms interact with market microstructure during periods of concentrated trading activity.

Figure 4 : Calendar Spread Movement of Combination of order price series





S50Z19H20 refers to the calendar spread between the near-month SET50 Index Futures contract expiring in December 2019 (S50Z19) and the deferred contract expiring in the following quarterly month, March 2020 (S50H20). The calendar spread presented reflects the actual trading price of the combination order in Thailand Futures Exchange.

As illustrated in Figure 4, volatility appears to increase during the rollover period. There tends to be an extreme value between the high and low prices of the calendar spread price series. To explain such a phenomenon, I would resort to the concept of convenient yield for investors rolling over their positions. For the S50Z19H20 series, at the expiration date, the price closes at a high of 2 points and a low of -6 points, resulting in a total range of 8 points, which exceeds all other days shown in the chart by far.

$$C_t^a = C_t^n - C_t^d \quad (1)$$

Where C_t^a is actual calendar spread

C_t^n is near contract of SET50 index futures price

C_t^d is deferred contract of SET50 index futures price

Figure 5 : Volatility of calendar spread combination order price series during rolling period

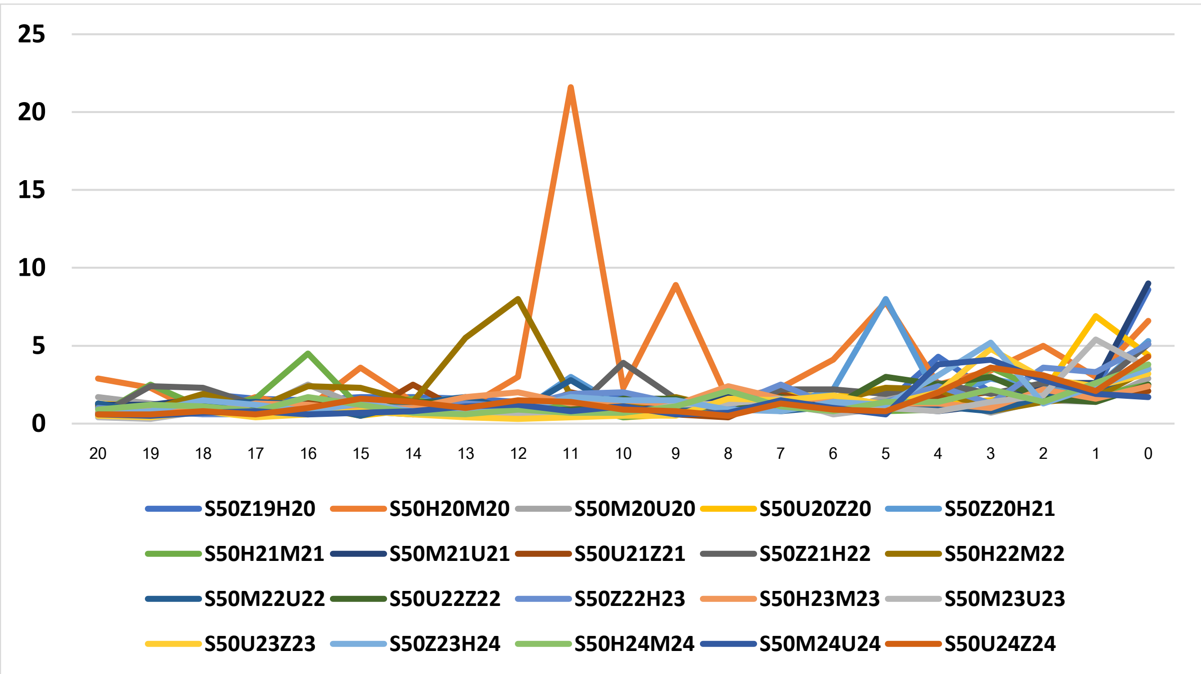
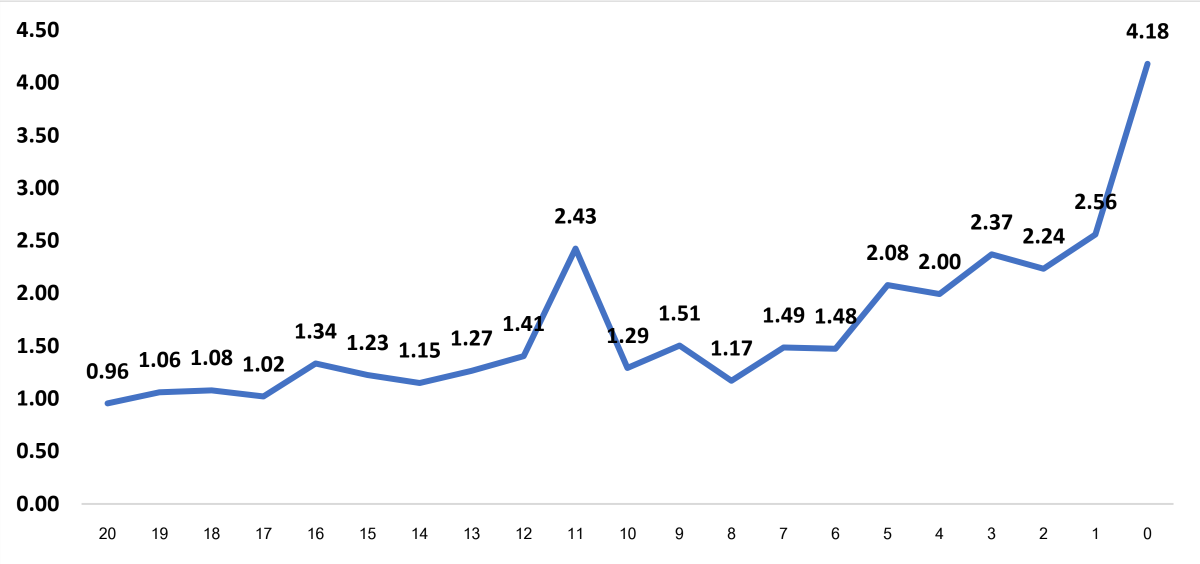


Figure 6 : Average intraday volatility (High – Low) of calendar spread combination order price series during rolling period



Despite the findings of MacKinlay and Ramaswamy (1998), which suggest that mispricing decreases as time to maturity draws closer, the actual market behavior contradicts this theory. As shown in Figure 5 & 6 above, volatility—defined here as the difference between the high and low prices—increases as time to expiration decreases. This excess volatility suggests that the mispricing phenomenon could be linked to position rollover.

Literature Review

It is often assumed that markets are efficient, meaning that systematic mispricing should not exist, as arbitrageurs are constantly seeking opportunities to profit from such inefficiencies. However, in reality, this assumption does not always hold. Arbitrageurs rely on models to determine the fair value of assets. In the context of futures contracts—the focus of this study—the most widely recognized model is the cost of carry model, which every finance student has either studied or at least heard of. The model is theoretically robust, as it is based on the arbitrage-free assumption to derive fair value.

The cost of carry model in this paper follow as derived by Cornell and French (1983):

$$F(0,T_1) = S(0)e^{(r(0,T_1)-d(0,T_1))T_1} \tag{2}$$

Where $F(0,T_t)$ is the current price of the futures contract expiring in T_1 $years$. S(0) is the current price of underlying stock index. $r(0,T_1)$ is risk-free rate over the period $(0,T_1)$. $d(0,T_1)$ is the annualized dividend yield of index over the period $(0,T_1)$. T1 is the time to maturity of contract divide by number of day in a year.

$$F(0,T_2) = S(0)e^{(r(0,T_2)-d(0,T_2))T_2} \tag{3}$$

Where equation (3) are all the same as in equation (1) but with different time period. T1 is near contract time to maturity and T2 is deferred contract time to maturity hence T1<T2.

With future price theoretical price being established, With the theoretical future price established, following Billingsley and Change (1988) and Frino and McKenzie (2002), the theoretical calendar spread of index futures is the difference between the near and deferred contracts under the cost-of-carry model. It can be calculated by subtracting (2) and (3) with some arrangement.

$$F(0,T_1) - F(0,T_2) = S(0)[e^{(r(0,T_1)-d(0,T_1))T_1} - e^{(r(0,T_2)-d(0,T_2))T_2}] \quad (4)$$

In reality, however, market conditions rarely align perfectly with theoretical assumptions. Certain assumptions, such as a perfect capital market with equal borrowing and lending rates and the absence of transaction costs, do not hold in practice. Mackinlay & Ramaswamy (1988) examined mispricing in futures markets while incorporating transaction costs as a band around the theoretical price. Their study found that despite transaction costs, futures prices could persistently deviate beyond the band, indicating mispricing. They attributed this to the time to maturity of contracts, arguing that:

I. Longer time to maturity increases the uncertainty of dividend payments for index components, raising the cost of incorrect dividend predictions for arbitrageurs.

II. Daily marking-to-market of futures positions exposes arbitrageurs to heightened cash flow risks.

III. Unanticipated interest rate changes become more significant as time to maturity increases.

Their findings suggest that mispricing diminishes as time to maturity decreases due to the reduction of these associated risks.

However, based on my observations of actual financial markets as seen in Figure 5, this does not always seem to be the case. Silvka et al (2017). studied the volatility of calendar spreads of index futures during the roll period, defined as approximately 15 days before expiration when investors roll over their expiring contracts into deferred contracts. Their research found that markets exhibit excess volatility as they approach expiration, and they tested various rolling strategies to optimize rollover costs. This finding contrasts with the idea that mispricing decreases over time.

Throughout the study period, the risk-free rate has consistently been lower than the annualized dividend yield of the SET50 Index as shown in Figure 11. This varies across different markets around the world. However, under these circumstances, the theoretical spread will always be positive, as both will have a negative basis. The near contract converges to the spot price faster as time to maturity decreases, causing the difference between them to become negative.

See Figure 7 below for an example. In situations where the risk-free rate is lower, the calendar spread will be positive and will gradually increase as the maturity of the near contract approaches zero. Conversely, when the risk-free rate is higher, the calendar spread will be negative and will decrease over time (see Figure 8).

Figure 7 : Theoretical price and calendar spread for r<d where r = 2% and d = 4%

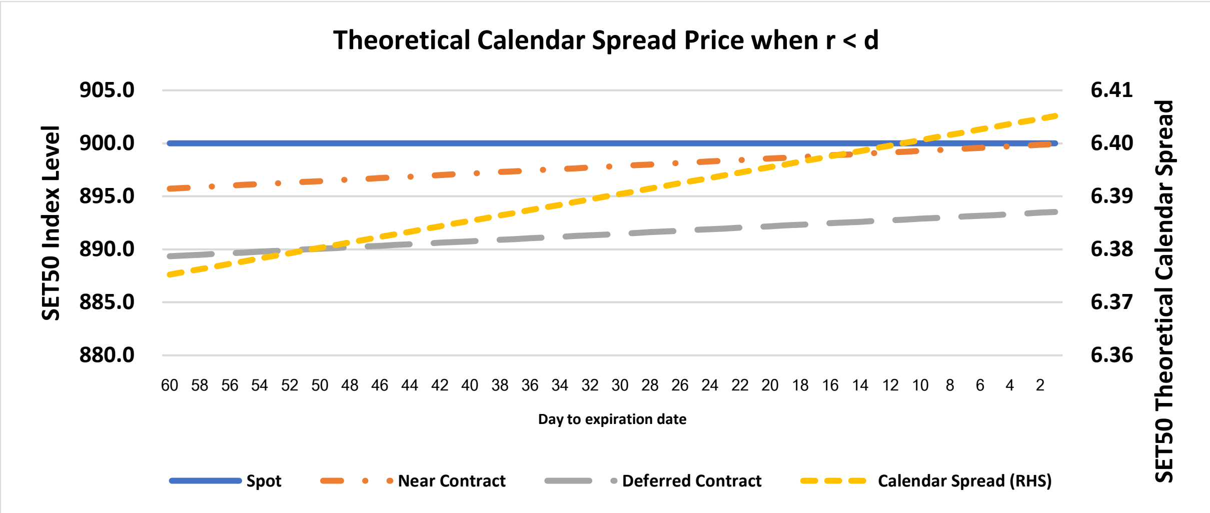


Figure 8 : Theoretical price and calendar spread for r>d where r = 4% and d = 2%

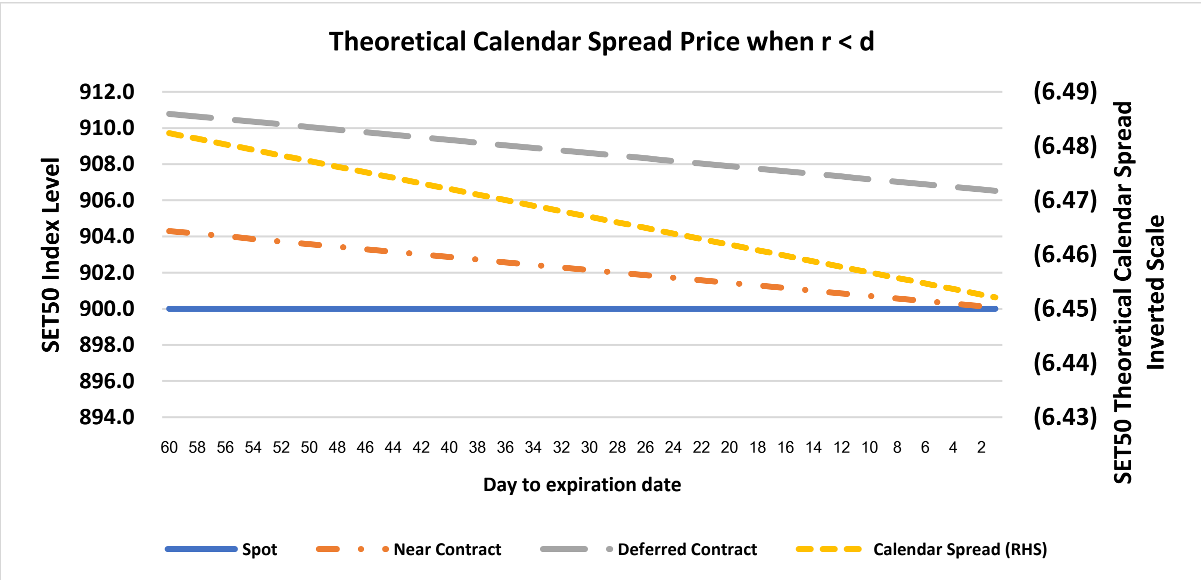
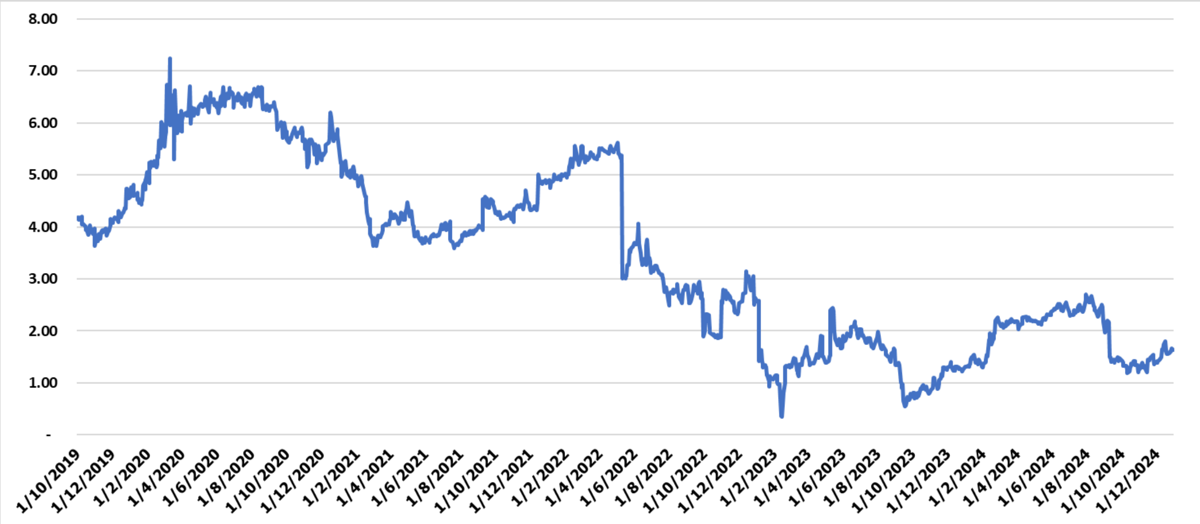


Figure 9 : Theoretical Price of Calendar Spread of SET50 Index futures from 2019 - 2024



As illustrated in Figure 11, the risk-free interest rate has consistently remained lower than the dividend yield throughout the study period. According to the cost-of-carry model, this condition implies that the theoretical futures price should be lower than the spot (underlying) index. However, because deferred futures contracts have a longer time to expiration, the cumulative cost of carry is greater than that of the near-month contracts. This results in the near-month futures price being relatively higher than the deferred-month futures price. Consequently, as shown in Figure 9, the theoretical 3-month calendar spread remains positive throughout the entire study period.

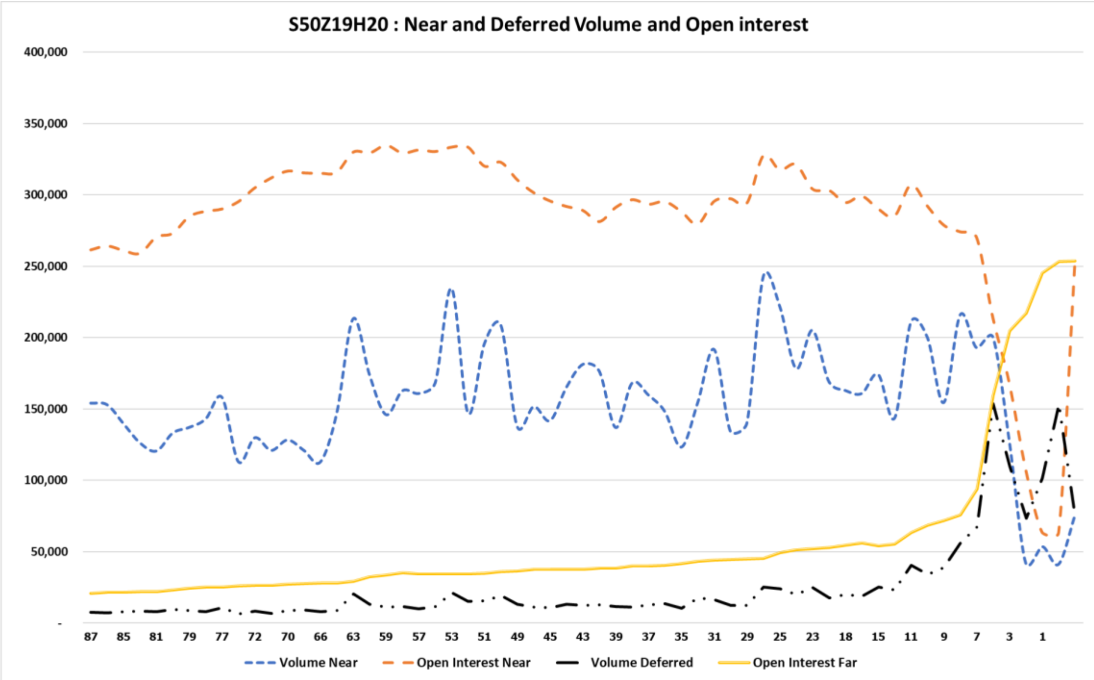
Furthermore, Carchano (2009) suggested that mispricing does not necessarily correlate with time to maturity, recommending that rolling over positions on the last trading day is the simplest strategy. However, studies such as Silvka et al. contradict this by showing excess volatility near expiration. Frixx (2009) found that rollover costs increase as contracts approach maturity, while Brailsford & Hodgson (2007) linked spread mispricing to both price volatility and contract maturity.

Clearly, there are competing arguments in the literature. Each study has its own merits, as variations in market structure, datasets, and methodologies can lead to differing conclusions. This diversity of findings makes the study of mispricing in calendar spreads within the context of the Thailand Futures Exchange even more intriguing.

One of the causes of excess volatility in the market during the rollover period could be the way volume and open interest decrease as contracts approach maturity. The concept of convenient yield for closing out positions before expiration may help explain why prices move sharply.

Figure 10 below shows that while the volume and open interest of the near contract decrease, the deferred contract attracts more attention, leading to an increase in its activity in place of the expiring contract. In general, lower liquidity translates to a wider bid-ask spread, which adds to transaction costs.

Figure 10 : S50Z19H20 Near and Deferred Volume and Open Interest



Data

The Mini SET50 Index Futures is an equity index future based on the SET50 index, which represents the top 50 companies listed on the Stock Exchange of Thailand (SET). The futures contract is called "Mini SET50" because, prior to February 2014, the SET50 Index futures had a multiplier of 1,000 points. However, the contract size was reduced to a multiplier of 200 points after the SET50 index experienced a significant increase in value between 2008 and 2013—from 261.3 points to a peak of 1,092 points. This surge in the index value made the original contract size much larger in notional value, requiring a higher initial margin. As a result, the contract size was reduced, and the old version was discontinued. Therefore, in this study, the term "SET50 Index Futures" will refer to the current Mini SET50 Index Futures.

General characteristics of SET50 Index Futures are as follows:

- Multiplier: 200
- Price limits: 30% above or below the previous closing price
- Settlement: Cash-settled

- Contract maturity: The longest maturity for a contract is one year, with monthly contracts available, covering a full 12-month period. As each nearest contract expires, a new contract for the same month of the next year is introduced.
- Minimum price tick: 0.10 points, which represents a movement of 20 Baht per tick.

This study uses end-of-day data for SET50 Index Futures contracts traded on the Thailand Futures Exchange (TFEX) from 2019 to 2024. The primary focus is on the quarterly contract months: March (H), June (M), September (U), and December (Z), due to the higher liquidity observed during these months compared to non-quarterly months. Non-quarterly months tend to have lower trading volumes, which increases bid-ask spreads and reduces investor interest. This is in line with other research that has focused on quarterly contract months.

Table I

List of SET50 Futures Index Series under studying period

Ticker	Last close	Expiration date	Ticker	Last close	Expiration date
S50Z19	1063.7	27/12/2019	S50U22	958.1	29/9/2022
S50H20	731.4	30/3/2020	S50Z22	1007.9	29/12/2022
S50M20	875.4	29/6/2020	S50H23	968.4	30/3/2023
S50U20	794.8	29/9/2020	S50M23	968.4	29/6/2023
S50Z20	922.6	29/12/2020	S50U23	911.9	28/9/2023
S50H21	973.6	30/3/2021	S50Z23	872.8	27/12/2023
S50M21	955.2	29/6/2021	S50H24	837.6	28/3/2024
S50U21	970.3	29/9/2021	S50M24	813.4	27/6/2024
S50Z21	987.3	29/12/2021	S50U24	912.8	27/9/2024
S50H22	1022.9	30/3/2022	S50Z24	905.4	27/12/2024
S50M22	962.5	29/6/2022			

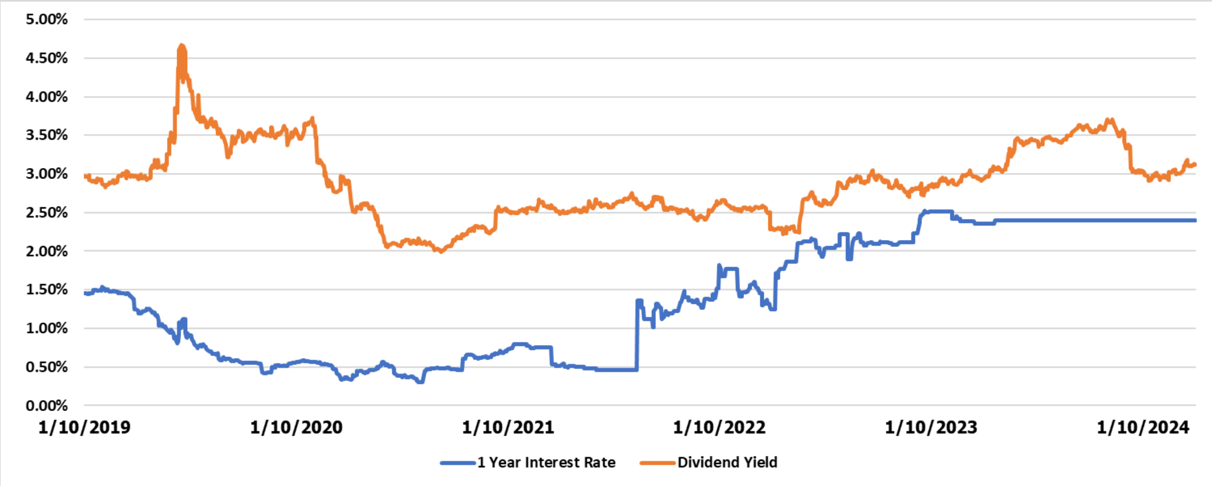
Table I presents the expiration dates of SET50 Index Futures contracts, with the date format shown as day/month/year (dd/mm/yyyy). The "Last Close Price" column reflects the final traded price on the expiration date of each respective futures contract.

Basic trading information, such as open, close, high, low, daily trading volume (in contracts), and open interest, is retrieved from the Refinitiv database. The 1-year risk-free rate, used as a key input in the cost of carry model, is also sourced from Refinitiv. This is consistent with the fact that TFEX uses a 1-year risk-free rate for theoretical price calculation, which also aligns with the maximum time to expiration for the most deferred contracts. Unfortunately, a limitation of the data is that there is no available time series for risk-free rates shorter than 1 year.

Index dividend rates, which are important for calculating the carry costs, are also sourced from Refinitiv. Furthermore, trading volume by investors, categorized by institutional and foreign investors, is retrieved from the SETSMART database. This database is unique in that it stores detailed records of investor trading activity for up to 5 years, which is not available from other data providers. The SET Smart database thus provides exclusive insights into investor behavior that are critical for understanding market dynamics and calendar spread mispricing.

During the study period, the dividend yield in Thailand has always been higher than the interest rate (see Figure 11). This implies that the theoretical price will always be positive under these market conditions. Therefore, if the actual calendar spread is negative, it would certainly indicate mispricing in the market.

Figure 11 : 1 year annualized interest rate and annualized dividend yield of SET50 index



Methodology

The first proposition I would like to address is whether SET50 mispricing correlates with time to maturity. As mentioned, there are many studies where the results contradict each other. To investigate and answer this question in the context of the Thai market, I will use the model proposed by Frino (2002):

$$\Delta|M_t^s| = \alpha_0 + \sum_{i=1}^{n} \alpha_i D_i + \varepsilon_t \; i = 1 \dots 7 \quad (5)$$

Where D is dummy variable for number of trading days available prior to expiration date of near contract. $i = 1$ represents dummy variable for 0 to 5 days prior to expiration which I will call for short as “DTE”. $i = 2$ would mean 6 to 10 DTE and so on until $i = 7$ which is 31 to 35 DTE. Using the first difference of the change in mispricing, denoted as $\Delta|M_t^s|$, helps limit the autocorrelation problem and possible non-stationarity. The model employs the Newey and West (1987) procedure to adjust for autocorrelation and heteroskedasticity in all t-statistics.

Null Hypothesis (H_0):

There is no significant relationship between the changes in mispricing of calendar spread ($\Delta|M_t^s|$) and the control variable (D_i), examining the potential correlation with time to maturity of near contract index futures.

$$H_0 : \alpha_1 = \alpha_2 = \cdots = \alpha_n = 0$$

Alternative Hypothesis (H_1):

At least one of the control variables (D_i) significantly influences the changes in SET50 mispricing, implying a relationship between mispricing and time to maturity.

$$H_1 : at\ least\ one\ of\ the\ coefficient\ \alpha_i \neq 0\ for\ i = 1,2,\dots,7$$

The difference between actual index futures and theoretical futures price shows degree of mispricing. (M^j) can be calculated as follows:

$$M^j = P_a^j - P_{th}^j \quad (6)$$

Where P_a^j stands for the actual futures price of series j while P_{th}^j stands for theoretical futures price of series j. While j can be both near contract or deferred contract denoted j = n (near contract) or j=d (deferred contract). Therefore M^s represents the difference between the actual futures spread and theoretical futures spread. It is equivalent to the following equation:

$$M_t^s = M^n - M^d \quad (7)$$

M^n represents near futures contract while M^d represents deferred futures contract.

Many prior studies, such as Brailsford & Hodgson (1997) and Frino and McKenzie (2002), suggest that calendar spread prices are related to volatility and trading volume. As illustrated in Figure 10, both volume and open interest decrease as the contract nears expiration. This decline often results in mispricing when many market participants attempt to roll over their positions to the deferred contract. Consequently, excess volatility is likely to occur during the rollover period, imposing additional costs on market participants who wish to extend their positions.

To test this proposition, Bessembinder and Seguin (1992) and Frino and McKenzie (2002) use open interest, volume, and volatility as control variables in their models. See following model below :

$$\Delta|M_t^s| = \alpha_0' + \beta_1 \Delta \ln(Interest_t^n) + \beta_2 \Delta \ln\left(Interest_t^d\right) + \beta_3 Volatility_t^a + \beta_4 \ln(\Delta Volume_t^n) + \beta_5 \Delta ln\left(Volume_t^d\right) + \sum_{i=1}^{n} \alpha_i' D_i + \varepsilon_t \quad (8)$$

To account for potential autocorrelation and heteroskedasticity in the error terms, I estimate the model in Equation (8) using Newey-West adjusted standard errors. The Newey-West procedure provides robust standard errors that are consistent in the presence of both autocorrelation and heteroskedasticity, which is critical for obtaining reliable statistical inference. This adjustment allows for the calculation of t-statistics that are robust to these common issues in financial data, ensuring more accurate hypothesis testing.

Null Hypothesis H_0 : There is no significant relationship between the changes in mispricing of calendar spread and open interest and volume of near and deferred contract.

$$H_0\colon\ \beta_i = 0\ for\ i = 1,2,4,5$$

Alternative Hypothesis H_1: There is significant relationship between the changes in mispricing of calendar spread and open interest and volume of near and deferred contract.

$$H_1\colon\ \beta_i \neq 0\ for\ i = 1,2,4,5$$

Most of the variables in the equation (8) are first-differenced to mitigate potential issues with autocorrelation. All t-statistics are adjusted for both autocorrelation and heteroskedasticity, following the approach outlined by Newey and West (1987).

Volatility measurement should not rely solely on close-to-close volatility, as it may not fully capture intraday price swings. Alternative measures, such as the German-Klass or Parkinson volatility, are more suitable because they account for the high and low prices within the trading day, offering a better reflection of volatility in calendar spreads. Therefore, in this model, volatility will be measured following the methodology used by Frino and McKenzie (2002).

$$Volatility_t^a = Log(H_t^a\ ) - Log(L_t^a) \tag{9}$$

Volatility is measured on SET50 Index underlying as a control.

Open interest is denoted as $Interest_t^k$ where k = n (near contract) and k = d (deferred contract).

$$\Delta\ln\ (Interest_t^k) = \ln\ (Interest_t^k)/\ln\ (Interest_{t-1}^k) \tag{10}$$

Volume is the amount of contract being traded on given period which in this study is end-of-day daily data. l= n (near contract) and d (deferred contract)

$$\Delta\ln\big(Volume_t^l\big) = \ln\ (Volume_t^l) - \ln\ (Volume_t^l) \tag{11}$$

Net long or net sell by investor types include three type of investors denoted as $Net\ Type_t^x$. Where x = f (foreign investors), int (local institutions) and l (local retails).

$$Net\ Type_t^x = Total\ Long\ Transaction^x - Total\ Short\ Transaction^x \tag{12}$$

From equation (8), I believe that the influence of investor type could also contribute to mispricing. If the market, in aggregate, has a bias toward one direction and the crowd is large enough, it should influence the market in a way that relates to the mispricing of calendar spreads. Regarding the endogeneity problem that could arise when using the total volume variable alongside volume by trader type, dropping the redundant variable should help mitigate the issue. Therefore, the model could be modified to incorporate this factor, as shown below:

$$\Delta|M_t^s| = \alpha_0' + \beta_1 \Delta \ln(Interest_t^n) + \beta_2 \Delta \ln(Interest_t^d) + \beta_3 Volatility_t^a + \beta_4 \frac{Net\ Type_t^f}{10{,}000} + \beta_5 \frac{Net\ Type_t^{int}}{10{,}000} + \beta_6 \frac{Net\ Type_t^l}{10{,}000} + \sum_{i=1}^{n} \alpha_i' D_i + \varepsilon_t \quad (13)$$

Null Hypothesis H_0 : There is no significant relationship between the changes in mispricing of calendar spread and net long or short by investor type.

$$H_0\!: \ \beta_i = 0 \ for \ i = 4, 5, 6$$

Alternative Hypothesis H_1: There is significant relationship between the changes in mispricing of calendar spread and net long or short by investor type.

$$H_1\!: \ \beta_i \neq 0 \ for \ i = 4, 5, 6$$

To further explore this, I propose testing the model in equation (8) with lags ranging from 1 to 3 to examine whether there are any correlations at different lags. Additionally, if significant results are observed when running the model with lags, it could provide valuable insights for market participants, suggesting that mispricing could potentially be anticipated, allowing for an estimate of rollover costs. Therefore, the following equation (14) will be tested at each lag, as shown below:

$$\Delta|M_t^s| = \alpha_0' + \beta_1 \Delta \ln(Interest_{t-l}^n) + \beta_2 \Delta \ln(Interest_{t-l}^d) + \beta_3 Volatility_{t-l}^a + \beta_4 \Delta \ln(Volume_{t-l}^n) + \beta_5 \Delta \ln(Volume_{t-l}^d) + \sum_{i=1}^{n} \alpha_i' D_i + \varepsilon_t \quad (14)$$

Where l which stands for number of lag = 1, 2, 3

Null Hypothesis (H_0):

There is no significant relationship between the lagged explanatory variables (interest rates, volatility, volume, and investor types) and the mispricing of near and deferred contracts at any lag (l = 1, 2, 3).

$$H_0 : \ \beta_i = 0 \ for \ i = 1,2,4,5 \ at \ any \ lag \ where \ l = 1,2,3$$

Alternative Hypothesis (H_1):

At least one of the lagged explanatory variables significantly affects the mispricing of near and deferred contracts at any lag (l = 1, 2, 3).

$$H_1 : \beta_i \neq 0 \ for \ i = 1,2,4,5 \ at \ any \ lag \ where \ l = 1,2,3$$

Many studies usually focus on the 3-month calendar spread. However, in actual financial markets, there are strategies that roll over to a further deferred month, such as a 6-month deferral or even up to 10 years for some commodity futures. Therefore, I would like to propose another model to investigate the relationship in more deferred-month calendar spreads. The model is proposed shown in equation (16) below:

Mispricing of 6 month deferred calendar spread is the difference between mispricing of near contract and 6 month deferred contract.

$$M^{sd} = M^{n} - M^{d6} \tag{15}$$

Where M^{sd} is difference of mispricing of near contract and mispricing of 6- month deferred contract.

M^{n} is mispricing of near contract

M^{d6} is mispricing of 6-month deferred futures contract

$$\Delta\left|M_t^{sd}\right| = \alpha_0' + \beta_1 \Delta Interest_{t-l}^{n} + \beta_2 \Delta Interest_{t-l}^{d} + \beta_3 Volatility_{t-l}^{a} + \beta_4 \Delta Volume_{t-l}^{n} + \beta_5 \Delta Volume_{t-l}^{d} + \sum_{i=1}^{n} \alpha_i' D_i + \varepsilon_t \tag{16}$$

Where l which stands for number of lag = 0, 1, 2, 3

Null Hypothesis H_0 : There is no significant relationship between the changes in mispricing of 6-month calendar spread and open interest and volume of near and deferred contract.

$$H_0:\ \beta_i = 0\ for\ i = 1,2,4,5$$

Alternative Hypothesis H_1: There is significant relationship between the changes in mispricing of 6-month calendar spread and open interest and volume of near and deferred contract.

$$H_1:\ \beta_i \neq 0\ for\ i = 1,2,4,5$$

As I discussed earlier, mispricing resulting from rollover could be related to the convenience yield during the rollover period. When a large influx of orders seeks to rollover long positions, executing such trades typically requires closing short positions and opening long positions. This would likely cause the deferred contract to move in the opposite direction of the near-term contract. Frino and McKenzie (2002) also theorized this phenomenon. Within this theoretical framework, there are two testable propositions: first, to examine whether the mispricing of near and deferred contracts is negatively correlated, and second, to explore whether this phenomenon is related to the time to maturity. The following model can be used to test these propositions:

$$\Delta M_t^{n} = \delta_0 + \delta_1 \Delta M_t^{d} + \sum_{i=1}^{7} \delta_i' \Delta M_t^{d} D_i + \varepsilon_t \tag{17}$$

Where M_t^{n} is the mispricing of near contract and M_t^{d} is the mispricing of deferred contract.

Estimation model in equation (17) also adjust with Newey-West standard errors similar to the other model so far. This to again mitigate potential autocorrelation and heteroskedasticity.

According to Frino (2002), the results indicate a positive mispricing for near and deferred contracts, which contradicts the hypothesis he proposed. Therefore, the expected coefficient for delta 1 would be negative. Meanwhile, the result of the second proposition aligns with Frino (2002) hypothesis, showing a significant negative relationship between time to maturity and the mispricing of near and deferred contracts.

Null Hypothesis (H_0):

Proposition 1 : There is no significant relationship between mispricing of near contract (M_t^n) and the mispricing of deferred contract (M_t^d).

Proposition 2 : There is no significant relationship between time to maturity and mispricing of near and deferred contract

$Proposition\ 1\ :\ H_0\ :\ \delta_1 = 0$

$Proposition\ 2 : H_0\ :\ \delta_1 = \delta_2 = \ldots = \delta_7 = 0$

Alternative Hypothesis (H_1):

Proposition 1 : δ_1 is significantly different from zero, indicating that there is significant relationship between mispricing of near and deferred contract.

Proposition 2 : At least one of the coefficient δ_i is significantly different from zero, indicating that there is significant relationship between mispricing of near contract and time to maturity.

$Proposition\ 1 : H_1\ :\ \delta_1\ \neq 1$

Proposition 2 : $H_1 : \delta_i \neq 0\ for\ i\ 1,2, \ldots ,7$

Table II

Descriptive statistics

	C_t^a	C_t^{theo}	$S50_t^n$	$S50_t^d$	$Volatility_t^a$	Rf_t^{1y}
Mean	3.267	3.557	930.087	926.530	0.01240	0.0138
Median	3.400	3.760	945.551	942.215	0.01060	0.0134
St. dev.	2.366	1.723	75.706	75.727	0.00865	0.0079
Minimum	10.090	0.343	679.619	673.782	0.00341	0.0030
Maximum	-5.090	7.242	1104.108	1100.279	0.21199	0.0252
N	1211	1211	1211	1211	1378	1273

	$Volume_t^n$	$Volume_t^d$	OI_t^n	OI_t^d	div_t
Mean	182,205.64	35,652.40	396,216.38	73,735.80	0.0288
Median	174,634.00	20,157.00	365,370.00	53,589.00	0.0287
St. dev.	59,193.51	48,269.86	131,339.28	80,663.11	0.0048
Minimum	32,734.00	4,770.00	27,923.00	12,532.00	0.0199
Maximum	630,128.00	326,647.00	678,455.00	587,627.00	0.0467
N	1211	1211	1211	1211	1273

	M_t^n	M_t^d	M_t^s	$\|M_t^s\|$	$\|M_t^d\|$	$\|M_t^s\|$
Mean	-1.141	-0.851	-0.290	2.291	2.457	1.682
Median	-1.041	-0.798	0.061	1.919	2.093	1.231
St. dev.	2.646	2.988	2.157	1.746	1.901	1.381
Minimum	-11.506	-9.782	-9.819	0.006	0.003	0.001
Maximum	7.598	8.238	6.757	11.506	9.782	9.819
N	1211	1211	1211	1211	1211	1211

	ΔM_t^s	M_t^{sd}	$\Delta\|M_t^{sd}\|$	$\Delta\ln(Volume_t^n)$	$\Delta\ln(Volume_t^d)$	$\Delta\ln(OI_t^n)$
Mean	0.419	2.674	0.001	-0.001	0.003	-0.001
Median	0.222	2.349	-0.022	-0.015	0.014	-0.003
St. dev.	0.799	1.860	1.138	0.340	0.478	0.289
Minimum	0.000	0.004	-12.984	-1.877	-3.293	-1.247
Maximum	11.185	14.063	12.383	1.994	1.346	2.487
N	1210	1211	1210	1210	1210	1210

	$\Delta\ln(OI_t^d)$	$\frac{Net\,Type_t^f}{10,000}$	$\frac{Net\,Type_t^{int}}{10,000}$	$\frac{Net\,Type_t^l}{10,000}$
Mean	0.003	-0.014	-0.014	-0.001
Median	0.021	0.009	0.001	-0.040
St. dev.	0.336	1.672	0.559	1.499
Minimum	-3.289	-9.493	-4.424	-7.034
Maximum	0.669	7.665	4.915	7.609
N	1210	1210	1210	1210

C_t^a is actual calendar spread

C_t^{theo} is theoretical calendar spread

$S50_t^j$ is SET50 index futures for j = n (near contract) and d (deferred contract).

Rf_t^{1y} is annualized 1 year risk-free rate

div_t is annualized index dividend yield

Results

This section presents the empirical findings of the study, based on the regression models outlined in the methodology. The results are organized by hypothesis and corresponding equations, beginning with the relationship between mispricing and time to maturity. Each table reports the estimated coefficients, standard errors, and statistical significance levels. Where applicable, the Newey-West adjustment is employed to account for autocorrelation and heteroskedasticity. The following discussion interprets the results in the context of existing literature, focusing on how the observed mispricing behavior relates to rollover activity, market structure, and trading dynamics in the SET50 Index Futures market.

Table III

Relationship between Mispricing of Calendar Spreads and Time to Expiration of Near Futures Contract

Variable	Model I : Equation (5) Newey-West S.E. $\Delta\lvert M_t^s\rvert$	Model II : Equation (17) ΔM_t^n	Model III : Equation (17) Newey-West S.E. ΔM_t^n
$adj. R^2$	0.255	0.861	0.861
$F - statistics$	60.09*	938.5*	938.5*
N	1,210	1,210	1,210
α	1.6072 (0.718)	-0.002 (0.026)	-0.002 (0.616)
ΔM_t^d	-	0.931* (0.012)	0.931 (2.186)
D_1	1.6072* (0.185)	-0.108* (0.042)	-0.108 (0.555)
D_2	0.529* (0.186)	-0.083* (0.030)	-0.083 (0.833)
D_3	0.130 (0.179)	-0.084 (0.045)	-0.838 (0.525)
D_4	0.139 (0.155)	-0.584 (0.052)	-0.058 (0.448)
D_5	0.030 (0.182)	-0.083 (0.050)	-0.083 (0.482)
D_6	0.112 (0.161)	-0.026 (0.054)	-0.026 (0.435)
D_7	-0.001 (0.167)	-0.019 (0.043)	-0.019 (0.558)

Note : This is the regression result of equation (5) $\Delta\lvert M_t^s\rvert = \alpha_0 + \sum_{i=1}^{n} \alpha_i D_i + \varepsilon_t$ ***where i = 1..7 and equation (17)*** $\Delta M_t^n = \delta_0 + \delta_1 \Delta M_t^d + \sum_{i=1}^{7} \delta_i' \Delta M_t^d D_i + \varepsilon_t$

Di* represents the time-to-expiration dummy variables. $\Delta|M_t^s|$ denotes the absolute change in mispricing of the 3-month calendar spread, while ΔM_t^n denotes the change in mispricing of the 6-month calendar spread. The coefficients are reported in absolute values, with standard errors shown in parentheses. *indicates statistical significance at 5% level.

Table III, Model I provides evidence that the time-to-maturity of the futures contract is correlated with changes in mispricing. The coefficients for D_1 and D_2 are both positive and statistically significant. Specifically, D_1 indicates that, on average, as the contract approaches five days to expiration time window, mispricing increases by approximately 1.6072 points. Although D_1 and D_2 is also significant, its coefficient is smaller than that of D_1, suggesting that mispricing intensifies as expiration approaches, likely due to investors rolling over their futures positions to the next deferred month. The remaining dummy variables ($D_3 \ldots D_7$), representing time-to-expiration periods from 11 to 35 days, are not statistically significant. The F-statistic for the model is also significant at the 5% level, indicating that the overall model has explanatory power.

Models II and III both estimate equation (17), with the key difference being the method used to calculate standard errors: Model III employs the Newey-West adjustment to account for heteroskedasticity and autocorrelation. Both models report significant F-statistics and a high adjusted R-squared of 0.861, indicating strong model fit. However, the use of Newey-West standard errors in Model III results in no variables being statistically significant, in contrast to Model II, which assumes homoscedasticity and identifies ΔM_t^d, D_1 and D_2 as significant predictors.

Interestingly, the coefficient for ΔM_t^d is positive, contrary to the initial hypothesis that rollover activity would reduce mispricing in the deferred contract from increasing liquidity. Meanwhile, the near contract would see higher mispricing due to declining open interest and volume. Despite this, the positive coefficient aligns with findings from Frino (2009). Furthermore, the negative coefficients on D_1 and D_2 imply positive relationship between mispricing of near and deferred contract diminishes as time-to-maturity decreases after 10 days is left, continuing until the contract expires.

Table IV

Open Interest, Volume and Volatility Relationship with Mispricing of Calendar Spread

Variable	Model I : Equation (8) Newey-West S.E. $\Delta\lvert M_t^s\rvert$	Model II : Equation (14) Newey-West S.E. $\Delta\lvert M_t^s\rvert$	Model III : Equation (14) Newey-West S.E. $\Delta\lvert M_t^s\rvert$	Model IV : Equation (14) Newey-West S.E. $\Delta\lvert M_t^s\rvert$
$adj. R^2$	0.372	0.376	0.381	0.383
$F - statistics$	60.78*	43.88*	34.81*	28.74*
N	1,210	1,209	1,208	1,207
Lag	0	1	2	3
α	0.180 (0.673)	0.167 (0.669)	0.164 (0.6716)	0.183 (0.674)
$\Delta\ln(Interest_t^n)$	0.180 (0.180)	0.0875 (0.464)	0.016 (0.321)	-0.288 (0.246)
$\Delta\ln(Interest_t^d)$	-0.861* (0.211)	0.1828 (0.133)	-0.343* (0.155)	0.010 (0.215)
$Volatility_t^a$	6.556* (0.010)	2.153* (0.008)	1.596* (0.007)	-4.215* (0.007)
$\Delta\ln(Volume_t^n)$	-0.020 (0.210)	0.231 (0.429)	-0.390 (0.387)	0.087 (0.311)
$\Delta\ln(Volume_t^d)$	0.146 (0.298)	-0.0828 (0.242)	0.203 (0.245)	-0.068 (0.290)
D_1	1.390* (0.170)	1.498* (0.519)	1.437* (0.514)	1.370* (0.509)
D_2	0.651* (0.170)	0.646* (0.209)	0.621* (0.211)	0.616* (0.211)
D_3	0.162 (0.164)	0.169* (0.074)	0.155* (0.073)	0.159* (0.076)
D_4	0.115 (0.140)	0.125 (0.067)	0.101 (0.065)	0.088 (0.064)
D_5	0.044 (0.140)	0.049 (0.071)	0.047 (0.072)	0.040 (0.072)
D_6	0.120 (0.147)	0.126 (0.082)	0.116 (0.084)	0.106 (0.083)
D_7	-0.002 (0.152)	0.006 (0.053)	0.000 (0.050)	-0.005 (0.050)

Note : This is the regression result of equation (8) $\Delta|M_t^s| = \alpha_0' + \beta_1\Delta\, ln(Interest_t^n) + \beta_2\Delta\, ln(Interest_t^d) + \beta_3 Volatility_t^a + \beta_4\, ln(\Delta Volume_t^n) + \beta_5\Delta ln(Volume_t^d) + \sum_{i=1}^{n}\alpha_i' D_i + \varepsilon_t$ ***and equation (14)*** $\Delta|M_t^s| = \alpha_0' + \beta_1\Delta\, ln(Interest_{t-l}^n) + \beta_2\Delta\, ln(Interest_{t-l}^d) + \beta_3 Volatility_{t-l}^a + \beta_4\Delta\, ln(Volume_{t-l}^n) + \beta_5\Delta\, ln(Volume_{t-l}^d) + \sum_{i=1}^{n}\alpha_i' D_{i-l} + \varepsilon_t$ ***where l is number of lag = 1, 2, 3***

The regression is estimated using concurrent and lagged variables. The results are summarized; the complete regression output is provided in Table VII in the Appendix.

Di ***represents the time-to-expiration dummy variables.*** $\Delta|M_t^s|$ ***denotes the absolute change in mispricing of the 3-month calendar spread. The coefficients are reported in absolute values, with standard errors shown in parentheses. *indicates statistical significance at 5% level.***

The regression results presented in Table IV indicate an improvement in the adjusted R-squared compared to Equation (5), which includes only time-to-maturity dummy variables. In Table IV, additional control variables are introduced, and each model represents the same regression specification with varying lags—up to three lags. The adjusted R-squared values range from 0.372 to 0.383.

Model I & III shows that the open interest of the deferred contract is statistically significant and negatively associated with mispricing. This suggests that as contracts are rolled over, the impact of the rollover effect diminishes. An increase in the open interest of deferred futures contracts implies rollover activity, which corresponds to a reduction in mispricing for the three-month calendar spread. However, this finding contrasts with Frino (2009), where the open interest in the deferred contract ($\Delta\ln\,(Interest_t^d)$) was found to be positively correlated with mispricing.

The trading volume of both the near and deferred contracts is not statistically significant, whereas volatility—as a control variable—is statistically significant across all models in Table IV.

The dummy variables D_1 and D_2 are statistically significant in Equation (8), consistent with the results in Table III. Furthermore, the coefficients indicate that the intensity of mispricing increases as the time to maturity shortens, with the effect of D_1 being greater than D_2. In lagged Models II, III, and IV, dummy variables D_1, D_2, and D_3 remain statistically significant and continue to exhibit the same intensifying effect.

Table V

Relationship Between Mispricing of Calendar Spread and Net Long-Short Volume by Investors Type

Variable	Model I : Equation (13) Newey-West S.E. $\Delta\|M_t^s\|$	Model II : Equation (13) Newey-West S.E. $\Delta\|M_t^s\|$	Model III : Equation (13) Newey-West S.E. $\Delta\|M_t^s\|$	Model IV : Equation (13) Newey-West S.E. $\Delta\|M_t^s\|$
$adj. R^2$	0.370	0.372	0.374	0.375
$F-statistics$	55.65*	38.69*	29.79*	24.37*
N	1,210	1,209	1,208	1,207
Lag	0	1	2	3
α	0.169 (0.674)	0.155 (0.669)	0.166 (0.672)	0.179 (0.675)
$\Delta\ln(Interest_t^n)$	0.179 (0.180)	0.276 (0.466)	-0.253 (0.318)	-0.237 (0.246)
$\Delta\ln(Interest_t^d)$	-0.714* (0.212)	0.110 (0.136)	-0.133 (0.147)	-0.064 (0.211)
$Volatility_t^a$	7.492* (0.010)	0.291* (0.008)	-0.756* (0.008)	-2.604* (0.007)
$\frac{Net\ Type_t^f}{10,000}$	-0.021 (1.055)	-0.034 (0.881)	-0.032 (0.921)	0.032 (0.982)
$\frac{Net\ Type_t^{int}}{10,000}$	0.013 (0.352)	-0.032 (0.290)	-0.055 (0.263)	0.078 (0.255)
$\frac{Net\ Type_t^l}{10,000}$	-0.010 (0.947)	-0.047 (0.743)	-0.042 (0.785)	0.035 (0.949)
D_1	1.376* (0.169)	1.490* (0.515)	1.412* (0.512)	1.351* (0.510)
D_2	0.663* (0.170)	0.657* (0.211)	0.658* (0.212)	0.645* (0.213)
D_3	0.163 (0.164)	0.169* (0.074)	0.171* (0.074)	0.176* (0.074)
D_4	0.115 (0.140)	0.112 (0.062)	0.089 (0.062)	0.085 (0.059)
D_5	0.040 (0.167)	0.051 (0.075)	0.050 (0.077)	0.042 (0.076)
D_6	0.117 (0.147)	0.126 (0.083)	0.122 (0.084)	0.107 (0.083)
D_7	-0.005 (0.152)	0.003 (0.050)	-0.003 (0.047)	-0.010 (0.049)

Note : This is the regression result of equation (13) $\Delta|M_t^s| = \alpha_0' + \beta_1 \Delta\, ln(Interest_t^n) + \beta_2 \Delta\, ln(Interest_t^d) + \beta_3 Volatility_t^a + \beta_4 \frac{Net\ Type_t^f}{10,000} + \beta_5 \frac{Net\ Type_t^{int}}{10,000} + \beta_6 \frac{Net\ Type_t^l}{10,000} + \sum_{i=1}^{n} \alpha_i' D_i + \varepsilon_t$

The regression is estimated using concurrent and lagged variables. The results are summarized; the complete regression output is provided in Table VIII in the Appendix.

Di ***represents the time-to-expiration dummy variables.*** $\Delta|M_t^s|$ ***denotes the absolute change in mispricing of the 3-month calendar spread. The coefficients are reported in absolute values, with standard errors shown in parentheses. *indicates statistical significance at 5% level.***

The results presented in Table V are consistent with those in Table IV, as the open interest of the deferred contract, dummy variables D_1, D_2, D_3, and volatility remain statistically significant. However, when lagged variables are included, the open interest of both the near and deferred contracts becomes statistically insignificant.

The models in Table V extend the analysis by replacing volume-related variables with the net long or short positions of different investor types, including local retail investors, local institutional investors, and foreign investors. The results provide clear evidence that net positions by investor type are not significantly correlated with mispricing.

This finding may appear counterintuitive, considering existing literature on liquidity effects, which suggests that dominant investor groups—such as foreign investors—can influence market prices and contribute to mispricing. Nevertheless, the insignificance observed in this analysis implies that position imbalances by investor type may not have a direct impact on mispricing within the context of the Thai futures market

Table VI

Open Interest, Volume and Volatility Relationship with Mispricing of 6-month deferred Calendar Spread

Variable	Model I : Equation (16) Newey-West S.E. $\Delta\left|M_t^{sd}\right|$	Model II : Equation (16) Newey-West S.E. $\Delta\left|M_t^{sd}\right|$	Model III : Equation (16) Newey-West S.E. $\Delta\left|M_t^{sd}\right|$	Model IV : Equation (16) Newey-West S.E. $\Delta\left|M_t^{sd}\right|$
$adj. R^2$	0.020	0.030	0.045	0.048
$F - statistics$	3.077*	3.163*	3.587*	3.229*
N	1,210	1,209	1,208	1,207
Lag	0	1	2	3
α	-0.036	-0.026	-0.062	-0.031
	(0.639)	(0.642)	(0.649)	(0.644)
$\Delta\ln(Interest_t^n)$	-0.299	-0.871	0.286	-0.425
	(0.341)	(0.961)	(0.366)	(0.218)
$\Delta\ln(Interest_t^d)$	-0.843*	-0.141	-0.737*	0.051
	(0.374)	(0.760)	(0.275)	(0.254)
$Volatility_t^a$	2.657*	1.309*	17.622*	-11.362*
	(0.011)	(0.011)	(0.018)	(0.010)
$\Delta\ln(Volume_t^n)$	-0.634	0.577	-0.755	0.289
	(0.423)	(0.899)	(0.588)	(0.367)
$\Delta\ln(Volume_t^d)$	0.488	-0.302	0.651	-0.225
	(0.566)	(0.854)	(0.619)	(0.462)
D_1	-0.082	-0.202	-0.261	-0.278
	(0.208)	(0.509)	(0.514)	(0.508)
D_2	0.148	0.219	0.122	0.155
	(0.209)	(0.304)	(0.308)	(0.305)
D_3	-0.047	-0.002	-0.088	-0.044
	(0.204)	(0.173)	(0.152)	(0.150)
D_4	0.061	0.085	0.069	0.066
	(0.187)	(0.155)	(0.153)	(0.158)
D_5	0.050	0.059	0.046	0.048
	(0.206)	(0.128)	(0.124)	(0.126)
D_6	-0.020	0.001	-0.036	-0.032
	(0.191)	(0.114)	(0.116)	(0.120)
D_7	-0.052	-0.051	-0.069	-0.058
	(0.196)	(0.114)	(0.115)	(0.114)

Note : This is the regression result of equation (16) $\Delta|M_t^{sd}| = \alpha'_0 + \beta_1 \Delta Interest_{t-l}^n + \beta_2 \Delta Interest_{t-l}^d + \beta_3 Volatility_{t-l}^a + \beta_4 \Delta Volume_{t-l}^n + \beta_5 \Delta Volume_{t-l}^d + \sum_{i=1}^{n} \alpha'_i D_{i-l} + \varepsilon_t$

The regression is estimated using concurrent and lagged variables. The results are summarized; the complete regression output is provided in Table XI in the Appendix.

Di ***represents the time-to-expiration dummy variables.*** $\Delta|M_t^{sd}|$ ***denotes the absolute change in mispricing of the 6-month calendar spread. The coefficients are reported in absolute values, with standard errors shown in parentheses. *indicates statistical significance at 5% level.***

The models in Table VI use the same control and independent variables as those in Equations (8) and (14), and the tests are similarly conducted with up to three lags. The key difference lies in the dependent variable: while most studies focus on the 3-month calendar spread—given its higher liquidity and its common use for futures rollovers—this model instead analyzes the 6-month deferred calendar spread.

The results are notable in that none of the time-to-maturity dummy variables are statistically significant across all model specifications. This suggests that, unlike in the 3-month spread, the approach of the near contract's expiration does not significantly affect the mispricing of the 6-month calendar spread. However, the explanatory power of these models is quite limited, with all adjusted R-squared values remaining low—the highest being only 0.020. F-statistics are significant in all models.

Model I shows a negative relationship between the open interest of the deferred contract and mispricing, consistent with earlier findings. This suggests that a decline in open interest in the deferred contract may lead to increased mispricing—possibly due to reduced liquidity. This is plausible, given that 6-month deferred contracts typically have lower trading activity compared to nearer quarterly futures.

Conclusion

This study aims to explain the financial phenomenon of significant mispricing in SET50 Index Futures calendar spreads. The findings reveal that mispricing tends to intensify during the rollover period, beginning approximately 10 days prior to the near contract’s expiration. Open interest is also shown to be significantly correlated with mispricing, which is consistent with theoretical expectations: as contracts approach maturity, changes in open interest for both near and deferred contracts influence the pricing dynamics of the spread.

In contrast, the net long or short positions held by different investor types show no statistically significant relationship with mispricing. This challenges the common market belief that dominant investor groups, such as foreign investors, have a direct impact on spread behavior.

A key practical takeaway is that, assuming no constraints on the investment horizon and a preference for simplicity in strategy, investors should aim to execute rollovers from the near to the deferred contract before the final 10 days of the near contract’s life. Doing so can help avoid periods of heightened mispricing, which are often accompanied by increased volatility (risk) and the potential cost of negative roll yield if market conditions are unfavorable.

Moreover, if early rollover is not feasible, the use of the 6-month calendar spread may serve as a more stable alternative. Unlike the 3-month spread, the mispricing of the 6-month spread does not exhibit any statistically significant correlation with the time to maturity of the near-month contract, offering investors a potentially less risky rollover mechanism.

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Appendix

Table VII

Open Interest, Volume and Volatility Relationship with Mispricing of Calendar Spread

Variable	Model I : Equation (8) Newey-West S.E. $\Delta\lvert M^s_t\rvert$	Model II : Equation (14) Newey-West S.E. $\Delta\lvert M^s_t\rvert$	Model III : Equation (14) Newey-West S.E. $\Delta\lvert M^s_t\rvert$	Model IV : Equation (14) Newey-West S.E. $\Delta\lvert M^s_t\rvert$
$adj.R^2$	0.372	0.376	0.381	0.383
$F-statistics$	60.78*	43.88*	34.81*	28.74*
N	1,210	1,209	1,208	1,207
Lag	0	1	2	3
α	0.180	0.167	0.164	0.183
	(0.673)	(0.669)	(0.6716)	(0.674)
$\Delta\ln(Interest^n_t)$	0.180	0.2638	0.222	0.167
	(0.777)	(0.772)	(0.764)	(0.760)
$\Delta\ln(Interest^n_{t-1})$	-	0.0875	0.012	-0.103
		(0.464)	(0.468)	(0.469)
$\Delta\ln(Interest^n_{t-2})$	-	-	0.016	-0.104
			(0.321)	(0.318)
$\Delta\ln(Interest^n_{t-3})$	-	-	-	-0.288
				(0.246)
$\Delta\ln(Interest^d_t)$	-0.861	-0.857	-0.855	-0.802
	(0.913)	(0.892)	(0.889)	(0.887)
$\Delta\ln(Interest^d_{t-1})$	-	0.1828	0.070	0.104
		(0.133)	(0.157)	(0.175)
$\Delta\ln(Interest^d_{t-2})$	-	-	-0.343*	-0.359
			(0.155)	(0.145)
$\Delta\ln(Interest^d_{t-3})$	-	-	-	0.010
				(0.215)
$Volatility^a_t$	6.556*	4.674*	4.400*	5.078*
	(0.010)	(0.009)	0.009)	(0.009)
$Volatility^a_{t-1}$	-	2.153*	1.832*	2.590*
		(0.008)	(0.008)	(0.008)
$Volatility^a_{t-2}$	-	-	1.596*	3.414*
			(0.007)	(0.008)
$Volatility^a_{t-3}$	-	-	-	-4.215*
				(0.007)
$\Delta\ln(Volume^n_t)$	-0.020	0.019	-0.027	-0.017
	(0.622)	(0.624)	(0.624)	(0.619)
$\Delta\ln(Volume^n_{t-1})$	-	0.231	0.084	0.086
		(0.429)	(0.431)	(0.427)
$\Delta\ln(Volume^n_{t-2})$	-	-	-0.390	-0.396
			(0.387)	(0.380)
$\Delta\ln(Volume^n_{t-3})$	-	-	-	0.087
				(0.311)
$\Delta\ln(Volume^d_t)$	0.146	0.1741	0.196	0.175
	(0.984)	(0.967)	(0.958)	(0.959)
$\Delta\ln(Volume^d_{t-1})$	-	-0.0828	0.000	-0.027
		(0.242)	(0.259)	(0.265)
$\Delta\ln(Volume^d_{t-2})$	-	-	0.203	0.163
			(0.245)	(0.234)
$\Delta\ln(Volume^d_{t-3})$	-	-	-	-0.068
				(0.290)
D_1	1.390*	1.498*	1.437*	1.370*
	(0.520)	(0.519)	(0.514)	(0.509)
D_2	0.651*	0.646*	0.621*	0.616*
	(0.214)	(0.209)	(0.211)	(0.211)
D_3	0.162	0.169*	0.155*	0.159*
	(0.076)	(0.074)	(0.073)	(0.076)
D_4	0.115	0.125	0.101	0.088
	(0.066)	(0.067)	(0.065)	(0.064)
D_5	0.044	0.049	0.047	0.040
	(0.072)	(0.071)	(0.072)	(0.072)
D_6	0.120	0.126	0.116	0.106
	(0.082)	(0.082)	(0.084)	(0.083)
D_7	-0.002	0.006	0.000	-0.005
	(0.050)	(0.053)	(0.050)	(0.050)

Note : This is the regression result of equation (8) $\Delta\lvert M^s_t\rvert = \alpha'_0 + \beta_1\Delta\, ln(Interest^n_t) + \beta_2\Delta\, ln(Interest^d_t) + \beta_3 Volatility^a_t + \beta_4\, ln(\Delta Volume^n_t) + \beta_5\Delta ln(Volume^d_t) + \sum_{i=1}^{n}\alpha'_i D_i + \varepsilon_t$

and equation (14) $\Delta|M_t^s| = \alpha_0' + \beta_1 \Delta \ln(Interest_{t-l}^n) + \beta_2 \Delta \ln(Interest_{t-l}^d) + \beta_3 Volatility_{t-l}^a + \beta_4 \Delta \ln(Volume_{t-l}^n) + \beta_5 \Delta \ln(Volume_{t-l}^d) + \sum_{i=1}^{n} \alpha_i' D_{i-l} + \varepsilon_t$ ***where l is number of lag = 1, 2, 3***

Di represents the time-to-expiration dummy variables. $\Delta|M_t^s|$ denotes the absolute change in mispricing of the 3-month calendar spread. The coefficients are reported in absolute values, with standard errors shown in parentheses. *indicates statistical significance at 5% level.

Table VIII

Relationship Between Mispricing of Calendar Spread and Net Long-Short Volume by Investors Type

Variable	Model I : Equation (13) Newey-West S.E. $\Delta\|M_t^s\|$	Model II : Equation (13) Newey-West S.E. $\Delta\|M_t^s\|$	Model III : Equation (13) Newey-West S.E. $\Delta\|M_t^s\|$	Model IV : Equation (13) Newey-West S.E. $\Delta\|M_t^s\|$
$adj. R^2$	0.370	0.372	0.374	0.375
$F-statistics$	55.65*	38.69*	29.79*	24.37*
N	1,210	1,209	1,208	1,207
Lag	0	1	2	3
α	0.168 (0.674)	0.155 (0.669)	0.166 (0.672)	0.179 (0.675)
$\Delta\ln(Interest_t^n)$	0.171 (0.772)	0.269 (0.769)	0.183 (0.772)	0.139 (0.770)
$\Delta\ln(Interest_{t-1}^n)$	-	0.276 (0.466)	0.139 (0.472)	-0.038 (0.475)
$\Delta\ln(Interest_{t-2}^n)$	-	-	-0.253 (0.318)	-0.390 (0.313)
$\Delta\ln(Interest_{t-3}^n)$	-	-	-	-0.237 (0.246)
$\Delta\ln(Interest_t^d)$	-0.714 (0.913)	-0.660 (0.891)	-0.661 (0.896)	-0.633 (0.895)
$\Delta\ln(Interest_{t-1}^d)$	-	0.110 (0.136)	0.062 (0.169)	0.072 (0.185)
$\Delta\ln(Interest_{t-2}^d)$	-	-	-0.133 (0.147)	-0.184 (0.133)
$\Delta\ln(Interest_{t-3}^d)$	-	-	-	-0.064 (0.211)
$Volatility_t^a$	7.492* (0.010)	7.443* (0.009)	7.356* (0.009)	7.867* (0.010)
$Volatility_{t-1}^a$	-	0.291* (0.008)	0.770* (0.008)	1.278* (0.008)
$Volatility_{t-2}^a$	-	-	-0.756* (0.008)	0.406* (0.008)
$Volatility_{t-3}^a$	-	-	-	-2.604* (0.007)
$\frac{Net\ Type_t^f}{10,000}$	-0.020 (1.074)	-0.012 (1.073)	-0.009 (1.079)	-0.016 (1.080)
$\frac{Net\ Type_{t-1}^f}{10,000}$	-	-0.034 (0.881)	-0.025 (0.875)	-0.030 (0.870)
$\frac{Net\ Type_{t-2}^f}{10,000}$	-	-	-0.032 (0.921)	-0.048 (0.928)
$\frac{Net\ Type_{t-3}^f}{10,000}$	-	-	-	0.032 (0.982)
$\frac{Net\ Type_t^{int}}{10,000}$	0.013 (0.316)	0.025 (0.319)	0.023 (0.307)	0.0117 (0.305)
$\frac{Net\ Type_{t-1}^{int}}{10,000}$	-	-0.032 (0.290)	-0.023 (0.280)	-0.014 (0.269)
$\frac{Net\ Type_{t-2}^{int}}{10,000}$	-	-	-0.055 (0.263)	-0.074 (0.264)
$\frac{Net\ Type_{t-3}^{int}}{10,000}$	-	-	-	0.078 (0.255)
$\frac{Net\ Type_t^l}{10,000}$	-0.010 (1.022)	-0.001 (1.015)	0.001 (1.023)	-0.006 (1.023)
$\frac{Net\ Type_{t-1}^l}{10,000}$	-	-0.047 (0.743)	-0.037 (0.737)	-0.043 (0.735)
$\frac{Net\ Type_{t-2}^l}{10,000}$	-	-	-0.042 (0.785)	-0.057 (0.791)
$\frac{Net\ Type_{t-3}^l}{10,000}$	-	-	-	0.035 (0.949)
D_1	1.376* (0.519)	1.490* (0.515)	1.412* (0.512)	1.351* (0.510)
D_2	0.663* (0.214)	0.657* (0.211)	0.658* (0.212)	0.645* (0.213)
D_3	0.163 (0.077)	0.169* (0.074)	0.171* (0.074)	0.176* (0.074)
D_4	0.115 (0.067)	0.112 (0.062)	0.089 (0.062)	0.085 (0.059)
D_5	0.040 (0.074)	0.051 (0.075)	0.050 (0.077)	0.042 (0.076)
D_6	0.117 (0.081)	0.126 (0.083)	0.122 (0.084)	0.107 (0.083)
D_7	-0.005 (0.050)	0.003 (0.050)	-0.003 (0.047)	-0.010 (0.049)

Note : This is the regression result of equation (13) $\Delta|\boldsymbol{M_t^s}| = \boldsymbol{\alpha_0'} + \boldsymbol{\beta_1}\Delta\, \boldsymbol{ln(Interest_t^n)} + \boldsymbol{\beta_2}\Delta\, \boldsymbol{ln(Interest_t^d)} + \boldsymbol{\beta_3 Volatility_t^a} + \boldsymbol{\beta_4}\frac{\boldsymbol{Net\,Type_t^f}}{\boldsymbol{10{,}000}} + \boldsymbol{\beta_5}\frac{\boldsymbol{Net\,Type_t^{int}}}{\boldsymbol{10{,}000}} + \boldsymbol{\beta_6}\frac{\boldsymbol{Net\,Type_t^l}}{\boldsymbol{10{,}000}} + \sum_{i=1}^{n}\boldsymbol{\alpha_i' D_i} + \boldsymbol{\varepsilon_t}$

Di represents the time-to-expiration dummy variables. $\Delta|\boldsymbol{M_t^s}|$ ***denotes the absolute change in mispricing of the 3-month calendar spread. The coefficients are reported in absolute values, with standard errors shown in parentheses. *indicates statistical significance at 5% level.***

Table IX

Open Interest, Volume and Volatility Relationship with Mispricing of 6-month deferred Calendar Spread

Variable	Model I : Equation (16) Newey-West S.E. $\Delta\lvert M_t^{sd}\rvert$	Model II : Equation (16) Newey-West S.E. $\Delta\lvert M_t^{sd}\rvert$	Model III : Equation (16) Newey-West S.E. $\Delta\lvert M_t^{sd}\rvert$	Model IV : Equation (16) Newey-West S.E. $\Delta\lvert M_t^{sd}\rvert$
$adj. R^2$	0.020	0.030	0.045	0.048
$F-statistics$	3.077*	3.163*	3.587*	3.229*
N	1,210	1,209	1,208	1,207
Lag	0	1	2	3
α	-0.036	-0.026	-0.062	-0.031
	(0.639)	(0.642)	(0.649)	(0.644)
$\Delta\ln(Interest_t^n)$	-0.299	-0.612	-0.568	-0.610
	(1.077)	(1.065)	(1.068)	(1.059)
$\Delta\ln(Interest_{t-1}^n)$	-	-0.871	-0.988	-1.120
		(0.961)	(0.936)	(0.935)
$\Delta\ln(Interest_{t-2}^n)$	-	-	0.286	0.179
			(0.366)	(0.349)
$\Delta\ln(Interest_{t-3}^n)$	-	-	-	-0.425
				(0.218)
$\Delta\ln(Interest_t^d)$	-0.843*	-0.843	-1.021	-0.931
	(1.062)	(1.062)	(1.081)	(1.069)
$\Delta\ln(Interest_{t-1}^d)$	-	-0.141	-0.589	-0.490
		(0.760)	(0.714)	(0.718)
$\Delta\ln(Interest_{t-2}^d)$	-	-	-0.737*	-0.650*
			(0.275)	(0.253)
$\Delta\ln(Interest_{t-3}^d)$	-	-	-	0.051
				(0.254)
$Volatility_t^a$	2.657*	0.501*	-4.109*	-1.994*
	(0.011)	(0.011)	(0.013)	(0.011)
$Volatility_{t-1}^a$	-	1.309*	-7.211*	-5.267*
		(0.011)	(0.010)	(0.010)
$Volatility_{t-2}^a$	-	-	17.622*	22.199*
			(0.018)	(0.017)
$Volatility_{t-3}^a$	-	-	-	-11.362*
				(0.010)
$\Delta\ln(Volume_t^n)$	-0.634	-0.369	-0.499	-0.504
	(0.866)	(0.852)	(0.857)	(0.852)
$\Delta\ln(Volume_{t-1}^n)$	-	0.577	0.391	0.411
		(0.899)	(0.887)	(0.889)
$\Delta\ln(Volume_{t-2}^n)$	-	-	-0.755	-0.742
			(0.588)	(0.579)
$\Delta\ln(Volume_{t-3}^n)$	-	-	-	0.289
				(0.367)
$\Delta\ln(Volume_t^d)$	0.488	0.369	0.562	0.519
	(1.233)	(1.225)	(1.235)	(1.222)
$\Delta\ln(Volume_{t-1}^d)$	-	-0.302	0.099	0.000
		(0.854)	(0.821)	(0.829)
$\Delta\ln(Volume_{t-2}^d)$	-	-	0.651	0.499
			(0.619)	(0.621)
$\Delta\ln(Volume_{t-3}^d)$	-	-	-	-0.225
				(0.462)
D_1	-0.082	-0.202	-0.261	-0.278
	(0.504)	(0.509)	(0.514)	(0.508)
D_2	0.148	0.219	0.122	0.155
	(0.304)	(0.304)	(0.308)	(0.305)
D_3	-0.047	-0.002	-0.088	-0.044
	(0.169)	(0.173)	(0.152)	(0.150)
D_4	0.060	0.085	0.069	0.066
	(0.163)	(0.155)	(0.153)	(0.158)
D_5	0.050	0.059	0.046	0.048
	(0.128)	(0.128)	(0.124)	(0.126)
D_6	-0.020	0.001	-0.036	-0.032
	(0.113)	(0.114)	(0.116)	(0.120)
D_7	-0.052	-0.051	-0.069	-0.058
	(0.113)	(0.114)	(0.115)	(0.114)

Note : This is the regression result of equation (16) $\Delta\left|M_t^{sd}\right| = \boldsymbol{\alpha}_0' + \boldsymbol{\beta}_1\Delta \boldsymbol{Interest}_{t-l}^{n} + \boldsymbol{\beta}_2\Delta \boldsymbol{Interest}_{t-l}^{d} + \boldsymbol{\beta}_3 \boldsymbol{Volatility}_{t-l}^{a} + \boldsymbol{\beta}_4\Delta \boldsymbol{Volume}_{t-l}^{n} + \boldsymbol{\beta}_5\Delta \boldsymbol{Volume}_{t-l}^{d} + \sum_{i=1}^{n} \boldsymbol{\alpha}_i' \boldsymbol{D}_{i-l} + \boldsymbol{\varepsilon}_t$

$\boldsymbol{Di}$ ***represents the time-to-expiration dummy variables.*** $\Delta\left|M_t^{sd}\right|$ ***denotes the absolute change in mispricing of the 6-month calendar spread. The coefficients are reported in absolute values, with standard errors shown in parentheses. *indicates statistical significance at 5% level.***