CME RATES CALENDAR SPREAD COINTEGRATION AND OTHER ROLL IMPROVEMENTS

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EXECUTIVE SUMMARY

- We recently improved our algo performance in rolls by fine-tuning our aggressive cross signal and improving our accuracy in tracking our queue position.
- In the June roll, our passive fills improved by almost 30% across all the CME IR spreads, and our arrival price slippage declined by more than 20%.
- Our forthcoming changes include another signal, cointegration, which will further enhance our arrival price performance. We also plan to extend these improvements to rolls on other exchanges.

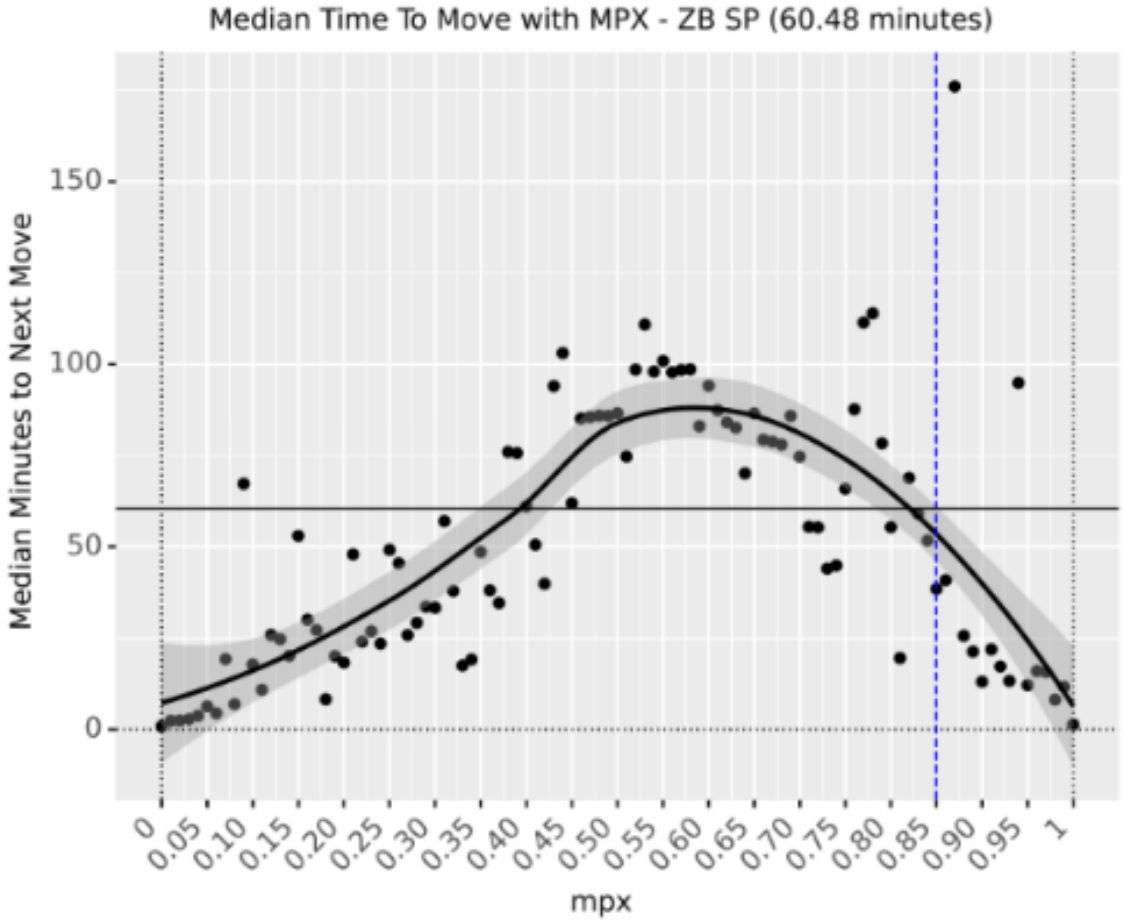
INTRODUCTION

IR calendar spreads tend to be considerably large-tick (narrow spread) instruments, with the quote sizes sometimes being several multiples of the daily traded volume. In such markets, staying in the book longer has the benefit of a passive fill at an uncertain time in the future, although at a better price. Crossing the spread gives an immediate execution, however, this comes at the cost of paying the spread. It is ideal to pay the spread when the probability of the price moving away from us is higher. However, forecasting the next price move is challenging for such large tick instruments, as the time between price changes can often be several hours, so the signal's accuracy is essential. We do so by enhancing our book imbalance signal using specific features like knowing the median time to move and adding a cointegration signal based on the spread's relationship with its outright. Additionally, we used our queue tracking logic to improve our sizing and replacement logic of child orders by considering whether we were at the front of the queue. Fine-tuning the thresholds based on the median time was already in production for CME in the June roll period. In the next roll in August, we will also use an empirically determined combination of our cointegration signal and the book imbalance for our aggressive crosses. We will share more details as we approach the roll period. We chose CME as our first exchange to implement these changes and plan to extend these ideas to other exchanges in the near future.

BOOK IMBALANCE THRESHOLD: FINE TUNING

FIGURE 1
Figure shows the relationship between our book imbalance signal and the median time for the product to move

Time-To-Move with Book Imbalance



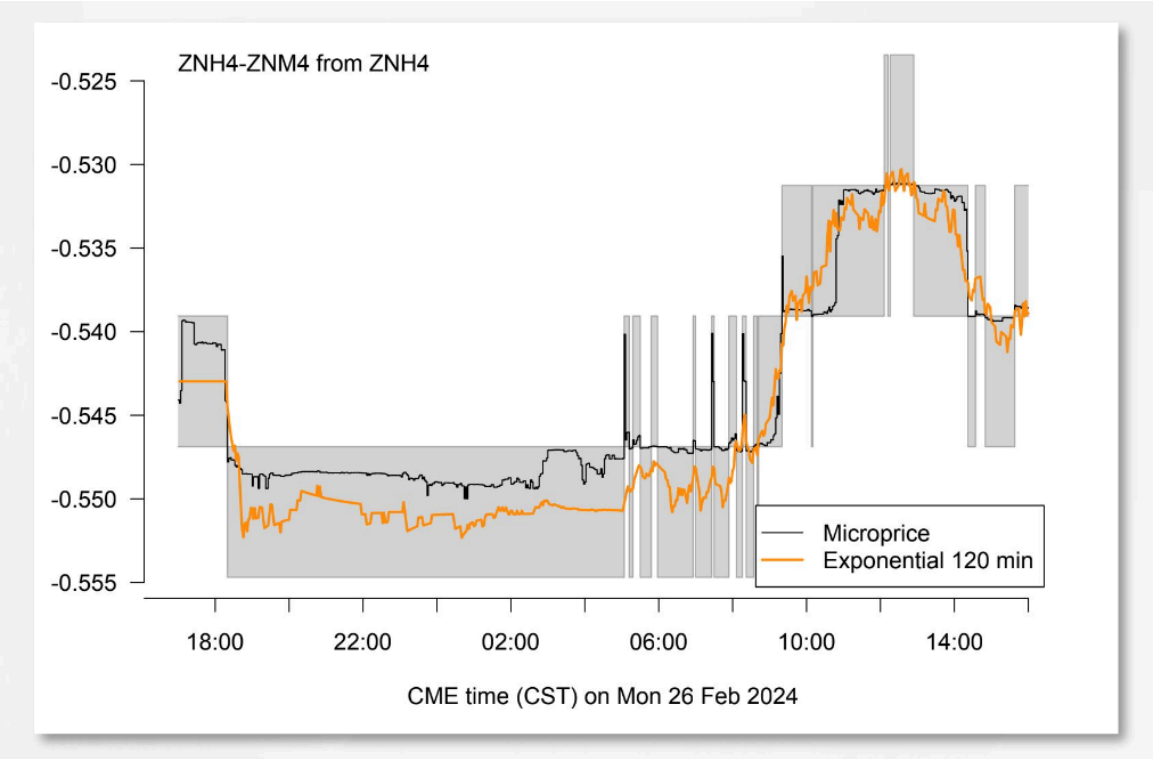
While trading calendar spreads, one of the parameters we look to optimize is the threshold of the book-imbalance signal at which we decide to cross. Previously, we were looking at only the direction's accuracy, but this tends to be deficient for large-tick products that could move in the expected direction after a long period of time. So, we introduced the time-to-move (TTM) as our target variable rather than targeting directional accuracy. Doing so maximizes our passive fill rates and minimizes our overall slippage to arrival price. For illustration, in Figure 1, if we chose a signal threshold such that the time to move is around 15 minutes, our threshold would be 0.97 (for buying) for the case of ZB spreads. This approach combined with queue tracking-based adjustments to replace resting orders improved the passive fill rate by almost 30% compared to the historical average. Our slippage to arrival price also decreased by more than 20% in the June roll. While it is hard to quantify the impact of the specific change, our simulation results showed similar improvements.

COINTEGRATION: WHERE ECONOMETRICS MEETS TRADING

Another signal that we use to trade calendar spreads is cointegration. Our CME IR roll forecast uses the same concept for multi-day forecasting during the roll periods. We use a high-frequency aspect of the same model. Also, we have cointegration in our algorithmic trading for STIRs and other related products for some time. The current signal has a slight variation. See[1] and[2] for details on these two topics.

FIGURE 2
Note that the book-imbalance signal, which is the black line, has a few false positives, but the cointegration signal is more reliable in this illustration

ZN: Cointegration Regression Signal



The central hypothesis is that price discovery in the calendar spread is driven by a duration-neutral (risk-adjusted) combination of near and far. The combination can be different from the observed difference in prices of the near and far-term outright future. Additionally, the duration-driven weights can be empirically determined and will be more accurate than the end-of-the-day values published on the exchange.

Consequently, we use high-frequency data and fit a parametric form $y_t = a + b * near_t + c * far_t$, where y mid-price of the calendar spread, a is the intercept, and b and c are slopes of the spread constituents respectively. The coefficients are determined in real time. It is noteworthy to mention that we also use exponential averages to compute our coefficients and take care of other nuances to prevent the singularity of the matrix. Our signal framework disseminates the coefficients, and the parametric form is simple enough for the trading engine to use in real time to determine the signal value.

We show the results of this model for the ZN(H-M-2024) calendar spread, where the orange line is forecast from the model. The other signal shown (black line), the book imbalance signal, tends to fire a few false positives in this case. However, we find that the cointegration-regression signal described above is more stable and has forecasting power to predict the move towards the end of the time period. A combination of the above signals puts QB in a favorable position to execute the upcoming roll in August 2024. We will discuss our results further as we approach the roll period.

References

[1] Shankar Narayanan and Reza Gholizadeh. Forecasting U.S. treasury futures' calendar spread around the roll period. Technical report, Quantitative Brokers, Nov 2018.

[2] Shankar Narayanan. Cointegration as a price forecast. Technical report, Quantitative Brokers, Jul 2019.