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Insights

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Market Structure

How Japan's settlement price methodology impacts option expiry

Settlement price methodologies are a crucial component in options markets because they affect the final valuation and proceeds of options contracts. When and how settlement prices are calculated varies greatly across products and markets. In this paper, we highlight problems with the settlement price methodology for the Large Nikkei 225 Index Options on the Osaka Exchange (OSE) and propose improvements.

Settlement is the process by which an options contract is settled between a buyer and seller on the expiry date, including how the reference price is calculated. It's a seemingly obscure technical mechanism that can nevertheless have significant ramifications.

Settlement methodologies overly sensitive to order imbalances, for instance, can lead to distorted payoffs that undermine confidence in markets and deter investors from trading, especially in the case of near-expiry options. Additionally, methodologies that reduce the tradeability or limit the effectiveness of options as risk management tools close to expiry can discourage investors from trading or holding these contracts.

In this paper, we focus on Japan's Nikkei 225 Index, one of the world's leading indices. The OSE deserves credit for operating the largest, most international and most liquid APAC futures market: the Nikkei 225 Index futures. However, investor participation in Nikkei 225 Index options has been falling over the past decade. Unlike other leading options markets, few investors are willing to trade these contracts on the day of expiry (0DTE) or on the day before (1DTE). We think the product's settlement methodology is a major reason for this, and we propose a principles-based solution as a way of reversing this decline.

How Nikkei 225 Index options settle

Options on the Nikkei 225 Index are one of the few index options globally that expire at the open of the cash market, rather than the closing. The reference price for the options contract is therefore based on the opening prices of the Nikkei 225 Index components on the date of expiry. This feature represents a significant issue with the index's settlement methodology.

First, the opening of the cash market is relatively illiquid, which makes the opening prices of the Nikkei 225 Index components susceptible to price moves caused by market imbalances. This wasn't always the case. Decades ago, the cash market opening was still very liquid, making the settlement methodology more appropriate. But today, the value traded at the opening of the Tokyo

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Stock Exchange represents just 4% of the volume traded during the day on average, a proportion that has been declining over the past decade. Under these circumstances, a large order in a stock at the opening can destabilise the price significantly, affecting the reference price of the option.

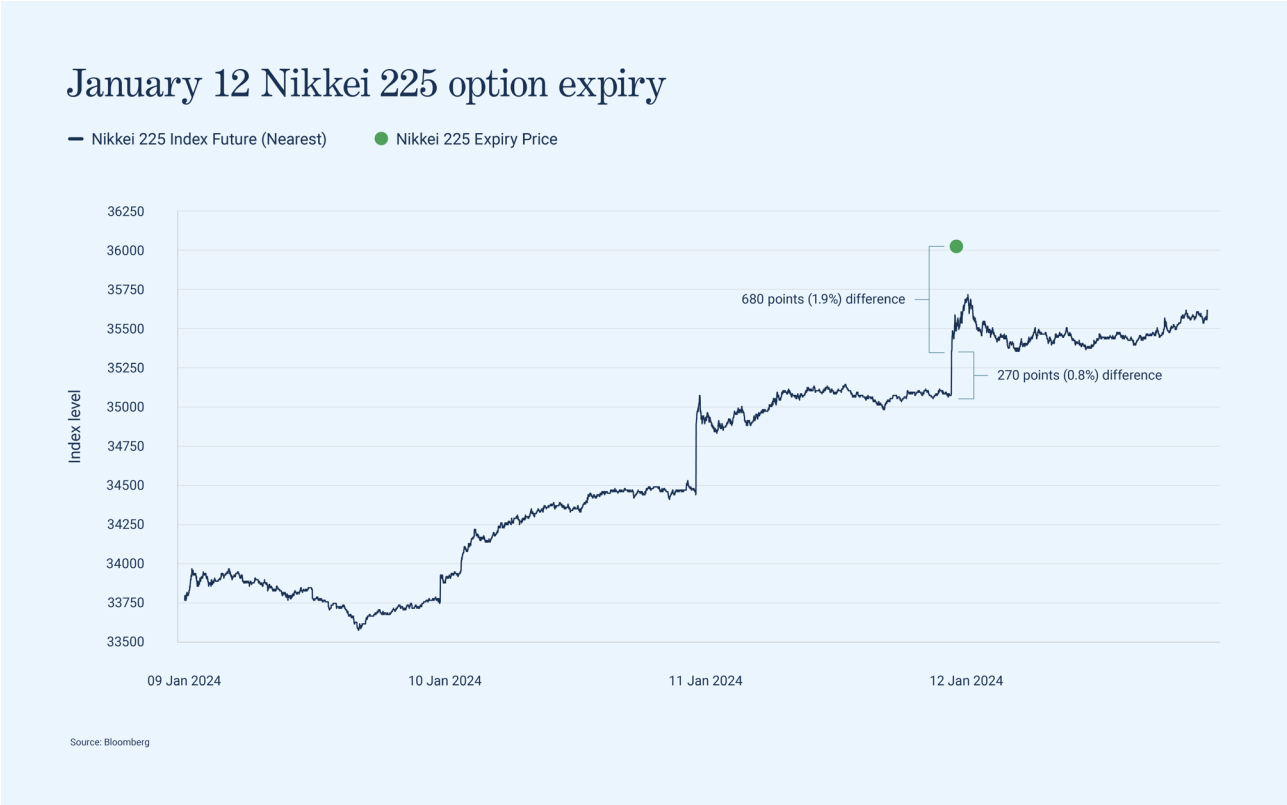
Second, as options expire at the opening, and since the option contract cannot be traded during the night market preceding expiry, there's a delay between the contract's last possible trade (Thursday 3pm) and the time of expiry (Friday 9am). Investors holding options during this 18-hour delay face the risk that the underlying will move against them, without having the ability to close or adjust their positions.

The Nikkei 225 Index is also one of the few major stock indices that employs a price-weighted methodology in its calculation, as opposed to the more common market capitalisation weighting. As a result, companies with high share prices but relatively small market caps can have a disproportionately high impact on the index. For example, Fast Retailing Co (Uniqlo) has a weight of ~12% while its market cap represents only 2% of the index.[1] Lower market cap companies tend to be less liquid, with increased potential for order imbalances and price volatility. This feature already makes the Nikkei 225 Index relatively more sensitive to order imbalances in its index components.

January 2024 case study

Let's take a look at what happened on the January 12 expiry of this year as an example of these two phenomena and their impact on investors. On this particular expiry date, the Large Nikkei 225 Index Option printed 680 points, or more than 1.9%, above the future. This is unusually high, considering the Nikkei 225 Index March future, which is typically an accurate representation of the actual value of the index, never traded more than 0.2%, or 75 points, away from the Nikkei 225 Index that week. The discrepancy impacted approximately 66,000 options contracts, which were in the money and expired even further in the money, causing gross gains or losses of $285 million, with some investors losing tens of millions of dollars.

[1] https://indexes.nikkei.co.jp/en/nkave/factsheet?idx=nk225



Not only did the expiry price print 680 points above the future, but the latter also opened 270 points, or 0.8%, above the closing price from the previous day, which is not an unusual occurrence. Because of the delay between the last possible trade and the expiry, investors could not rebalance positions during the night or use a similar product to take opposite positions.

Impact on market volumes and trends

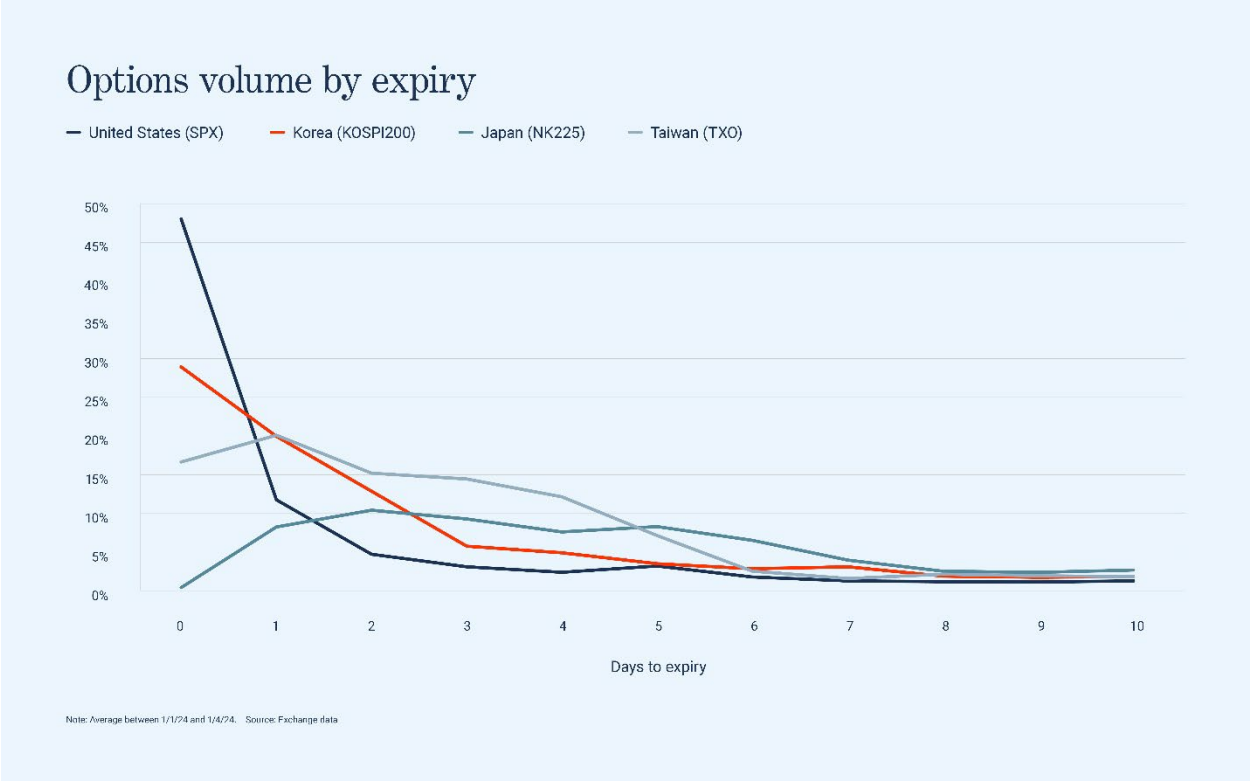
These two factors – the delay between the last trade and expiry, and the unreliability of the reference price at the opening – have made investors reluctant to hold Nikkei options in the days leading up to expiry, contributing to a widening of spreads and falling demand and liquidity for 1DTE and 0DTE contracts. Investors who do hold until expiry – and experience the variance described above – may choose to avoid Nikkei 225 Index options products altogether.

Between 2013 and 2023, the number of Nikkei 225 Index options contracts traded decreased by 60%, while other leading index options (with well-functioning settlement methodologies) experienced large growth in contract volumes (e.g. SPX +250%, KOSPI + 30% and TXO + 19%).[2]

In the US, trading 0DTE or 1DTE now accounts for 59% of CBOE's S&P 500 Index options volumes, up from less than 20% five years ago. In Japan meanwhile, near-expiry trading has stagnated, with only around 8% of index options traded 0DTE or 1DTE. Even for CBOE's weekly and monthly expiry contracts, over 30% trades 0DTE or 1DTE. Investors have embraced this style of trading as a way to take more accurate and cost-efficient positions around macro events and

[2] Source: Bloomberg data

news releases. In markets such as Korea and Taiwan, near-expiry options trading now represents a significant portion of total volume, as the chart below shows.



A comparison with US markets

It may be worthwhile as part of our analysis to consider how Japan's methodology compares with those in the US. While the US is one of the most popular places in the world for near-expiry options trading, it has no single settlement process.

In the case of cash-settled CBOE weekly S&P 500 options, the most popular index option in the US, the reference price at expiry is calculated using the closing price in the primary market for each component of the index on the expiry date. The reference price for the cash settled CBOE monthly S&P index options, by contrast, is calculated using the opening price. It's worth noting that using the opening price to calculate a reference price is not as problematic in the US, as order imbalances that can destabilise opening prices are less common, with US cash volumes more than ten times higher than those of Japan.[3] Additionally, the S&P 500 Index, on which CBOE's SPX options are based, is a market capitalisation-weighted index, as opposed to a price-weighted index like the Nikkei 225 Index. Nevertheless, demand for this product has been falling, with contracts traded declining by 6% between 2013 and 2023.[3]

[3] Source: Bloomberg and CBOE data

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Proposed solution

While there is no universally-accepted standard for a settlement methodology, we propose a set of principles that we believe should apply to settlement across all options markets.

1. **Reliable Reference Price** – Expiration methodologies should be fair and equitable, producing a reliable reference price that minimises sensitivity to order imbalances. This enhances investor confidence, contributes to market stability and stimulates liquidity.

2. **Continuously Tradeable** – The economic nature of a complex of options contracts should remain consistent throughout the trading day, up until expiry and settlement, promoting liquidity and incentivising investor participation. This allows investors to effectively manage risk and hedge their exposures, contributing to orderly markets.

In the case of Japan's index options market, we believe the settlement price for all Nikkei 225 Index options series should be based not on the opening price, but on the closing price on the expiry date. The volume traded at the close of the cash market is around five times higher than at the open on average, making the reference price far more reliable. Using the closing price as the reference price would also eliminate the lengthy gap between the last trading opportunity and expiry. Japan could also consider using a VWAP taken during the last 20 minutes or so before closing, but the additional benefit would likely be small and not worth the added complexity.

Settlement price methodologies should produce a reliable reference price while ensuring that options remain continuously tradeable until expiry. By adopting these principle-based solutions, Japan can strengthen the foundations of one of its flagship products to make it more appealing to investors and bring it in line with international best practices.

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About Optiver

Optiver is a global market maker with offices in Amsterdam, London, New York, Chicago, Austin, Sydney, Shanghai, Hong Kong, Singapore, Mumbai and Taipei. Founded in 1986, today we are a leading liquidity provider, with close to 2,000 employees in offices around the world, united in our commitment to improve the market by competitive pricing, execution and thorough risk management. By providing liquidity on multiple exchanges across the world in various financial instruments we participate in the safeguarding of healthy and efficient markets. We provide liquidity to financial markets using our own capital, at our own risk, trading a wide range of products: listed derivatives, cash equities, ETFs, bonds and foreign currencies.