brixx™

Advanced Fundamentals

Devexperts

BRIXX™ Commercial Real Estate Options

White Paper

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Introduction

While almost all asset classes have derivatives markets that dwarf the underlying markets, the real estate derivatives market in the United States is almost nonexistent. The reason for this is simply that a true, real-time valuation measurement index to provide the transparency and relationships required for widespread use and adoption did not exist until now.

"Derivatives on US private equity real estate have the potential to reshape direct real estate investment activity. A fully functioning derivatives market would allow investors to separate property-level acquisition decisions from portfolio-level allocation choices. Innovative real estate investment funds, including direct real estate 130/30 and portable alpha strategies, could emerge." Asieh Mansour, Sandy Naylor, US Private Equity Real Estate Derivatives: Is Now the Time? 2007

BRIXX™ Commercial Real Estate (CRE) Indexes are the first family of real estate indexes to incorporate commodity pricing to overcome the limitations of appraisal lag, self-reporting, and leverage disparities to establish an accurate view of the real estate market. The performance of the BRIXX Indexes is calculated on an unlevered basis using publicly traded equity pricing and data, resulting in a 12-month leading correlation, higher order of transparency, liquidity and price determination to private market real estate benchmark indexes that rely on survey, transaction, or appraisal data; and significant reduction of volatility from market cap weighted REIT indexes that have an indeterminate level of leverage.

Real Estate Derivatives as a Solution

"Real estate derivatives provide some obvious and very appealing benefits for real estate that has been characterized by high transaction cost, long transaction lead time and lack of short-selling mechanism. By eliminating the physical delivery of the asset, many of the negatives in real estate transactions can be mitigated."

"First, investing in real properties involves large amount of due diligence expenses, management fees and sales commissions. These expenses typically amount to 3-5% of the property value in the U.S. In comparison, real estate derivatives would allow investors to get exposure to a diversified portfolio of commercial real estate at minimum cost (fees to brokers and spreads to investment banks). Second, to acquire a piece of property entails months of due diligence before closing and it would take another few months to sell it when it is decided to dispose of the property. The long lead time in acquiring and disposing the physical property largely limits investors' ability to act in anticipation of changes in the marketplace or to respond to current market conditions. Real estate derivatives can speed up this process achieving a much quicker execution once the liquidity is fully developed in the market. Third, investors cannot short physical properties when the market is down and real estate has been an asset class where investors can only be long to make money. Real estate derivative provides a short-selling mechanism that would allow investors to hedge or make profit in a declining market." Jong Yoon Lim and Yi Zhang. A Study of Real Estate Derivatives. 2000

Limitations of Real Estate Benchmark Indexes

Traditional real estate indexes rely on appraisal, paired transaction and market capped methodologies to determine the investment returns associated with commercial real estate. Although each of these indexes have broad appeal in benchmarking, the traditional indexes suffer from significant disadvantages to support a liquid, sustainable, and reliable real estate derivatives market.

NAREIT, MSCI and Cohen & Steers Indexes use public market data to measure corporate stock performance that incorporates limits to measure the full capital stack that may result in differences to actual changes in property valuations. These indexes are used as benchmarks for over $100 billion of REIT ETFs and Mutual Funds.

NCREIF, RCA/Moody and IPD Indexes rely on private market data sourced from transactions and survey data. The private market data is collected for benchmarking Pension and Investment Trusts, Private Funds, and Separate Accounts. These indexes include a lag period created from transactional timing and the subjective nature of data discovery.

"There are two major types of commercial property price indexes in the U.S.- appraisal-based indexes and transaction-based indexes. In these two genres, noise tends to be more of a potential problem in transaction- based indexes, and lag tends to be more of a problem in appraisal-based indexes. In a traditional appraisal-based index all of the properties in the index population are appraised regularly and the index periodic returns are based on a simple aggregation of those appraised values each period. In the case of the NPI, this has the advantage of similarity to the way many institutional real estate investment funds in the U.S. mark to market their asset values and correspondingly report quarterly returns to their investors."

"Many U.S. fund managers are benchmarked wholly or partly on the NPI. As a result, the NPI has a particular use in derivatives of interest to the managers of such funds. Against these advantages, it must be recognized that the dampening of actual property market volatility caused by appraisal-based lag in the NPI may reduce a source of potential profit that might motivate some derivatives traders. In addition to the tendency of the underlying property appraisals to lag market prices, in the case of the NPI in the U.S., not all properties are seriously or independently reappraised every period that the index is reported. This causes a stale-appraisal effect that adds additional lag into the index. Traditionally, in the NPI, there has been a greater frequency of reappraisals in the fourth calendar quarter, and this has imparted an artificial seasonality to the index in that it tends to spike in the fourth quarter. Another consideration is that the NPI represents a relatively narrow segment of the population of U.S. properties. As of 2006, the NCREIF population of properties consisted of less than 10% of the value of investable commercial properties in the U.S., a much smaller percentage than the IPD Index represents in the U.K. For smaller market segments there may be only a few NCREIF properties available in the index and their specific identities generally cannot be concealed, yet the underlying property appraisal process for each property is a fundamentally subjective evaluation made by a single appraiser or appraisal firm." David Geltner and Jeffrey Fisher, Pricing and Index Considerations in Commercial Real Estate Derivatives, 2007

Market-Based Indexes

The BRIXX Indexes measure real-time changes in commercial real estate valuations across various sectors of the commercial real estate market to support hedging, benchmarking, and portfolio allocation strategies for both public and private real estate investors using data that is updated through continuous real-time changes in equity share prices, 10Q, 10K, and interim period 8K filings.

- BRIXX Residential Index (BRIXR)
- BRIXX Retail Index (BRIXT)
- BRIXX Office Index (BRIXO)
- BRIXX Hospitality Index (BRIXH)
- BRIXX Composite Index (BRIXC)

Key features of the BRIXX Indexes include:

- Real-time pricing
- Aggregates $600+ billion in property values
- Unlevered returns
- Pricing in $/Sqft, $/Key, and $/Unit
- Leading correlations to private market benchmarks

Public and Private Markets are the Same Real Estate Assets

"lagged REIT returns are highly predictive of private market returns. However, when standard asset pricing control variables are included in the VARs, the significance of lagged REIT returns in the private market return equations is eliminated. That is, REIT returns do not appear to contain additional CRE specific information useful in predicting private market returns. These results strongly suggest that equity REIT returns simply react to fundamental (latent) asset pricing information more quickly than private market returns given their greater liquidity and transparency. Said differently, REITs serve as a fundamental information transmission channel to private market returns when asset pricing variables are omitted."

"We find that four lags (quarterly) provide the best fit. With four lags and a TBI return series starting date of 1994Q1, the estimated sample period spans 1995:Q1–2012:Q4. We report the sum of the four lagged coefficients of the endogenous variables and tests of their joint significance." David C. Ling and Andy Naranjo, Returns and Information Transmission Dynamics in Public and Private Real Estate Markets. 2015

"An important characteristic of investment property pricing that is revealed in part by price indexing is that real estate asset market pricing seems to share the characteristic of securities markets asset pricing that much of the volatility and cyclical price movements are driven more by capital market forces than by news or changes in the underlying operating cash flows that fundamentally undergird the value of the capital assets." David Geltner, Real Estate Price Indices & Price Dynamics: An Overview from an Investments Perspective. 2014

"This suggests that real estate may be fundamentally volatile, i.e., that the observed volatility in property values is not merely revaluation in the capital market due to "mood swings" or preference shifts among investors." Jeffrey D. Fisher, Alternative Measures of Real Estate Performance. Exploring the Russell-NCREIF Database. Fall 1994

"Expectedly, in the cases where pairwise cointegration is detected between REITs and direct real estate, the long-run accumulated responses of REITs and direct real estate closely resemble each other and the relative magnitudes of the responses are the same regardless of the origin of the shock, even though the short-run reactions typically differ substantially. The similarity between the real estate assets is substantially greater than that between REITs and the general stock market. In principle, the differences between REITs and the stock market might be due to different leverage levels. However, also the relative magnitudes of the reactions considerably vary between stocks and REITs. This is in line with the hypothesis that REITs reflect direct real estate performance more than it does overall stock market performance, and also with the variance decomposition results." Martin Heolsi, Elias Oikarinen, Are REITs Real Estate? Evidence from International Sector Level Data, 2012

Leverage & Volatility

"while REIT returns include the impact of leverage, the direct market indices consist of unleveraged properties. The magnitude of leverage naturally affects the mean and volatility of the returns. Therefore, we restate the REIT returns for the effect of leverage."

"We find evidence of cointegration between the public and private markets in all four U.S. sectors and in the U.K. retail sector. In three U.S. sectors and the U.K. retail sector the hypothesis of a one-to-one relation between the adjusted total return indices can be clearly accepted. The return volatilities generally do not differ significantly between REITs and direct real estate regardless of sector and time horizon." Martin Heolsi, Elias Oikarinen, Are Public and Private Asset Returns and Risks the Same Evidence from Real Estate Data, 2013

"While NAREIT includes the impact of leverage, the NCREIF indices consist of unleveraged properties. The magnitude of leverage naturally affects the mean and volatility of securitized real estate returns. The greater the leverage, the higher are the mean and standard deviation of returns." Elias Oikarinen, Martin Hoesli, and Camilo Serrano, The Long-Run Dynamics between Direct and Securitized Real Estate, 2011

Benefit of an Equal-Weighted Index

"... from a statistical perspective value-weighting implies that the NCREIF properties are being viewed as a complete "population" rather than as a representative "sample" of some larger population of properties. This suggests that an alternative view, and a corresponding alternative way of defining the index return, might be of interest. If we view the properties in the Russell-NCREIF database as a representative sample drawn from a larger population consisting of all "institutional grade" commercial properties in the country (not just those currently held for tax-exempt clients by NCREIF members), then an equal-weighted index might be more appropriate than a value-weighted one. In an equal-weighted index each property's return would count equally in the calculation of the quarterly index return. The individual property returns would simply be summed across all properties and divided by the total number of properties in the index that period." Jeffrey D. Fisher, Alternative Measures of Real Estate Performance. Exploring the Russell-NCREIF Database. Fall 1994.

MIAX License Agreement

Miami International Holdings, Inc. (MIH), the parent holding company of the MIAX®, MIAX Pearl™ and MIAX Emerald™ options exchanges (the MIAX Exchange Group™), and Advanced Fundamentals have partnered to develop a complex of proprietary financial products based on the BRIXX Indexes.

As part of this partnership, MIH has been granted an exclusive, worldwide license to develop and commercialize financial products based on the BRIXX Indexes. These products will be available exclusively on the MIAX Exchange Group. The first tranche of products, cash-settled options and futures on the BRIXX Indexes, are expected to be listed in 2021. All products remain subject to SEC and CFTC approval, respectively.

About MIH
Miami International Holdings, Inc. (MIH) is the parent holding company of Miami International Securities Exchange, LLC (MIAX®), MIAX Pearl, LLC (MIAX Pearl™) and MIAX Emerald, LLC (MIAX Emerald™ and together with MIAX and MIAX Pearl, the MIAX Exchange Group), three fully electronic options trading exchanges.

MIAX, MIAX Pearl and MIAX Emerald leverage the MIAX Exchange Group's industry-leading technology and infrastructure to provide their member firms with traditional pricing and pro rata allocation (MIAX), maker-taker pricing and price-time allocation (MIAX Pearl) market structures, and a hybrid market structure with maker-taker pricing and pro rata allocation (MIAX Emerald).

MIAX Options serves as the exclusive exchange venue for cash-settled options on the SPIKES® Volatility Index (Ticker: SPIKE), a measure of the expected 30-day volatility in the SPDR® S&P 500® ETF (SPY). The MIAX Exchange Group's executive offices and National Operations Center are located in Princeton, NJ, with a Miami Operations Center and additional offices located in Miami, FL. To learn more about MIH and the MIAX Exchange Group visit www.MIAXOptions.com.

Market factors

On August 31, 2016, the Global Industry Classification Standard (GICS ®) included a new sector for Real Estate.

Equity REITs and other real estate companies were reclassified from the Financial Sector to the newly created Real Estate Sector. Real Estate should now receive more attention from institutional investors, individual investors and financial advisors, expanding to a larger group of owners. More important, we have recognized that the reclassification has led to a significantly reduced correlation between publicly traded real estate securities and the broader market as a whole.

Commercial Real Estate comprises a large asset class that is crudely estimated at $16 trillion in total value in the U.S alone[1] – this can be compared with roughly $35 trillion of U.S. corporate equity and $33 trillion in household owned U.S. residential real estate. Of the $16 trillion, roughly half is thought to be composed of "institutional quality" assets. The institutional quality CRE asset base in the U.S. is comparable in size with the Treasury bond market or with the publicly traded corporate bond market. With increasing allocations to commercial real estate, it seems reasonable to expect that commercial real estate professionals working in institutional settings would face increasing pressures to deploy quantitative tools and transparency on par with the other components of their institution's portfolio.

In 2019, U.S. real estate transaction volume totaled more than $550 billion[2], representing nearly half of the global total, and more institutional real estate assets under management than the next three largest institutional markets combined; Japan, China and the U.K. This volume of activity provides steady opportunity for new real estate investment to include real estate derivatives, with futures, options and swaps under a common regulatory structure and shared market conditions with equities, bonds and commodities.

Market Coverage

BRIXX are the only indexes that use real-time data from the public markets to generate real-time, unlevered property valuations that do not require regression restraints, capped weighting, alternative market identifiers, and self-reporting.

BRIXX covers four (4) individual sectors and a Composite comprised of the four underlying sector returns:

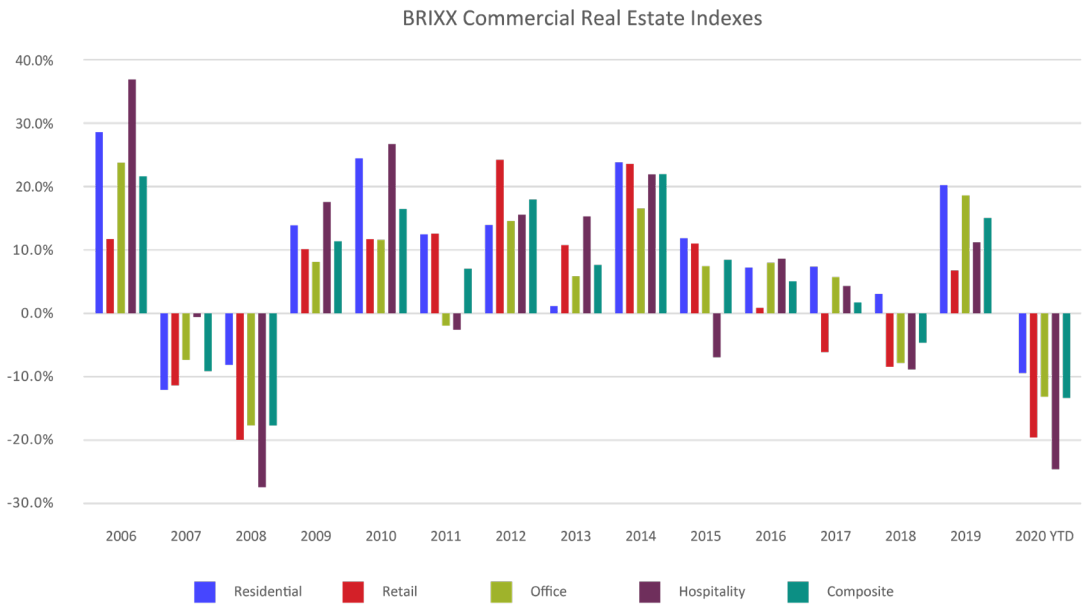
Sector	Components*	Pricing	Property Values**
Residential	15	$/Unit/1,000	$200 billion
Retail	15	$/Square Foot	$225 billion
Office	15	$/Square Foot	$130 billion
Hospitality	15	$/Key/1,000	$85 billion
Composite	60	Index	$640 billion

* If less than 15 components are eligible, the individual sector indexes will be calculated using less than 15 components, with a minimum of 10 components in each index. In the event that fewer than 10 companies are eligible for inclusion, the indexes will be supplemented with the next most eligible equity company to meet the minimum requirement within each individual sector until the minimum number of components is reached.

** As of 12/31/2019

1. https://www.reit.com/sites/default/files/Size%20of%20CRE%20market%202019%20full.pdf
2. https://www.cbre.com/research-and-reports/Global-MarketFlash-Global-Investment-Volume-Falls-by-2-in-2019-EMEA-Volume-Surges-in-Q4

Historical Unlevered Returns



2020 Coronavirus Impacts

It is times like these that highlight the power of capturing real time, unlevered commercial real estate values without the lag time inherent with traditional benchmarks and the leveraged returns as measured in the stock market.

At Advanced Fundamentals, we measure the real-time, tick-by-tick, impact of events to $600 Billion+ of commercial real estate assets across the residential, retail, office, and hospitality sectors. And the reality is that values have declined significantly due to the impact of this pandemic, and sector allocation has again proven to be paramount in portfolio construction strategies. What the 2008 market and the 2020 market have made clear is that there is a glaring absence in the commercial real estate market of the resources available to every other asset class- that is the ability to hedge in a liquid, transparent and timely market.

Index	Symbol	Value (03/31/2020)	YTD Δ*
Residential	^BRIXR	$280,300/unit	-15.88%
Retail	^BRIXT	$184.17/sq ft	-27.85%
Office	^BRIXO	$467.72/sq ft	-14.62%
Hospitality	^BRIXH	$281,150/key	-28.76%
Composite	^BRIXC	199.6	-19.52%

* Unlevered

Methodology

Individual Sector & Composite Index Unit of Measure

The individual sector indexes are commodity priced on per unit metrics ("Per Unit Values"):

- Residential- $/Unit/1,000
- Retail- $/Square Foot
- Office- $/Square Foot
- Hospitality- $/Key/1,000

The base values were calculated as the total Enterprise Value (as defined below) divided by the total number of units for each sector using 12/31/2005 values. The base values for the Composite were set at 100 using a 12/31/2005 date.

Index	Base Value	Pricing
Residential	$88.03	Per Unit
Retail	$132.83	Per SF
Office	$258.67	Per SF
Hospitality	$159.27	Per Key
Composite	100.00	Index

Component Selection

The composition of the Index is determined in a reconstitution on the Thursday before the third Friday of March, June, September, and December or the previous business day if this is a non-business day. At that time the most recent quarterly filing and share data are used as inputs. Devexperts Inc. (Devexperts) sources public data from audited SEC company filings and supplemental filings updated each quarter and intra-quarter based on 8-K, 10-Q, and 10-K filings.

Any routine changes to index components, other than changes due to Corporate Actions as described below, are made effective after the close on the third Friday of each quarterly month, or the previous business day if this is a non-business day.

The individual sector index components are determined from the equity companies that have the largest Enterprise Value within each individual sector and must also meet the minimum eligibility requirements. The individual sector index components are each an NMS stock as defined in Rule 600 of Regulation NMS under the Securities Exchange Act of 1934.

To be eligible for inclusion, an equity company must:

- be classified as an Equity Real Estate Investment Trust
- be listed on a U.S. Securities Exchange
- have a minimum Enterprise Value of $1 billion
- have at least 85% of its revenue derived from the associated asset class
- have issued a quarterly filing or annual report after their initial listing

If less than 15 components are eligible, the individual sector indexes will be calculated using less than 15 components.

Component Weighting

Component weights for all indexes are reset monthly. Each component is equally weighted taking into account each of the components' Leverage Ratio with the equity component equal to Market Cap/Enterprise Value, as described in the below equations. The weights are determined and Index Shares are set after the close on the Thursday before the third Friday of each month or the previous business day if this is a non-business day. At that time the most recent quarterly filing and share data are used as inputs. The new Index Shares are made effective after the close on the third Friday of each month, or the previous business day if this is a non-business day. Index weight not assigned to the REIT component securities is treated as a static cash balance.

For the Composite, each sector index is weighted in a ratio of the sum of its components Enterprise Values to the total sum of the Enterprise Values for all sector indexes.

Weighting of Components

Market Cap = Common Shares Outstanding * Common Share Price

Enterprise Value = Market Cap + Total Liabilities + Minority Interest + Preferred Equity – Cash & Equivalents

Leverage Ratio = 1- (Market Cap /Enterprise Value)

Initial Component Index Weight = (1-Leverage Ratio)/Number of Components

$\text{Per Unit Value}_i = \text{Enterprise Value}_i / \#\ \text{Units}$

# of Units
The # of Units for each Component is sourced from the latest quarterly filings and earnings reports (10-Q, 10-K, 8-K, or Supplemental).

BRIXX Residential Index = amount of residential units owned by the Component.
BRIXX Retail Index = amount of square footage owned by the Component.
BRIXX Office Index = amount of square footage owned by the Component.
BRIXX Hospitality Index = amount of hotel rooms owned by the Component.

The weights are then adjusted to take into account Per Unit Value for each component, using the most recent two quarterly Per Unit Values.

$\text{Adjustment}_i = (PUV_2 - PUV_1)/ PUV_1$

$Z_i = (\text{Adjustment}_i/\text{sum}(\text{Adjustment}_i)) * \text{avg}(\text{Adjustment}_i)$

$\text{Adjusted Weight}_i = (Z_i * \text{sum}(\text{weight}_i) + \text{weight}_i) / (1 + \text{avg}(\text{Adjustment}_i))$

These are the final weights used at each monthly rebalance to determine the index shares for each component.

Index Calculation

Individual Sector Index Returns are calculated as follows:

$$Index_t = \frac{\sum_{i=1}^{n} x_{i,t} * p_{i,t}}{D_t}$$

Where:

$x_{i,t}$ **= Number of Index Shares of the Index Component i on Business Day t**

$p_{i,t}$ **= Price of Index Component i on Business Day t**

D_t **= Divisor on Business Day t**

n **= Number of Index Components**

Composite Index Return is calculated in the same manner, with each component a sector index.

Modified Market Capitalization-Weighted Index Discussion

The BRIXX Indexes are modified market capitalization-weighted indexes. The Market Capitalization is used to determine the weight of each component in the following manner: First, the Market Capitalization is divided by one (1) minus the Enterprise Value (which is calculated as the Market Capitalization plus Total Liabilities plus Minority Interest plus Preferred Equity minus Cash and Equivalents) – which is called the "Leverage Ratio"; then, the Component Index Weight is calculated as one (1) minus the Leverage Ratio divided by the number of components.

Corporate Actions

Adjustments to the indexes may be made with respect to corporate actions of the components as follows:

Spin-off: A spun-off entity will be added to the index per the terms of its distribution.

Special Cash Dividend: Special Cash Dividends are treated the same as other dividends whereby the price of the day before the ex-date is adjusted for the special cash dividend.

Rights Offering: A Rights Offering is treated as a market-capitalization-neutral event, i.e., the weight of the company is maintained until the next adjustment to the balance sheet is made, using the adjusted market capitalization post rights offering.

Merger: A company that is merged into another company will be removed from the index upon the closing of a merger. For companies that survive a merger, the weight of the company is maintained until the following quarter at which point an adjustment to the balance sheet is made, using the post-merger financial statements.

Bankruptcy/Delisting: If an index component files for bankruptcy protection or is delisted from its principal exchange because of reasons like failure to meet financial or regulatory standards, bankruptcy proceedings, or extreme financial distress, it will be removed from the index.

If a component is removed due to a merger transaction, bankruptcy, or delisting, the weighting of the removed component will be proportionally redistributed over the remaining index components.

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Appendix Contract Specifications

BRIXX™ Indexes Contract Specifications

Description	BRIXX™ Commercial Real Estate (CRE) Indexes measure real-time real estate returns. Indexes are priced using real-time public market data that aggregates over $600 billion in property values, measuring unlevered returns in commodity pricing. The Composite Index measures the weighted average returns of the four underlying BRIXX Indexes (Residential, Retail, Office, and Hospitality). The index consists of up to 60 publicly traded real estate investment trusts / equity companies, which comprise the four underlying sector returns that are listed on a U.S. Securities Exchange..
Symbols	BRIXR, BRIXT, BRIXO, BRIXH, BRIXC
CUSIP	TBD
Strike Interval	Strike price intervals are set at $2.50 where the strike price is $50 or less, and at $5 where the strike price is greater than $50.
Minimum Trading Increment	$0.05 for series trading below $3 and $0.10 for series trading at or above $3. Complex Orders and PRIME Price Improvement Auctions are in $0.01 increments.
Expiration Date	The third Friday of the expiration month.
Expiration Month	Up to twelve expiration months. Short-term, quarterly and LEAPS may also be available.
Exercise Style	European
Last Trading Day	Trading will ordinarily cease at 4:00 p.m. (Eastern Time) on the Thursday preceding an expiration Friday.
Settlement Type	Cash
Settlement Value	The exercise and settlement value will be calculated using the opening sales price in the primary market of each component security on the expiration date. The exercise-settlement amount will be equal to the difference between the settlement value and the exercise price of the option, multiplied by $100. Exercise will result in the delivery of cash on the business day following expiration.
Settlement of Exercise	Next business day following expiration.
Position and Exercise Limits	The position limit is 25,000 contracts on the same side of the market.
Trading Hours	9:30 a.m. - 4:00 p.m. (Eastern Time)