![CME Group logo] **CME Group**
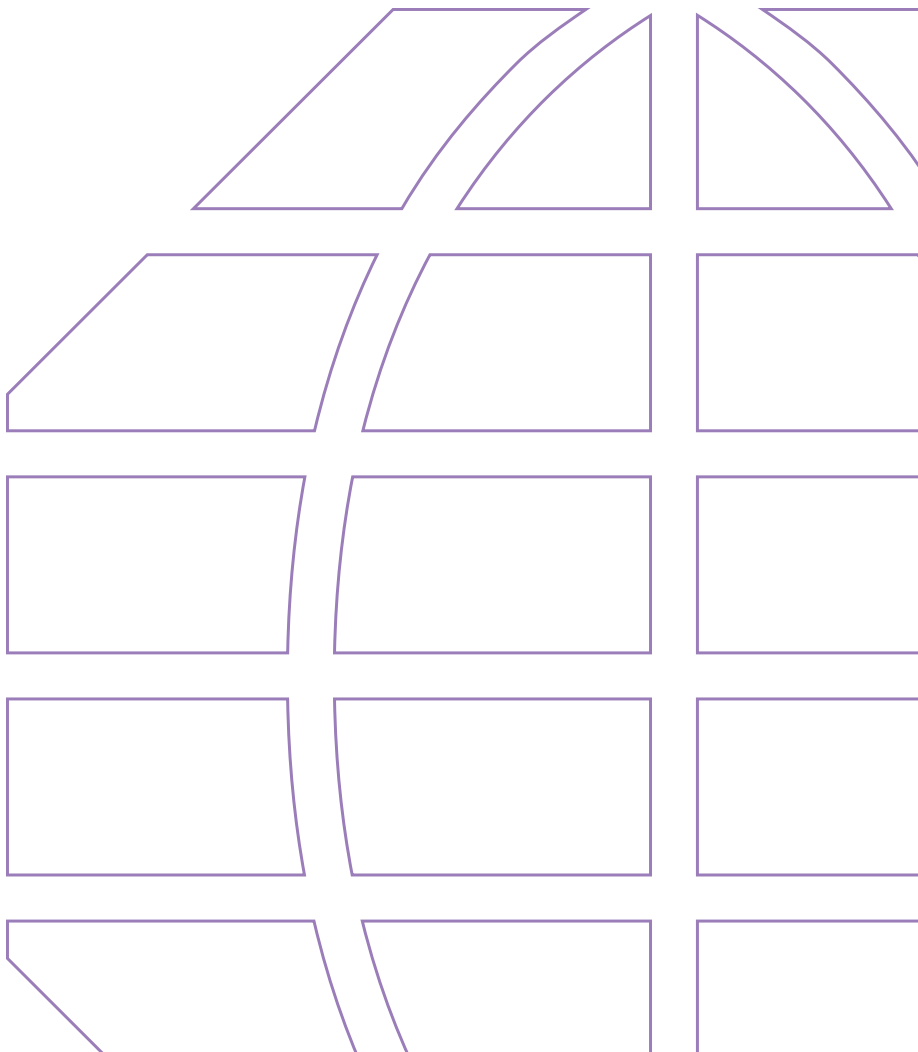A CME/Chicago Board of Trade/NYMEX Company

RESEARCH AND PRODUCT DEVELOPMENT

Spread Trading U.S. and Brazilian Stock Index Futures

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This article discusses potential opportunities from spread trading E-mini S&P 500 vs. Mini Ibovespa futures and important facets to the trade setup.

One of the most intriguing aspects of the electronic linkage between CME Group and BM&F Bovespa is the possibility of spread trading various stock index futures between the two markets. While the objective of trading is first and foremost to benefit from the fluctuation of prices – buying when the instrument is priced low and selling when the instrument is priced high – the remoteness of the overseas market presents the trader with an access latency disadvantage versus the local trader. This disadvantage is more pronounced if the trading strategy calls for a relatively high trading frequency.

By spreading between two highly correlated instruments, the nature of the strategy changes from buying and selling each instrument separately – and hence requiring high trading frequency – to buying the instrument that is temporarily cheap and selling the instrument that is temporarily expensive relative to one another, thus reducing the trading frequency and mitigating the impact of the latency disadvantage.

In this article, we explore certain aspects of constructing such a trade – i.e., what constitutes a reasonable spread between two index futures and the attendant risk factors, such as currency exposure. We will not examine the methodology for predicting the relative cheapness or richness of the contracts. The "indicators" of richness/cheapness are proprietary in nature, and each trader should develop his or her own view. Although it is possible to spread trade among all the liquid index futures at the CME Group exchanges and BM&F Bovespa, for simplicity, we will illustrate our arguments with a hypothetical spread between the E-mini S&P 500 futures listed at CME and the Mini Ibovespa futures listed at BM&F Bovespa.

Nature of Spread Trades

Before we delve into the details of constructing a spread trade, we first need to confirm that the spread is reasonably well-behaved and therefore a good candidate for spread trading purposes.

Exhibit 1 shows the intraday correlation between the S&P 500 and Ibovespa indexes. The sample is taken from the March 27 – October 9, 2009 time period during common trading hours. The correlation between the two indexes is based on 1-, 5-, 10-, 15- and 30-minute intervals.

EXHIBIT 1: Intraday correlations over varying time intervals between S&P 500 and the Ibovespa indexes for March 27 – October 9, 2009.

Interval	1 min	5 mins	10 mins	15 mins	30 mins
Intraday Corr.	69.09%	80.40%	81.69%	81.87%	81.51%

The observed correlations are not as high as those among U.S. domestic stock indexes[1] but may still be quite significant, and appear to be more than statistical patterns. Many of the large constituents of the Ibovespa index also trade in the U.S. stock market in the form of American Depository Receipts (ADRs).

In fact, statistics show that over 75 percent (by weight) of the stocks of the Ibovespa Index are traded as ADRs in the U.S. market. Furthermore, the trading volumes of these ADRs are large and comparable with the underlying stocks listed in Brazil. Some trading volume even exceeds the underlying listings. The overlapping trading hours between the U.S. and Brazil imply that cross border arbitrage of ADRs and their corresponding stocks in Brazil is possible.

1. Typically, intra-day correlations among various U.S. domestic indexes are above 90 percent.

Looking at the composition of the two indexes (as shown in Exhibit 2), the sector representations are quite different – over 72 percent of the Ibovespa Index is weighted in energy, basic materials and financials. While these three sectors also are prominently featured in the S&P 500 Index, their combined weights are below 30 percent. As such, the performance of the two indexes is expected to diverge to some extent.

EXHIBIT 2: Sector weighting comparison between the S&P 500 and the Ibovespa indexes.

| Main Ibovespa Sectors*	
Oil & Gas	19.27%
Basic Materials	31.02%
Financial	21.97%
Construction and Transportation	6.03%
Consumer Non Cyclical	6.34%
Consumer Cyclical	3.22%
Information Technology	0.00%
Telecommunications	4.32%
Utilities	7.16%
Capital Goods and Services	0.67%

Industry Classifications: Bovespa

Main S&P 500 Sectors**	
Energy	12.40%
Basic Materials	3.20%
Financial	13.60%
Industrials	9.90%
Consumer Discretionary	9.00%
Consumer Staples	12.00%
Information Technology	18.30%
Telecommunications	3.50%
Utilities	4.10%
Health Care	14.00%

**Industry Classifications: GICS*

As a result, we expect correlation between the indexes, but not so much so that the changes in relative valuation between the two indexes become trivial. Exhibit 3 shows the intraday chart of the two indexes on a randomly selected trading day. The two indexes take turns gaining on one another throughout the day. As such, it might be logical to conclude that the index pair qualifies as a reasonable candidate for spread trading.

Contract specifications are provided at the end of this paper. Unlike common inter-commodity spread strategies such as E-mini S&P 500 vs. E-mini Dow ($5) futures, spread trading of E-mini S&P 500 vs. Mini Ibovespa futures contracts is affected by fluctuations in currency exchange rate, as the two contracts are denominated in different currencies. We will discuss this later in the article.

EXHIBIT 3: Intraday index level movements of S&P 500 and Ibovespa indexes on October 5, 2009.
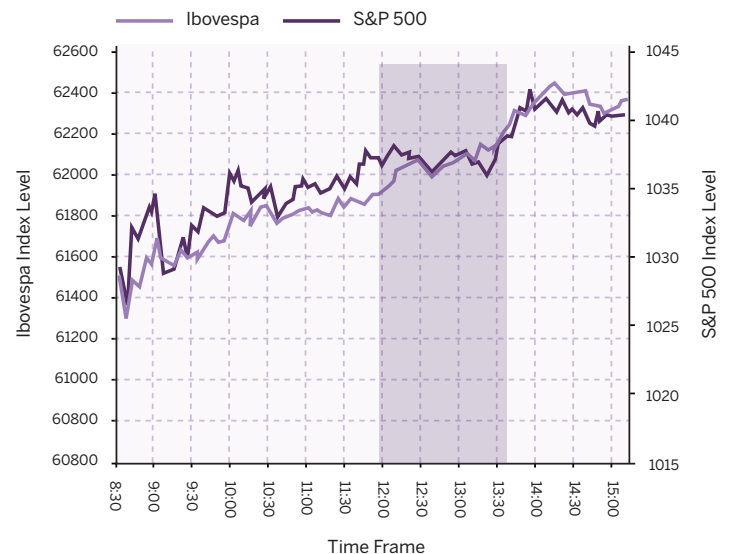
Now let's turn to the construction of an index spread trade. The most intuitive spread is to buy one index futures and sell the other index futures using a number of contracts that would equate the long and short positions with approximately the same notional value, after accounting for currency conversion.

Suppose we enter into a "notional value neutral" spread trade on October 5, 2009, to sell E-mini S&P 500 futures and buy Mini Ibovespa futures at 12:00 p.m. Chicago Time (CT). The notional value of a 100-lot E-mini S&P 500 futures is simply 100 x $50 (multiplier) x 1,033.00 (current index level) = $5,165,000.

At the then prevailing spot Brazilian Real (BRL)/US Dollar (USD) exchange rate of 1.768, buying 737 Mini Ibovespa futures contracts at the price of 61,955 will produce a notional value of BRL 9,132,167, or USD $5,165,252.

Subsequently, the opposing positions in E-mini S&P 500 and Mini Ibovespa futures will produce offsetting gains and losses. Suppose that the positions are closed out at 1:45 p.m. CT at the then prevailing prices, the loss in the short E-mini S&P 500 position of USD $12,500 would be offset by the gain in the mini Ibovespa futures of BRL 67,804. If the exchange rate remains at 1.768, combined P/L would be USD $25,851. Exhibit 4 shows the breakdown of the calculation.

EXHIBIT 4: Simple spread trade example, based upon real prices as of October 5, 2009.

Selling Short E-mini S&P 500					
Time	Price	# Cnts	Notional value		
12:00 p.m.	1033.00	Sell 100	USD $5,165,000		
1:45 p.m.	1035.50	Buy 100			
Net	+2.50	P/L	- USD $12,500		
Buying Long Mini Ibovespa					
Time	Price	# Cnts	Notional value	BRL/USD	USD-Equiv
12:00 p.m.	61955	Buy 737	BRL 9,132,167	@1.768 =	USD $5,165,253
1:45 p.m.	62415	Sell 737			
Net	+460	P/L	+BRL 67,804	@1.768 =	USD $38,351

EXHIBIT 5: Volatility adjusted spread trade example based upon real prices as of October 5, 2009.

Selling Short E-mini S&P 500					
Time	Price	# Cnts	Notional value		
12:00 p.m.	1033.00	Sell 100	USD $5,165,000		
1:45 p.m.	1035.50	Buy 100			
Net	+2.50	P/L	- USD $12,500		
Buying Long Mini Ibovespa					
	Price	# Cnts	Notional value	BRL/USD	USD-Equiv
12:00 p.m.	61955	Buy 688	BRL 8,529,444	@1.768 =	USD $4,824,346
1:45 p.m.	62415	Sell 688			
Net	+460	P/L	+BRL 63,329	@1.768 =	USD $35,820

Volatility Adjustments

The preceding analysis does not account for the fact that different indexes tend to have different volatilities. Indeed, the sector weightings in Exhibit 2 show that the more volatile sectors (energy, basic material and financials, especially in the last year) are featured more prominently in the Ibovespa Index, whereas the less volatile healthcare sector is virtually non-existent. The net result is a more volatile Ibovespa Index relative to the S&P 500 Index.

Given the difference in volatility, if one buys and sells the two index futures with the same notional value, the higher volatility of the Ibovespa Index implies that the resulting spread between the two index futures would carry net market directional risk. Although there is nothing inherently wrong with carrying market directional risk, it does appear to be at odds with the objective of profiting from the temporary relative richness/cheapness between the two contracts, or in other words, to capture the relative pricing without being exposed to market directional risk. Assuming that we would like to eliminate the volatility induced directional risks, the exercise is rather logical and straightforward. It does, however, require additional statistical analysis.

For instance, if we perform a linear regression of 1-minute returns of the two indexes, the regression coefficient estimate[2] of S&P 500 on Ibovespa equals 0.934. Confirming that Ibovespa is more volatile than the S&P 500 Index at this time.

Put differently, if we put equal notional value in each contract on a spread trade, we are exposing ourselves to a market directional risk to the tune of 6.6 percent of the notional value.

Armed with this recognition, we may want to reduce the notional exposure of Ibovespa by the same amount. The volatility adjustment hedge ratio for the trade in Exhibit 4 should be adjusted downward to 100:688 (i.e., 737 contracts x 0.934).

Currency Hedges

Regardless of how you construct the spread ratio, an important factor of the spread trade is the ability to convert the profit and losses denominated in two different currencies into one. As we illustrated earlier, the Ibovespa P/L is in Brazilian Real (BRL), while the E-mini S&P 500 futures is denominated in U.S. Dollars. The foregoing spread trades are designed to have (partially) offsetting P/L in two currencies while the stock market drifts in either direction, and to capture the relative pricing movement. Two important factors need to be recognized:

- **Outstanding debits and credits in different currencies –** Regardless of whether the spreads are closed out, there will be a debit balance in one currency and a credit balance in the other. The balances could be realized or just projected based on marking to market valuation. In other words, within the accounts is a currency exposure that needs to be closed out or hedged. Either an outright currency spot trade or a currency futures trade may be advisable. For Brazilian domiciled traders, converting both credit and debit balances to BRL may be more convenient. The BM&F Bovespa USD futures might be handy.

- **Ongoing spread ratio monitoring –** As with any spread trades, the appropriate spread ratio may drift over time before the positions are closed. Traders need to maintain a lookout for dramatic changes in hedge ratio given changes in the exchange rates between the two currencies.

Given the nature of spread trading, small mistakes tend to be magnified – possibly enough to overwhelm an otherwise profitable trade.

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2. The estimated statistical relationship between the S&P 500 and Ibovespa indexes was found to be:

$$\Delta \text{SPX} = 0.934 * \Delta \text{IBOV} - 0.000004 + \epsilon$$

Note that the coefficient estimate depends on the sampling methodology and period. We include our result here for illustrative purpose only.

Currency Correlations

Apart from the need to use periodic currency hedges, the foregoing discussion has equal relevance to spreading index futures with the same underlying currencies as to spreads involving futures with different underlying currencies. For cross-currency index futures spreads, however, there is one more consideration to explore – that of the currency correlation.

As with most emerging markets, the Brazilian Real appears to be strongly correlated with the global risk appetite – the same risk appetite that also drives the global stock market pricing. The graph in Exhibit 6 shows the rolling correlation between the Ibovespa Index and the USD/BRL exchange rate.

More specifically, it appears that Brazilian Real strengthens when the global stock market gains. As such, a hypothetical spread of long Mini Ibovespa futures and short E-mini S&P 500 futures behaves as if it possesses some embedded positive "gamma."[3] We will illustrate the consequences as follows:

- When global stock market gains, there is a tendency for BRL to strengthen along with the buoyant stock market. As such, the gain from the long position in Mini Ibovespa futures will be compounded by the currency gain; i.e., the BRL profit is further propelled when the currency gains vis-à-vis U.S. dollars. While the short E-mini S&P 500 will likely pose a loss, the gain from Mini Ibovespa futures in the spread (constructed based on a lower Brazilian Real exchange rate) would have more than offset it.

- Conversely, when the global stock market declines and BRL declines along with it, the losses from the long position in Mini Ibovespa futures would have been mitigated given the weakened Brazilian Real exchange rate vis-à-vis U.S. dollars.

To further illustrate the currency effect, the volatility adjusted spread trade on October 5, 2009, is demonstrated in Exhibit 7, with P/L from the Mini Ibovespa futures position converted at the then prevailing BRL/USD exchange rate. Because Brazilian Real appreciated against U.S. dollars as the Ibovespa Index advanced at 13:45 p.m. compared to 12:00 p.m., the gain from long position in Mini Ibovespa futures was boosted by about $111 due to the currency effect.

EXHIBIT 6: Ibovespa index level and USD/BRL exchange rate historical trends from September 30, 2002 – September 30, 2009.

Correlation = 60.91%

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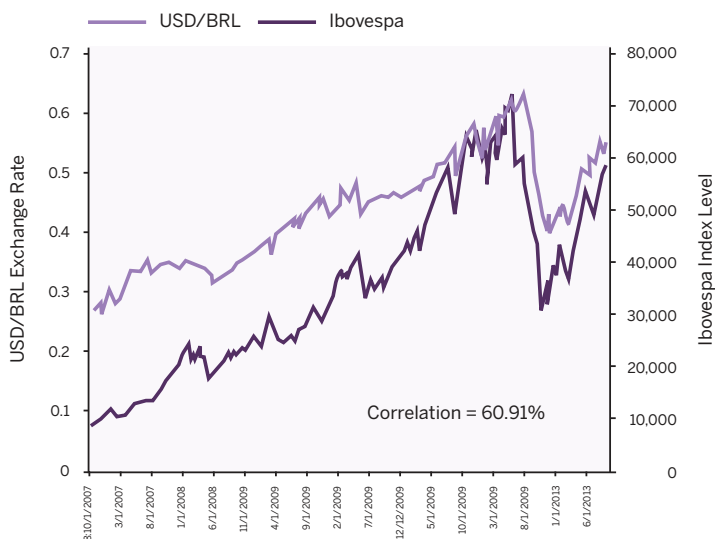
3   For derivatives such as options, "delta" is the sensitivity of the price of the derivatives to the price of the underlying security, while "gamma" is the sensitivity of delta to the price of the underlying security. More specifically, for a call option, gamma is positive, meaning that as the underlying security increases in value, the delta also increases.

   While there is no explicit gamma in the spread trade, the USD-equivalent multiplier of the iBovespa contract is positively related to the value of BRL, which in turn is positively correlated with the index – from a statistical point of view. As such, the spread would appear as if it has an embedded positive gamma.

EXHIBIT 7: Volatility and currency exposure adjusted spread trade, based upon real prices as of October 5, 2009.

Selling Short E-mini S&P 500					
Time	Price	# Cnts	Notional value		
12:00 p.m.	1033.00	Sell 100	USD $5,165,000		
1:45 p.m.	1035.50	Buy 100			
Net	+2.50	P/L	- USD $12,500		
Buying Long Mini Ibovespa					
Time	Price	# Cnts	Notional value	BRL/USD	USD-Equiv
12:00 p.m.	61955	Buy 688	BRL 8,529,444	@1.768 =	USD $4,824,346
1:45 p.m.	62415	Sell 688			
Net	+460	P/L	+BRL 63,329	@1.763 =	USD $35,931

Of course, we are identifying the tendency for the currency / stock market correlation only. It is possible for the reverse to happen – i.e., the stock market rally coupled with a weakening of BRL. We are simply identifying the tendency of the correlation to fall in favor of a long Mini Ibovespa/short E-mini S&P 500 futures spread.

While the currency correlation consideration often seems small in magnitude when the spread position is only open for a short period of time (such as minutes or hours), the market is prone to bouts of dislocation or price gaps – leading to potentially serious consequences. For back-of-the-envelope calculation purposes, one can reason via the following mathematics:

For a USD $5 million notional value spread, a 2 percent change in exchange rate will lead to a spread ratio mismatch of USD $5 million x 2 percent, or USD $100,000. This type of price gaps, while more likely to happen overnight, is not out of the realm of possibilities. Such large price gaps are likely to be accompanied by large price gaps in indexes as well. If the index move is also 2 percent, we are looking at a P/L of USD $2,000. Given the nature of the spread trade, it is likely that significant leverage has been deployed. The USD $2,000 P/L could represent a very significant portion of the capital. Further, such a large dislocation also is likely to accompany equally significant changes to the relative valuation between the Ibovespa and the S&P 500 indexes. When contemplating a cross-currency spread, this is a significant factor to consider.

For more information, visit www.cmegroup.com/equities.

APPENDIX - Salient features of CME E-mini S&P 500 Futures and BM&FBOVESPA Mini Ibovespa futures.

	CME E-mini S&P 500 Futures	BM&F BOVESPA Mini Ibovespa Futures
Contract Multiplier	USD $50	BRL 0.2
Minimum Price Chg	0.25 Index points =$12.50	5 Index points =BRL1
Final Settlement	Cash-settled to SOQ of the S&P 500 Index on 3rd Friday of the contract expiry month	Cash-settled at the settlement Ibovespa published by the São Paulo Stock Exchange
Last Trading Day	8:30 a.m. on the 3rd Friday of the contract month on Globex	Wednesday closest to the 15th calendar day of the contract month
Contract Months	6 Quarterlies	Even-numbered months as authorized by BM&F
Trading Venue	CME Globex	CME Globex – GTS ordering routing system
Position Limits	100,000 contracts in conjunction with S&P 500 Futures	Greater of 20% of the total open interest per contract month for either contract or 20,000 Mini contracts per contract month
Exchange	Listed on and subject to the rules and regulations of CME	Listed on and subject to the rules and regulations of BM&F Bovespa

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