The Big Picture: A Cost Comparison of Futures and ETFs

How the world advances

CME Group

EXECUTIVE SUMMARY

- This report compares the all-in cost of replicating the S&P 500 total return via equity index futures and exchange-traded funds (ETFs) across a variety of different use cases and time horizons.
- The specific products used in the analysis are the CME E-mini S&P 500 future and the three US-listed S&P 500 ETFs: the SPDR SPY, iShares IVV and Vanguard VOO.
- The analysis begins with a detailed look at the components of total cost and the assumptions that underlie the calculations. This includes observations about recent changes in the implied financing rates of futures and the drivers of these moves.
- The total cost of index replication across a range of time horizons is calculated for four common investment scenarios: a fully-funded long position, a leveraged long, a short position and a non-US investor.
- The choice between futures and ETFs is not an either-or decision. E-mini S&P 500 futures are shown to be more cost-effective than S&P 500 ETFs for leveraged, short and non-US investors across all time horizons.
- For fully-funded investors, the optimal choice depends on time horizon. Investors with holding periods up to four months are better served by futures, while for longer holding periods, ETFs are preferable with the VOO the most cost efficient alternative.

	Cheapest Option	
Scenario	**Short Term (<3m)**	**Long Term (>3m)**
Fully-Funded	Futures	ETFs
Leveraged (2x, 8x)	Futures	Futures
Short Seller	Futures	Futures
International	Futures	Futures

INTRODUCTION

This report compares the all-in cost of replicating the S&P 500 total return[1] via equity index futures and ETFs.

Given the diversity of clients and potential uses for both ETFs and futures, there is no "one-size-fits-all" answer to the question of which is more cost efficient. The optimal choice depends on the details of both the client and the specific trade.

The approach is therefore to consider four common investment scenarios – a fully-funded long position, a leveraged long, a short position and a non-US investor – and compare the costs of index replication with futures and ETFs in each. While these scenarios do not represent all possible applications for either product, they cover the majority of use cases and analysis of the scenarios provides insights into factors that investors should consider when making their implementation decisions.

This analysis compares the CME E-mini S&P 500 future (ticker: ES) with the three US-listed S&P 500 ETFs: SPDR S&P 500 ETF (SPY), iShares Core S&P 500 ETF (IVV) and Vanguard S&P 500 ETF (VOO).

COST ESTIMATES AND ASSUMPTIONS

The goal of this report is to quantify the cost of replicating the total return of the S&P 500 index over a given period of time using equity index futures and ETFs. The framework for analysis will be that of a mid-sized institutional investor executing through a broker intermediary (i.e. not DMA) for a hypothetical order of $100 million.

The total cost of index replication is divided into two components: *transaction costs* and *holding costs*.

Transaction Costs

Transaction costs are expenses incurred in the opening and closing of the position. These apply equally to all trades, regardless of the time horizon.

Commission: The first component of transaction cost is the commission or fee charged by the broker for the execution. These charges are negotiated between parties and vary from client to client. This analysis assumes execution costs of $2.50 per contract (0.25 bps) for E-mini futures and 2.5 cents per share (1.25bps) for ETFs.[2]

Market Impact: The second component of transaction costs is market impact, which measures the adverse price movement caused by the act of executing the order.

Market impact can be very difficult to quantify. In the simplest case – an unlimited market order sent directly to the exchange – the impact can be accurately defined as the difference between the market price immediately prior to the order being submitted and the final execution price of the trade. However, as the execution methodology becomes more sophisticated and extends over a longer period of time (e.g. a working order participating at 25% of the volume, or an over-the-day VWAP target) it becomes increasingly difficult to separate the impact that was *caused by* the trade from market movements *unrelated* to the trade.

The analysis in this report requires an estimate of the *expected* market impact from a hypothetical execution, rather than the actual impact of any specific trade. This anticipated impact is therefore a statistically-based estimate and may be very different from that of any particular execution.

In deriving this estimate for the anticipated market impact, it is important to factor in the transfer of liquidity that occurs between different products tracking the S&P 500.

1 *Price return plus dividends.*

2 *These rates are indicative of typical "middle of the range" pricing for institutional clients. While commissions and fees are a focus for short-term traders, in the context of the longer-term analysis here, they make only a very small contribution to the total cost.*

When facilitating investor orders in any one of the products under consideration, liquidity providers will hedge with the least expensive alternative between futures, ETFs and the replicating stock portfolio. This creates a "pool" of S&P 500 liquidity in which each product benefits from the liquidity of the others, which in turn greatly increases the liquidity of all products.

Based on broker estimates and CME's own analysis, the market impact of the hypothetical $100m order is estimated to be 1.25bps for E-mini futures, 2.0bps for the SPY ETF, and 2.5bps for both IVV and VOO.

Table 1: Liquidity Comparison

Product	AuM / OI ($Bn)	ADV ($Mn)
ES	291.6	161,843
SPY	194.7	21,113
IVV	70.7	824
VOO	30.4[3]	232

Full year 2014 ADV averages. AuM / OI as of 18 Feb, 2015.
Source: CME and Bloomberg

As a "sanity check" on these values, it is observed that $100 million represents 0.06% of the average daily notional value traded in the ES future of approximately $162 billion (2014 average). As such, a 1.25bps impact estimate – equivalent to one tick increment – appears reasonable.

Given that the liquidity of the ES future is nearly 8x that of the SPY and more than 150x that of the IVV and VOO *combined*, the impact estimates for these products initially appear quite low. However, if one factors in the liquidity pool effect in the S&P 500 and the frictional costs of converting between the various products, the incremental cost of 0.75bps for SPY and 1.25bps for IVV and VOO – corresponding to approximately 1.5cps and 2.5cps, respectively – appear reasonable.

Holding Costs

Holding costs are expenses that accrue over the time the position is held. These generally grow linearly with time (e.g. ETF management fees which accrue daily) although there are some, which are discrete but recurring (e.g. execution fees on quarterly futures rolls).

The sources of holding costs for ETFs and futures are different, owing to the very different structures of the two products.

ETFs: The holding cost of an ETF is the management fee charged by the fund for the service of replicating the index return (generally through the purchase and maintenance of the underlying stock portfolio). The management fee for the three ETFs in our analysis ranges between 5.0 and 9.45bps per annum.

A second potential source of holding cost would be tracking error between the fund's returns and those of the index (other than those due to the application of the management fee). This risk will be ignored in the analysis that follows, as it has never been an issue with the ETFs under consideration and as such, there is very limited basis for estimating the magnitude or impact of potential deviations.

Futures: Futures contracts are derivatives and provide leverage. Unlike an ETF, where the full notional amount is paid by the buyer to the seller at trade initiation, with futures contracts no money changes hands between the parties. Rather, both buyer and seller deposit margin of approximately 5%[4] of the notional of the trade with the clearing house to guarantee their obligations under the contract.

As compared with the ETF management fee, buyers of futures contracts are implicitly paying the sellers not only to replicate the index returns, but also to do so with their

3 The VOO ETF is a share class of Vanguard's unlisted S&P 500 Index Fund which has $195.8 billion in AuM.

4 At time of writing the margin requirement on E-mini S&P futures is $4,600 on a contract notional of roughly $100,000. Margin amounts are subject to change.

own money. As a result, the price of a futures contract contains a component that represents the interest charges on these "borrowed" funds[5].

Given the trading price of the futures, one can infer the rate that the market is implicitly charging on these "borrowed" funds. While this funding cost is implied in all futures transactions, it is most readily inferred from trading in the futures roll and frequently referred to as the "roll cost".

Comparing this implied interest rate with the corresponding USD Libor rate over the same period, one can calculate the spread to Libor, and determine whether the future is rolling "rich" (implied funding above Libor, positive spread) or "cheap" (implied financing below Libor, negative spread).

For a fully-funded investor (i.e. one that has cash equal to the full notional value of the position), the richness or cheapness of the roll is not merely a "theoretical" cost but the actual holding cost for index replication via futures. The investor realizes this cost by buying the futures contracts and holding his unused cash in an interest-bearing deposit. Through the futures contracts he pays the implied financing rate on the full notional of the trade, while on the unused cash on deposit he receives a rate of interest, which we assume to be equal to 3m Libor[6]. The difference between the interest paid and interest earned is the holding cost of the position and is equal to the richness or cheapness of the roll.

Observations on the Futures Roll

Unlike a management fee, the implied financing cost of the quarterly futures roll is not constant but determined by the forces of supply and demand and arbitrage opportunities in the market.

Historically, the implied spread to Libor of ES futures was below the lowest management fees on any ETF. Over the 10 year period between 2002 and 2012, the ES futures roll averaged 2 bps below fair value[7].

Since 2012, the pricing of the roll has become more volatile and traded at higher levels as shown in Figure 1, with the richness averaging 35bps in 2013 and 26 bps in 2014.

This recent richness is attributable to two main factors: changes in the mix between natural sellers and liquidity providers on the supply-side of the market, and changes to the costs incurred by liquidity providers (particularly banks) in facilitating this service.

In a balanced market, natural buyers and sellers trade at a price close to fair value – neither party being in a position to extract a premium from the other. When no natural seller is available, a liquidity provider steps in to provide supply (i.e. sell futures) at a price. The greater the demand on liquidity providers, the higher (and more volatile) the implied funding costs will be.

The persistently strong S&P 500 returns over the last three years – averaging 20.3% annual growth since the start of 2012 – has caused a decrease in the size of the natural short base as investors reduce shorts and bias their positions towards long exposure. This has increased the demand on liquidity providers – especially U.S. banks – to meet the excess demand.

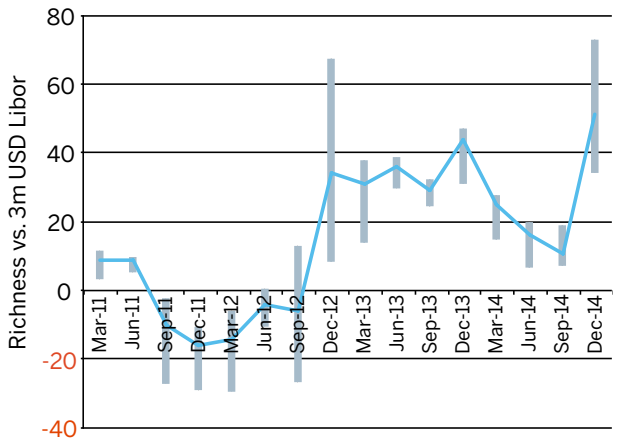
Beginning in 2013, however, changes in bank sector regulation have increased the capital and liquidity requirements for banks, making it more expensive for them to facilitate futures buyers. The result has been a higher implied financing cost in the futures rolls.

5 *The argument is symmetric for the seller. The short sale of an ETF would generate cash which would earn a rate of interest. The sale of a futures contract generates no cash and so the implied interest in the futures price compensates the seller for this.*

6 *As with other assumptions in the analysis, this value represents a "middle of the range" yield on uninvested cash.*

7 *Goldman Sachs, "Futures-Plus", 22 January, 2015.*

Figure 1: Roll Richness with High/Low Range[8]



Source: CME

It is unlikely that either of these factors represent permanent shifts in the market. In 2014 the roll market began to renormalize with the Mar, Jun and Sep rolls averaging just 17bps (less than half the Dec 2012 – Dec 2013 level) and trading as low as 7bps in Sep[9]. The subsequent richness of the Dec 2014 roll indicates that some year-end effects remain. However, there have already been indications that the opportunity to capture above-market financing rates is attracting new participants to the equity futures market, which will in turn drive yields lower.

As for the reduction in the natural short base, this is primarily a function of the low-volatility grind higher in equity markets which cannot continue indefinitely. An increase in volatility or an equity market correction will lead to an increase in natural short positions.

In the analysis that follows, E-mini S&P 500 futures are assumed to roll 20bps above 3-month USD Libor.

Table 2 summarizes the cost estimates used in the analysis. The execution fees of the quarterly futures roll are assumed to be the same as in the transaction cost, applied twice at each roll.

Table 2: Summary of Assumptions (in bps)

Product	Execution Fees	Market Impact	Holding Cost (per annum)
ES	0.25	1.25	20.0
SPY	1.25	2.00	9.45
IVV	1.25	2.50	7.0
VOO	1.25	2.50	5.0

SCENARIO ANALYSIS

Having established baseline transaction and holding cost estimates, it is now possible to compute the total cost of index replication via futures and ETFs for various use cases. This report will consider four scenarios: a fully-funded investor, a leveraged investor, a short seller and an international investor (i.e. non-US domicile). In each case, total cost is computed for all holding periods up to 12 months.

All scenarios assume the same transaction costs and recognize the round-trip fees and market impact at trade initiation. Futures roll costs are assessed on the Wednesday before each quarterly expiry.

While it is not specifically mentioned in explanations of each scenario, all futures carry calculations have been adjusted for the margin deposited with the CME clearing house, which does not earn interest. At current interest rates the impact is approximately 1.3bps / annum.

8 *The blue line shows the weighted average richness of the roll over the three weeks leading up to expiry, and the grey bars indicate the highest and lowest average daily rate over the period.*

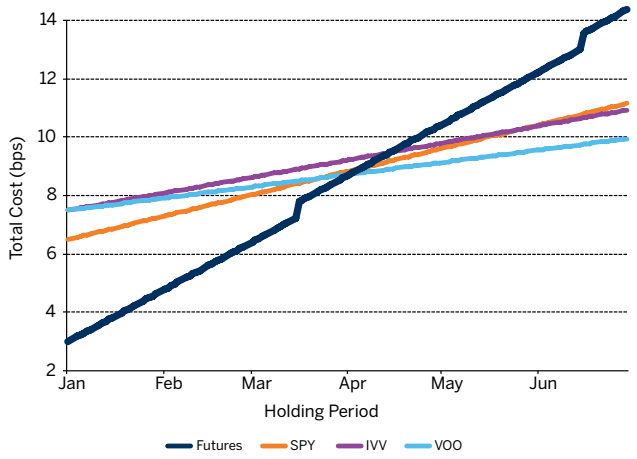
9 *Source: CME Equity Quarterly Roll Analyzer tool*

Scenario 1: Fully-funded Investor

For the fully-funded investor, the total cost of index replication over a given period is the sum of the transaction costs plus the pro-rata portion of the annual holding costs.

Figure 2 shows the cost of index replication via index futures and ETFs for time horizons out to six months assuming an initial trade execution on January 2, 2015 and the transaction and holding cost estimates in Table 2.

Figure 2: Fully-funded Investor, 6 months



The starting point for each graph (the intersection with the vertical axis) represents the round-trip execution cost, ranging from 2.9bps for futures to between 6.5 and 7.5 bps for ETFs. The lines slope upward as time passes, reflecting the gradual accrual of the annual holding costs, with small jumps in the futures line due to the cost of quarterly futures rolls. Because the annual management fees on the ETFs are below the implied richness of the futures, the graphs of the ETFs slope upward more slowly than that of the futures.

For short holding periods, the higher transaction costs of the ETFs make the futures more economically attractive (futures line below all three ETF lines). This makes futures a particularly attractive tool for more active, tactical and short-term traders. For longer-term holders, the cumulative effects of higher implied financing make the ETF a more efficient alternative.

The breakeven point at which ETFs become a more economically efficient alternative occurs in the fourth month. In this specific example, the VOO breakeven arrives first on April 3 (91 days), followed the SPY on April 7 (95 days) and the IVV on April 16 (104 days).

Extending the analysis out to a 12-month holding period, one can see that ETFs are cheaper than futures by between 10.2 and 13.7bps. These results are consistent with recent analysis published by sell-side banks[10].

Figure 3: Fully-funded Investor, 12 months

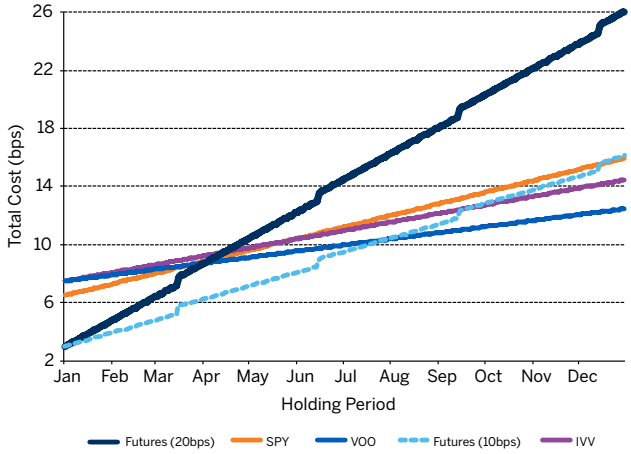


Figure 3 shows how a 10bps renormalization of the futures implied funding rate from 20bps to 10bps (the dotted line) impacts these breakeven points. In this more normal futures environment the breakeven points move out several months. The VOO is still the first, crossing on July 29 (208 days). The IVV crosses two months later on September 23 (263 days) and the SPY a further two months on December 15 (347 days). The 12-month cost advantage of ETFs in this scenario ranges from 0.2 to 3.7bps.

10 BNP Paribas: "Accessing Efficient Beta: ETFs vs. Futures", October 2014; Bank of America Merrill Lynch, "Cost Comparison of Equity Futures, ETFs and Swaps", 22 April, 2014.

Scenario 2: Leveraged Investor

Equity index futures are leveraged instruments. The investor posts less than 5% margin to the exchange, which results in over 20x leverage on their position. The three ETFs in this analysis are not leveraged[11] but may be purchased on margin by investors who desire leverage.

The difference is the quantity of leverage that is possible. Under Federal Reserve Board Regulations T and U, there are limits on the amount a broker may lend to an investor wishing to purchase securities on margin.

Under Reg T, the maximum amount that can be lent is 50% of the purchase price, resulting in a maximum of 2x leverage. More sophisticated investors may be eligible for portfolio margining through a prime broker under which they could potentially achieve 6-8x leverage under Reg U. Greater than 8x leverage is not possible.

To derive a holding cost for the leveraged ETF position, standard prime broker lending rates for an institutional client of 3m Libor + 40bps are assumed.

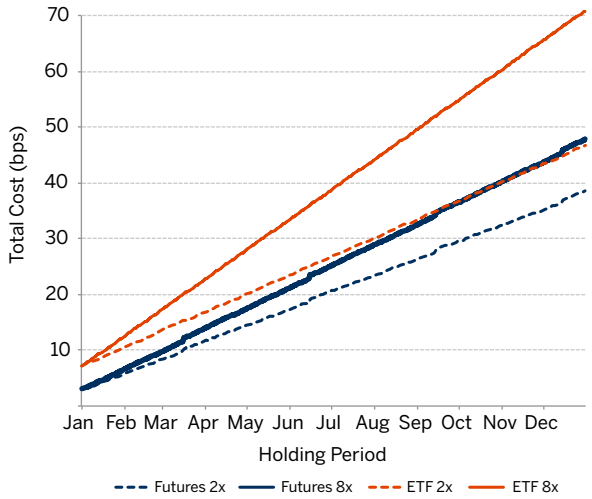
Two-times Leveraged Investor

The starting point for the analysis is the 2x leveraged case. This implies that the investor has $50 million with which to take on $100 million of exposure.

The ETF investor, who must pay the full notional amount of the trade at initiation, borrows $50 million from a prime broker to fund the purchase. The holding cost of the leveraged position is therefore the same as the fully-funded position (Scenario 1) plus the interest carry on the borrowed $50 million at 3mL + 40bps.

With futures, it is not a question of borrowing money, as an investor with $50 million already has more than 10x the required margin deposit. Rather, it is a case of leaving less money on deposit. In the fully-funded case it was assumed that the investor earned 3m Libor on the $100 million left on deposit. In the 2x leveraged case, the amount of deposited cash is reduced by $50 million. This can be viewed equivalently as the investor depositing the *full* $100 million and then *paying back* the interest earned on $50 million. Viewed this way, the holding cost of the 2x leveraged scenario for futures is identical to the fully-funded scenario plus the interest expense on $50 million at 3m Libor.

Figure 4: Total Cost for 2x and 8x Leverage, 12 months[12]



The dashed lines in Figure 4 show the total cost of index replication on a 2x levered basis for holding periods up to 12 months.

Compared to the fully-funded scenario in Figures 2 and 3, the total cost has increased for both positions. However, due to above-Libor rates charged on borrowed funds by a prime broker, the ETF holding cost has increased by 20bps per annum more than the futures (40bps spread on one half of the trade notional). As a result, futures are the more economical option across all time horizons.

11 Leveraged ETFs are excluded from this analysis, as these have path-dependent returns which are very different from standard ETFs or futures.

12 To simplify the graphical representations, Figures 4-6 show the average of the total costs of the SPY, IVV and VOO. The individual results for each ETF are within 2bps of the value shown at all time horizons.

Eight-times Leveraged Investor

The analysis for the 8x leveraged case proceeds in a similar fashion. In this case, the investor has $12.5 million of cash with which to obtain $100 million of exposure. The ETF investor therefore has an $87.5 million loan from the prime broker while the futures investor has an $87.5 million reduction in their deposit.

The solid lines in Figure 4 show the cost comparison for the 8x levered case. As the amount of funds borrowed increases, the incremental borrowing cost of a prime-broker funded ETF position increases, as compared with the intrinsic leverage of futures. In the 8x levered case, the 40bps funding differential on 87.5% of the notional of the trade results in a 35bps greater increase in the holding cost of ETFs relative to futures.

The cost advantage of futures over ETFs for a one year holding period is 8.2 and 23.1bps for the 2x and 8x leveraged cases, respectively.

This analysis has been conducted using current 3m Libor rates of approximately 0.25%. As interest rates rise, the absolute cost of leveraged exposure will increase for both products. However, the *difference* between the holding costs of ETFs and futures is not a function of the *absolute* rate but of the spread between cash on deposit and borrowed cash and persists across different interest rate regimes.

Scenario 3: Short investor

A short position provides negative market exposure and is inherently leveraged.

With ETFs, the leverage comes in the form of a loan of shares to sell short by a prime broker. The sale of the borrowed shares raises cash, which remains on deposit with the prime broker. The short seller pays a bps per annum fee to the lender of the ETF which is deducted from the interest paid on the cash raised by the sale.

A typical prime broker borrow fee of 40bps per annum is assumed, resulting in a return on cash raised of 3m Libor – 40bps[13].

In addition to the cash raised from the short sale, the investor must post an additional 50% of the notional of the trade in cash to the broker as margin [14]. The additional funds posted to the prime broker will be assumed to earn 3m Libor.

Because they are using derivatives, the short seller of futures does not need to borrow shares or pay the associated fee. The sale of a futures contract is identical to the purchase, with the same margin posted with the clearing house.

When analyzing the economics of a short position it is important to remember that the holding costs for the long investor become benefits for the short. ETF management fees cause a systematic underperformance relative to the benchmark which, for the short investor, represents an excess return. The richness of the futures roll provides a similar benefit for futures investors.

The holding costs for short positions in futures and ETFs can be decomposed as follows:

Futures:

1) Receive futures' implied funding rate of 3m Libor + 20bps on the $100 million

2) Receive 3m Libor on $50 million cash

13 This rate, combined with the assumption on long funding of 3m Libor + 40bps, results in an 80 bps "through the middle" prime broker bid / offer, which is consistent with market standards.

14 Higher leverage may be eligible under portfolio margining but we will focus on the 2x levered case.

ETFs:

1) Receive the management fee of 5 - 9.45bps

2) Receive 3m Libor – 40bps on $100 million raised from the short sale

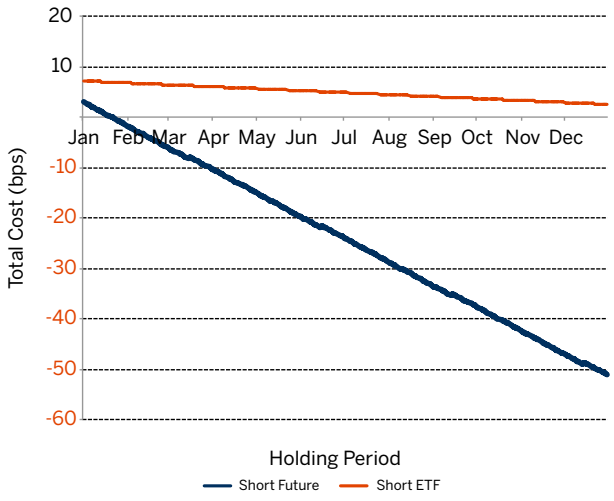
3) Receive 3m Libor on the $50 million deposited with the prime broker.

Figure 5 shows that in both cases the holding costs are negative – over time, the investor's relative performance versus the short return of the benchmark improves, as demonstrated by the downward slope of the line.

However, due to the combination of higher ETF transaction costs and the funding spreads charged by prime brokers, the futures provide a more cost-effective implementation across all time horizons.

The cost advantage of futures over ETFs for a 12-month holding period is 53.6bps.

Figure 5: Short Futures vs. ETF, 12 months



Scenario 4: International

CME does not provide tax advice. Investors should consult their own advisors before making any investment decision.

In general, foreign investors in the US equity market are subject to a withholding tax on dividend payments by US corporations. The base withholding rate is 30%, resulting in a "net" dividend received by foreign investors equal to 70% of the "gross" dividend available to US investors.

This withholding tax also applies to fund distributions paid out by ETFs. All three of the ETFs in this analysis pay a quarterly distribution which represents the pass-through of dividend income received by the fund on the underlying shares held. The dividend yield of the S&P 500 is approximately 2.0%, which implies a 60bps additional holding cost per annum for foreign ETF investors due to the withholding tax.

Futures contracts, unlike ETFs, do not pay dividends. The market price of the future contains an implied dividend amount which generally corresponds to the full gross dividend yield on the underlying index[15]. There is no futures equivalent to the dividend withholding tax on shares.

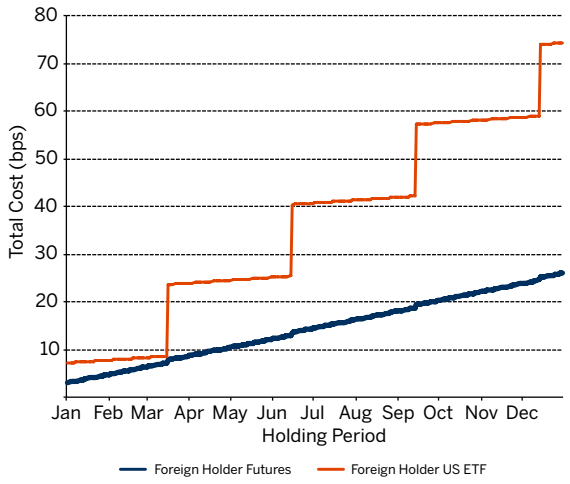
Figure 6 shows holding cost comparison for a fully-funded long position (Scenario 1) as experienced by a non-US investor based on a 30% withholding.

In the 3-month period prior to the first dividend ex-date the comparison is identical to Scenario 1: the lower transaction costs of futures make them a cheaper alternative. Just prior to the cross-over point where ETFs become more cost effective, the 15bps impact of the withholding tax on the first quarterly dividend hits the total cost of the ETF causing the jump in the red line. As a result, the future is a more cost effective alternative over all time horizons.

15 *The market price of a futures contract is a function of interest rates and anticipated future dividends. Deviations from fair value can be attributed to either component based on the investor's assumptions. For example, the futures roll trading above fair value can be viewed as the result of above-market implied funding rates, a lower dividend assumption or a dividend withholding tax. The market standard is to attribute deviations to implied funding costs unless there is a known ambiguity around the timing or quantity of a particular dividend.*

The cost advantage of futures over ETFs for a 12-month holding period is 48.3bps.

Figure 6: Foreign Investor (30% WHT), 12 months



Certain international investors are able to reclaim some or all of the dividend / distribution withholding tax on ETF distributions. A partial reclaim reduces the size of the "steps" in Figure 6 while a tax-exempt foreign investor (i.e. a full reclaim) is economically equivalent to a US investor (Scenario 1).

For dividend rates less than 92% of gross (i.e. 8% withholding), futures are more cost effective across all time horizons.

Unlike ETF management fees, which are beneficial to short investors, the withholding cost on fund distributions does not result in outperformance for foreign investors looking to take on short exposure. The standard in the stock loan market is that the borrower of the security pays the full gross dividend.

Other considerations

This analysis has, thus far, focused on cost. There are, however, a number of other factors that impact investors' product selection decisions. For completeness, the more salient considerations are enumerated here.

Tax: E-mini S&P 500 futures are section 1256 contracts with a blended U.S. capital gains treatment of 60% long term and 40% short term, regardless of holding period, which may improve the after-tax efficiency of futures versus other alternatives.

UCITS: Equity index futures are eligible investments for European UCITS funds, while US-listed ETFs are not.

Currency: The leverage inherent in a futures contract allows non-USD investor greater flexibility in the management of their currency exposures as compared to fully-funded products like ETFs.

Short Sale: Many funds have limitations, either by mandate or regulation, which limit the ability to sell short securities. These funds may, however, be able to take on short exposure via derivatives such as futures. (UCITS funds have such restrictions.) Futures are also not subject to locate requirements, Regulation SHO or Rule 201.

Fixed Versus Variable Dividends: A futures contract locks in a fixed dividend amount at the time of trade, while ETFs accrue the actual dividends to the fund's NAV as and when they occur.

Product Structure: ETFs are mutual funds while futures are derivatives. Fund investment mandates and local regulations may treat these structures differently and impose differing degrees of flexibility in their usage by the fund manager. The asset management company (or the particular fund manager) may also have preferences. Some funds may look to limit their use of derivatives and therefore prefer the ETF. Alternately, managers may prefer not to use a product which pays a management fee to another asset manager or have concerns about investors' perceptions of their use of other issuers' funds in the portfolio.

CONCLUSION

Figure 7 summarizes the results of the analysis. For all scenarios but one, futures provide a more cost-effective vehicle for replicating S&P 500 index returns.

Figure 7: Summary of Results

	Cheapest Option	
Scenario	Short Term (<3m)	Long Term (>3m)
Fully-Funded	Futures	ETFs
Leveraged (2x, 8x)	Futures	Futures
Short Seller	Futures	Futures
International	Futures	Futures

The exception is that of a fully-funded US investor (or tax-exempt foreign investor) with a long time-horizon, where the recent richness of the ES roll has increased the cost of futures relative to ETFs. With S&P 500 implied and realized volatility higher in 2015 than at almost any point in the last two years, it remains to be seen how long this situation can persist.

Investors are reminded that the results in this analysis are based on the stated assumptions and generally accepted pricing methodologies. The actual costs incurred by an investor will depend on the specific circumstances of both the investor and the particular trade including the trade size, time horizon, broker fees, execution methodology and general market conditions at the time of the trade, among other. Investors should always perform their own analysis.

For more information on CME Group's suite of equity index futures and options on futures, please contact your CME Group account manager or sales representative.

For questions or comments about this report or CME Equity Index products, contact equities@cmegroup.com.

CME GROUP HEADQUARTERS

20 South Wacker Drive
Chicago, Illinois 60606
cmegroup.com

CME GROUP GLOBAL OFFICES

Chicago
+1 312 930 1000

Singapore
+65 6593 5555

Houston
+1 713 658 9292

Tokyo
+81 3242 6232

New York
+1 212 299 2000

Calgary
+1 403 444 6876

São Paulo
+55 11 2565 5999

Washington D.C.
+1 202 638 3838

London
+44 20 3379 3700

Hong Kong
+852 2582 2200

Seoul
+82 2 6336 6722

PM1304/00/0315