

# Understanding Bond ETF Premiums and Discounts:

A conceptual framework

by Matthew Tucker and Stephen Laipply

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# Executive summary

Fixed income exchange-traded funds (ETFs) are an efficient way for investors to gain exposure to bond markets. This efficiency, however, has been called into question recently. In particular, the focus has been on apparent “premiums and discounts,” divergences between where an ETF trades and its calculated net asset value.

Factors that drive fixed income ETF price behavior are a combination of the same factors that drive price behavior in equities and other asset classes, as well as factors unique to the fixed income markets. What makes fixed income ETFs different is the magnitude of these factors and the clarity with which they are revealed in an exchange-traded fund. This is in sharp contrast to how liquidity and cost relationships may be hidden in the sometimes opaque over-the-counter bond market.

In this article, we develop and explore a framework for understanding the drivers of these premiums and discounts, helping investors make decisions for their own fixed income portfolios. The price of a fixed income ETF is driven by four factors: the value of the underlying securities, the level of ETF supply and demand in the secondary market, the cost of share creation through the underlying fixed income markets, and the level of fixed income market volatility and liquidity.

We illustrate how these factors drive market premiums and discounts, and examine how they determine fixed income ETF price levels. For example, there are two

common methodologies for creating and redeeming ETF shares: in-kind (securities are exchanged in-kind for shares of the fund) and cash-create (cash is exchanged for shares of the fund, as with traditional mutual funds). Premiums and discounts may be seen with each methodology; the key difference is transparency of cost.

Regardless of how shares are created and redeemed, ETFs can provide transparency and price discovery beyond that of the underlying securities. This is illustrated in a case study that analyzes trading and execution risk at the peak of the credit crisis, an extremely volatile period during which many individual fixed income securities did not trade.

As the ETF market continues to expand, it is important for investors to understand pricing and trading behavior to help achieve more efficient execution. Liquidity and cost affect all types of investment vehicles—the key is finding the right balance that suits an investor’s needs.

## Introduction

Over the past decade, the ETF market has expanded in terms of both assets and market coverage. Investors can now choose from a wide variety of equity, fixed income, and alternatives markets through ETFs.

The first fixed income ETF was established in 2002. More than US\$160 billion is now invested in hundreds of funds listed on exchanges around the globe.<sup>1</sup> As fixed income ETFs have grown in popularity, a robust discussion has evolved with respect to how the funds trade on an exchange. In particular, recent dialogue has focused on the funds' premiums and discounts, where an ETF's trading price diverges from its calculated net asset value, or NAV.

Some of this divergence can be traced to the mechanics that govern ETFs across all asset classes. The rest lies in how over-the-counter fixed income securities behave when held in an exchange-traded instrument. In this paper, we develop a framework for understanding the drivers of fixed income ETF premiums and discounts to help investors better evaluate these funds and achieve more efficient execution.

## Premiums and discounts defined

We begin by introducing the following factors that relate to premiums/discounts and liquidity:

- Value of the underlying bond portfolio,
- Level of ETF supply and demand in the secondary market,

- Cost of share creation through the underlying fixed income markets, and
- Level of fixed income market volatility and liquidity.

Investors purchase and sell shares of ETFs on an exchange, trading them in exactly the same way as a listed stock. A share of an ETF represents partial ownership of the portfolio of securities in the ETF itself, much like shares in a traditional open-end mutual fund represent partial interest in the underlying fund holdings. What differs is the ETF's creation/redemption mechanism.

During periods of strong demand for an ETF, the price of the shares is bid up in the market. If the ETF price is higher than the value of the underlying securities held within the ETF, an arbitrage opportunity may exist. Authorized participants (e.g., broker/dealers) could purchase the underlying fixed income securities, create new ETF shares, and then sell the newly created ETF shares in the market for a profit.

Conversely, this same set of mechanics operates in markets of strong selling pressure, to help keep the ETF from trading at a persistent discount. Authorized participants could purchase the ETF shares (at a discount), redeem them, and then sell the fixed income securities received from the redemption at a net profit. Arbitrage helps keep the ETF price in line with the value of the underlying securities. The premium or discount is calculated as follows:

**Premium/discount = ETF market price – value of underlying securities**

A premium or discount can exist and even persist for an ETF as long as it is not large enough to trigger an arbitrage opportunity. This means that the size of the premium/discount will be bounded by the

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<sup>1</sup> Source: BlackRock, as of 12/31/09.

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## Fixed income ETFs trade at a premium to net asset value under most market conditions.

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transaction costs participants would incur in executing the underlying arbitrage transaction. As long as the premium or discount is less than these transaction costs, there is no economic incentive to execute the arbitrage opportunity.

The largest cost component is the expense to trade the underlying securities held by the ETF, as represented by their bid/offer spreads. This implies that an ETF can trade anywhere within the bid/offer spread of the underlying securities market. How much of this underlying market transaction cost is reflected in the ETF price is a function of trading flows. In balanced markets (i.e., symmetrical buy versus sell orders), there is no need for authorized participants to access the underlying securities markets; therefore, only a fraction of the underlying market bid/offer spread is reflected in the price of the ETF. In unbalanced markets (e.g., excessive buy orders), the entire underlying bid/offer spread may be priced in.

This concept can be explained by defining the underlying bid/offer spread as the creation cost, and the balance of trading activity in the ETF as the flow factor.

### Creation cost = bid/offer spread of underlying market

In fixed income markets, the fund NAV is determined using the *bid* side of the underlying market, while individual bonds purchased to facilitate creation of new ETF shares are acquired on the *offer* side of the market.

As a result, this creation cost is meaningful when there is sufficient buying pressure to result in the creation of new shares. Strong selling pressure, on the other hand, results in security redemptions. The underlying securities received from a redemption are sold at the bid side of the market, which is in line with where the fund NAV is valued.

In markets where the fund NAV is determined using mid or offered prices, the creation cost term must be adjusted accordingly.

### Premium/discount = (creation cost x flow factor)

This framework may now be expanded to include other factors that impact the arbitrage opportunity. The most significant factor is the level of execution risk present in a market. During periods of high volatility and low liquidity, it can be difficult for authorized participants to execute what appears to be an arbitrage opportunity—the magnitude of an ETF’s premium or discount can move to levels that would not be sustainable in normal markets but are appropriate given volatile market conditions. This risk level is called the execution risk adjustment. We add this term to determine the premium/discount level that can exist without the presence of an arbitrage opportunity:

### Premium/discount = (creation cost x flow factor) + execution risk adjustment

Further adjustments are made for factors that are market specific. In the case of fixed income ETFs, an adjustment must be made when evaluating end-of-day premiums and discounts. The market standard is to value individual fixed income securities that comprise the ETF at the close of the US bond market, 3:00 pm eastern time. The fixed income ETF itself, which trades on the stock exchange, continues to trade until 4:00 pm ET. As a result, market movements that occur between 3:00 and 4:00 pm ET may create the appearance of premiums or discounts to NAV. The timing adjustment is generally a fairly small portion of the total premium or discount, with the potential exception of more volatile funds such as those that invest in long-duration US Treasuries.

Combining these factors, we see that the level of premium or discount for any fixed income ETF is a function of the creation cost of the ETF, the fund flows in the ETF secondary market, the level of execution risk for creating or redeeming shares in the underlying

bond market, and differences in the timing of bond market and ETF valuations. A complete conceptual relationship may now be defined:

**Premium/discount = (creation cost x flow factor) + execution risk adjustment + timing adjustment**

Where,

- Creation cost is defined by the bid/offer spread in the underlying market.
- Flow factor is a scalar between 0 and 1, representing the balance of ETF flows in the market (0 = all sell orders; 1 = all buy orders).
- Execution risk adjustment encompasses the cost of basket execution and intraday hedging to facilitate creation/redemption (it is generally positive for creation activity, negative for redemption activity).
- Timing adjustment represents market movements between the valuation of the underlying bond portfolio at market close and trading price of the ETF at market close (e.g., 3:00 to 4:00 pm ET in the US); this may be positive or negative.

As an example, consider an ETF trading at a 150 bp premium to NAV, while the underlying securities trade at a 200 bp bid/offer spread. The creation cost—defined by the 200 bps underlying bid/offer spread—generally represents the largest component of the premium. Assuming a flow factor of 0.6 and a timing adjustment of 0, the 150 bp premium would comprise 200 bps of total creation cost weighted by the flow factor (200 bps x 0.6 = 120 bps) plus 30 bps of execution risk adjustment.

## Creation cost: In-kind or cash-create

Creation cost is the cost of originating new fixed income ETF shares, and is generally the largest driver of fixed income ETF premiums. Given that the bonds underlying the ETF are always marked on the bid side of the market for NAV calculations, and that

the ETF generally trades within the underlying market bid/offer spread, creation costs are visible through the ETF premium to the NAV. This is the reason that fixed income ETFs trade at a premium to NAV under most market conditions. The size of the creation cost for a given ETF, and resultant impact on the fund premium, is dependent upon the creation methodology used by the ETF. The two most common creation/redemption methodologies are in-kind and cash-create (Figure 1):

- **In-kind methodology:** With an in-kind methodology, broker/dealers deliver bonds to the ETF provider in exchange for ETF shares. The creation cost reflects the cost of acquiring bonds in the underlying market; the magnitude of the creation cost varies according to liquidity and the level of transaction costs in the underlying bond market. Because the creation cost impact on the ETF premium is incurred only by new investors, existing investors in the fund are not affected.

As liquidity changes through time, so does the level of transaction costs. This leads to changes in the creation cost and, as a result, the level of the ETF premium. As an example, Figure 2 depicts the premium on a Treasury Inflation Protected Securities ETF (the iShares Barclays TIPS Bond Fund) through time versus the bid/offer spread in the underlying TIPS market. The chart illustrates that as TIPS market liquidity improved through 2009, and the bid/offer spread on TIPS securities declined, the creation cost of the ETF (as reflected in the premium) also declined. The correlation between the level of the premium and the level of the bid/offer spread was approximately 0.70 over this time frame, with a t-statistic of 15.3, indicating a high degree of statistical significance.<sup>2</sup>

- **Cash-create methodology:** Broker/dealers deliver cash to the ETF provider in return for new shares. All creations occur at NAV, so this mechanism is very similar to that of traditional open-end mutual funds. Because the broker/dealer is delivering cash

<sup>2</sup> The t-statistic is a measure of an independent variable's ability to explain the behavior of a dependent variable. A value of approximately +/- 2.0 is generally considered to be significant under a normal distribution.

to the ETF provider and does not need to access the underlying bond market, the premium for cash-create funds may be lower than that of in-kind creation funds. A premium to NAV will likely still be present (and discounts may still be possible) as the broker/dealer still incurs intraday risk that must be hedged.

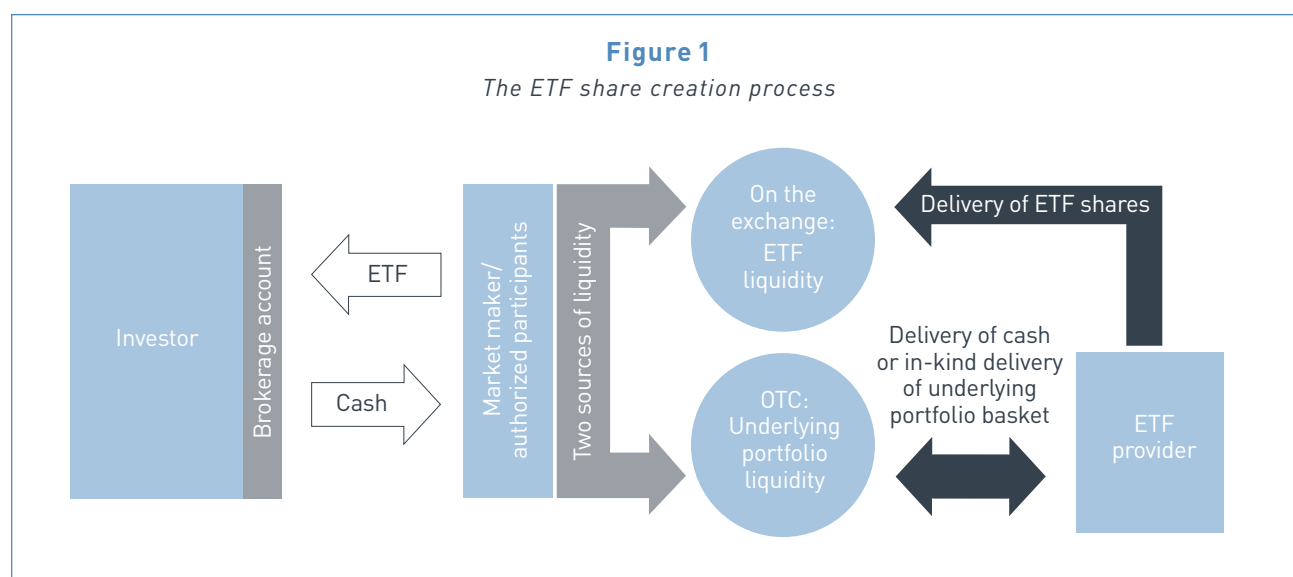
When the broker/dealer sells shares into the market, they become short the economic exposure of the ETF. Because the broker/dealer will purchase new ETF shares from the ETF provider at the closing NAV, they must hedge any potential price movement between the time at which shares are sold and the end of the day when the cash creation occurs (i.e., the closing NAV may be above or below where shares were priced intraday, resulting in a possible loss for the broker/dealer). Some level of creation cost may be built into the ETF price to account for the hedge risk and intraday market volatility, as available hedging instruments are likely to offer an imperfect hedge.

Cash-creation funds initially take in cash and subsequently purchase securities, so transaction costs are ultimately reflected in the performance of the fund. While open-end mutual funds and ETFs employing

a cash-creation methodology appear to initially shield investors from transaction costs—since they may be purchased and sold at or near NAV (as opposed to market price)—the transaction costs are still incurred. Instead of being borne by the purchasing investor, however, the transaction costs are effectively distributed among all investors in the fund.

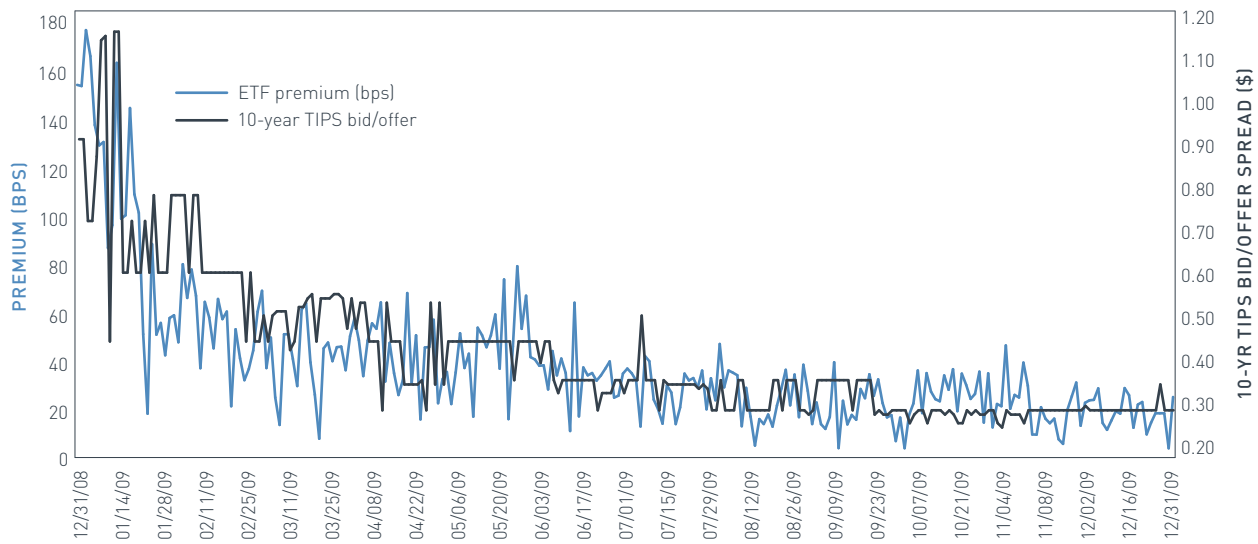
This is a key point. Transaction costs must be borne by investors in either the cash-create or in-kind structures. For investors, the difference between the two is in the transparency of the costs. With an in-kind methodology, transaction costs are transparent in that they are reflected in the price at which the ETF is traded. With a cash-create methodology, transaction costs are less visible; they are embedded in the fund's performance.

This difference in transparency affects how investors perceive and react to transaction costs. With the in-kind methodology, investors can evaluate the impact of transaction costs they bear through the level of premium to NAV, and adjust their trades accordingly. They do not bear the cost of additional transactions generated by the activity of other fund investors.



**Figure 2**

*Ten-year TIPS bid/offer spread versus TIPS ETF premium*



Source: Tradeweb and BlackRock, as of 12/31/09. ETF represented by the iShares Barclays TIPS Bond Fund.

With a cash-create methodology, investors are able to transact at or near NAV, which initially results in lower transaction costs (distributed among all fund investors). However, these investors will bear the cost of subsequent transactions generated from the activity of all fund investors.

Generally speaking, the cash-create methodology results in lower initial transaction costs, in return for bearing the impact of future transaction costs created by other fund participants. The in-kind structure, on the other hand, results in higher initial costs, in return for protection from future transaction costs generated by other fund participants.

The in-kind methodology is most common in more liquid markets, such as US Treasuries, where the underlying portfolio securities are readily available. In less liquid segments of the market, such as municipal bonds and high-yield corporate debt, some funds employ a cash-create model.<sup>3</sup>

#### **HYPOTHETICAL EXAMPLE: IN-KIND VERSUS CASH-CREATION**

To understand the difference between the methodologies and the impact on new and existing investors, consider the following simplified example. For illustrative purposes, we focus only on the impact of creation/redemption methodology, and not on the other factors that may contribute to premiums and discounts.<sup>4</sup>

Assume a hypothetical fund with one share outstanding, a market price of \$100, and a NAV of \$100. The underlying market is illiquid and has a bid/offer spread of 200 bps. Assume that a new investor wishes to purchase one share of the fund, in effect doubling its NAV to \$200. Further assume that the new share must be created. (In reality, some portion of an order would be absorbed by the existing exchange liquidity of the ETF.)

For an in-kind transaction, the broker/dealer would purchase the underlying bonds and deliver them to the ETF provider in exchange for the share created at

<sup>3</sup> Even in funds that primarily utilize the in-kind methodology, it may be advantageous in certain instances (such as fund rebalancing) to accept a cash creation/redemption in order to manage fund cash flow and minimize trading activity and transaction costs. Additionally, in-kind transactions may not be possible in all markets, due to limitations in security delivery and settlement.

<sup>4</sup> This hypothetical example does not represent any specific investment outcome.

the NAV. The broker/dealer would pay the offer-side price for the underlying bonds, so the *price* of the ETF would likely increase from \$100 to \$102, offsetting the cost of the underlying bond execution. Purchasing a new share at \$102, the new investor bears the cost of transacting in the underlying market through the premium, while the existing investor is unaffected.

If this were a cash-creation transaction, the fund would receive cash and immediately purchase new securities or elect to hold cash and purchase securities over time. Either way, the fund and its investors (both new and existing) would absorb the 200 bps in transactions costs. The fund may also experience a return drag while the cash is invested. Both effects impact fund performance and contribute to tracking error.

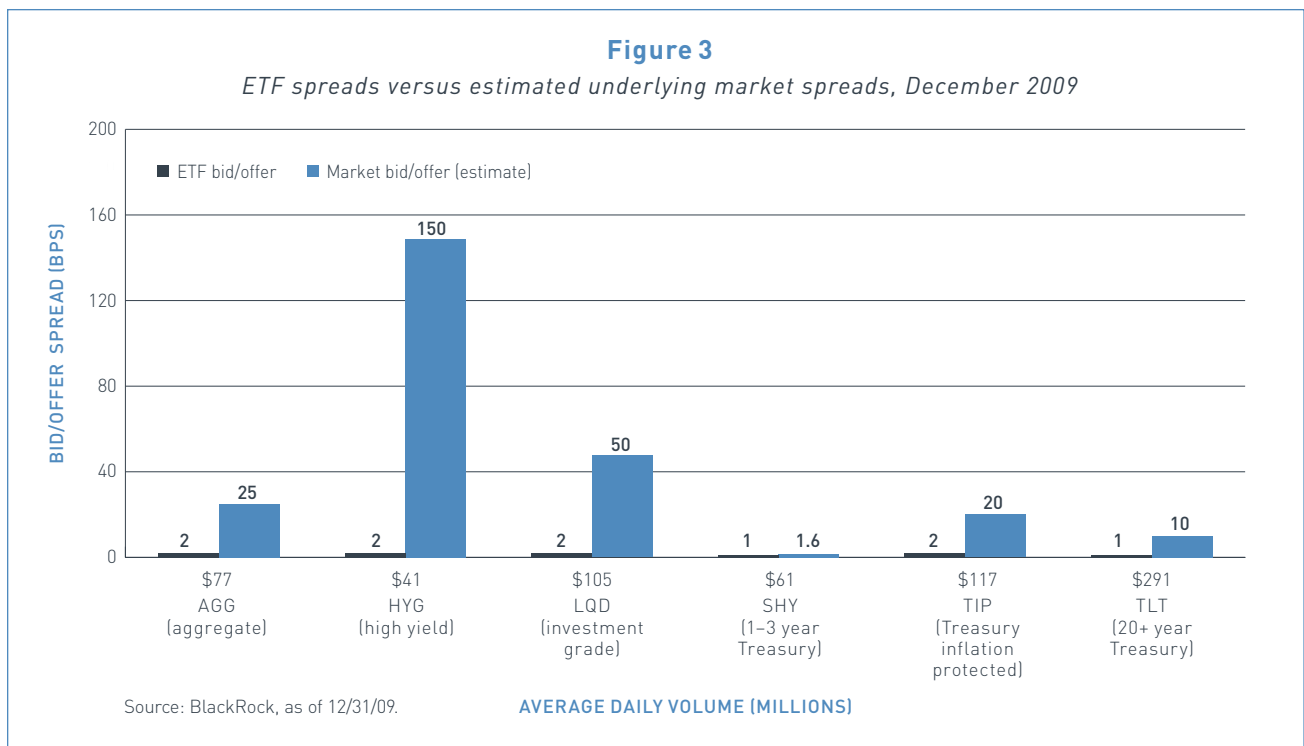
In the case of a cash creation, the fund would invest \$100 in a market with a 200 bp bid/offer spread (\$2 in transaction costs). This would drag the overall fund's performance by 100 bps (i.e., \$2 transaction costs/\$200 total NAV). The original investor in the fund would see the value of his holdings drop by 1%, as a result of the

new share creation. This is a subsidy to the new investor who ended up incurring only 100 bps of transaction costs for investing into a market with a 200 bp bid/offer spread.

Comparing the benefits and drawbacks of the two methodologies, investors should be aware that the impact of client activity in a cash-create ETF is exactly the same as that of a traditional open-end mutual fund. These funds also operate in an environment in which all subscriptions and redemptions occur in cash.

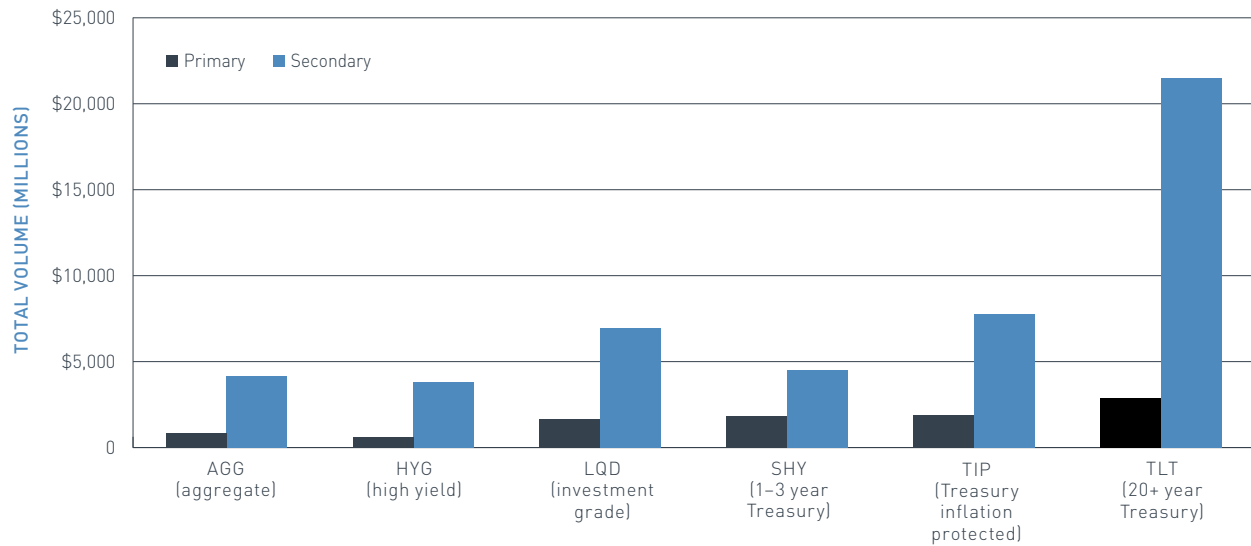
## ETF liquidity layer

One of the central benefits of ETFs is that they develop their own independent exchange liquidity "layer" (through the secondary market) as trading volume and shares outstanding grow. This liquidity layer allows investors to trade in the ETF without having to create or redeem shares, and can lead to the ETF's trading at a much tighter bid/offer spread than the underlying market.



**Figure 4**

Primary versus secondary trading volume, Q4-09



Source: BlackRock, as of 12/31/09.

To illustrate, Figure 3 presents observed bid/offer spreads for trades on some of the largest fixed income ETFs relative to spreads in the respective underlying market.

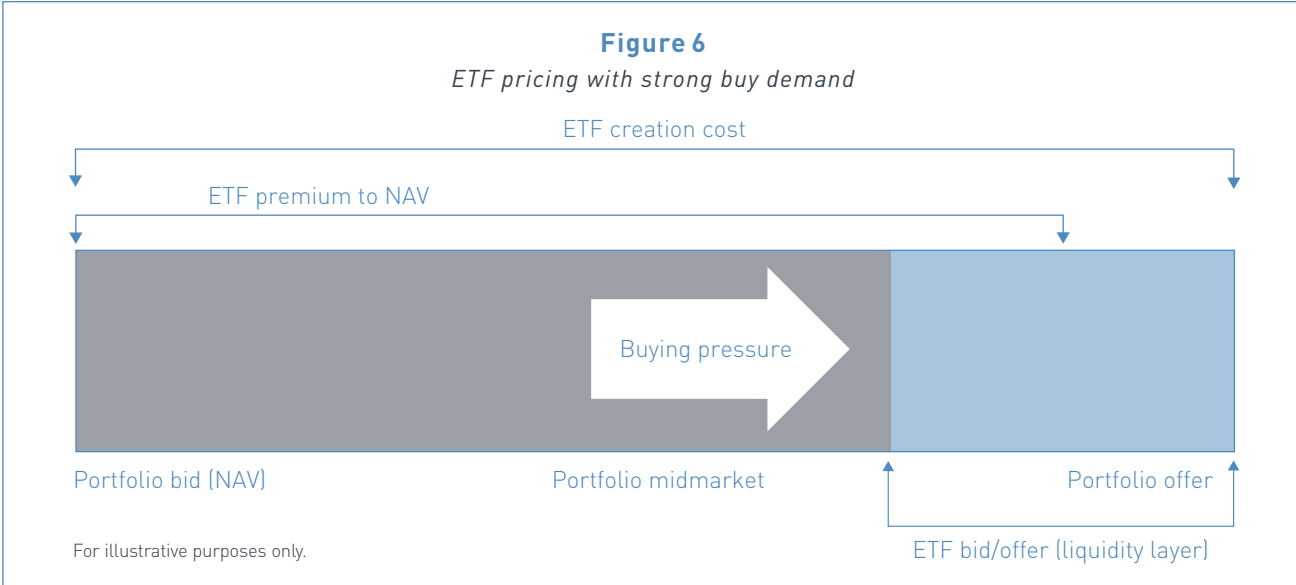
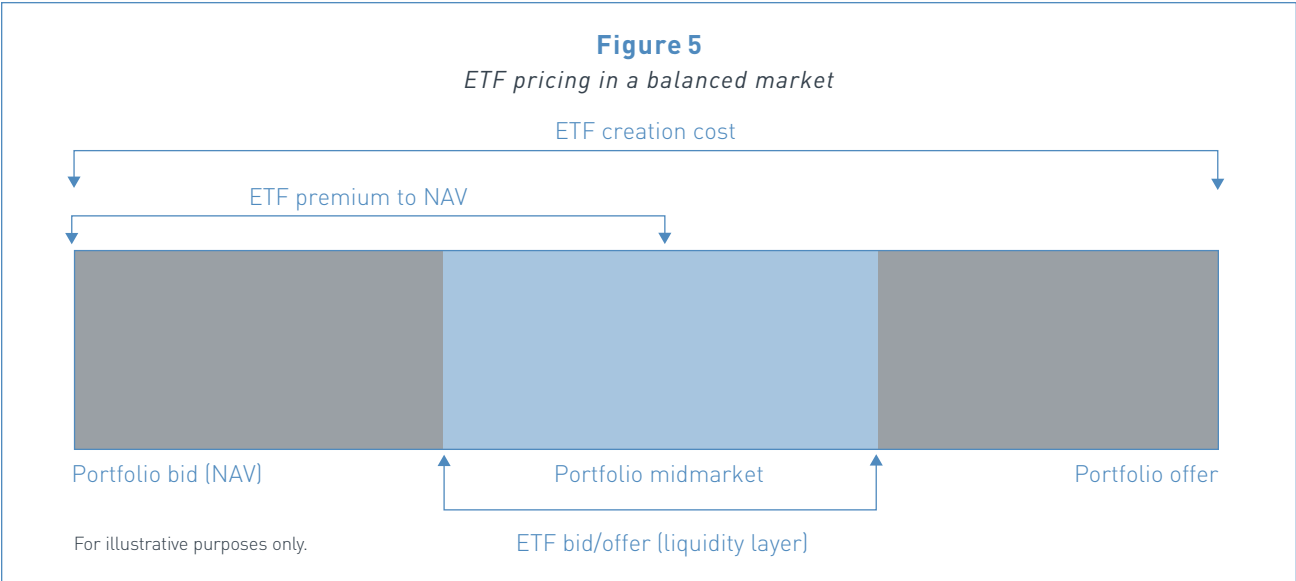
Secondary market activity accounts for the majority of trading volume, as most ETF transactions occur without the need to trade the underlying bond market. This secondary market liquidity is a key benefit of ETFs generally and fixed income ETFs in particular. Bid/offer spreads in underlying fixed income markets can be wide; the secondary market helps keep transaction costs low. Figure 4 compares primary market volume (i.e., gross creation/redemption activity) and secondary (exchange) market volume. Volume in the secondary market dwarfs the primary market for these fixed income ETFs.

## The flow factor

The balance of ETF flows in the market, known as the flow factor, drives how much of the creation cost is

priced into the ETF and *where* the ETF bid/offer spread resides within the underlying portfolio bid/offer spread. The flow factor is a scalar between 0 and 1 that represents the percentage of purchases versus sales of the fund relative to the available exchange liquidity. A flow factor near a value of 1 indicates a high level of net purchases relative to the available exchange liquidity, and may result in share creations. Conversely, a flow factor near a value of 0 indicates a high level of net sales relative to the available exchange liquidity, and may result in share redemptions.

Figure 5 represents the dynamics of the ETF liquidity layer in a balanced market and the impact of the flow factor on creation cost. The gray area represents the underlying bond portfolio bid/offer, or the full creation cost for an in-kind creation fund. The blue area represents the ETF bid/offer. In markets where secondary trading flows are balanced, the flow factor will be roughly at the midpoint (approximately 0.5), and the ETF bid/offer will rest near the midpoint of the portfolio bid/offer, all else being equal.



If the flows are predominantly buy orders, the flow factor shifts toward a value of 1, and the bid/offer of the ETF shifts to the right. Note that the distance between the *ETF bid and offer* may remain unchanged. If buy orders are large enough to exceed the ETF’s available exchange liquidity layer, and therefore result in the creation of new shares, the flow factor will converge to a value of 1, and the ETF offer will converge to the underlying portfolio offer (Figure 6). This is due to the fact that broker/dealers must access the underlying bond market to acquire the requisite securities in order to create new shares to satisfy demand. In doing so, they will likely purchase bonds on the offer side of

that market. The same dynamic occurs with sales and redemptions. Sales cause the flow factor to shift toward a value of 0. Under strong selling pressure, the flow factor converges to 0, and the ETF bid converges to the bid side of the underlying bond portfolio (as bond holdings will be liquidated at the bid side of the market).

The result of this dynamic is that, once the ETF is fully priced to the bid or offer of the underlying market, additional market impact from large orders may be limited—the ETF is already fully reflecting the cost of the underlying portfolio bond execution.

Figure 7 shows the average premiums for a cross section of fixed income ETFs during 2009 versus the estimated range of bid/offer spreads for the underlying bond markets over the same time period. The liquidity and bid/offer spreads of fixed income markets varied substantially, and the average size of fund premiums moved accordingly. ETFs that saw strong buying interest (e.g., high yield) tended to have premiums that averaged closer to the full underlying market bid/offer spread. ETFs that had more balanced flows (e.g., US Treasuries) tended to have premiums that were less than the full underlying market bid/offer spread.

The relationship between creation cost and the balance of flows factor is summarized as follows:

- **Symmetrical flows:** If an ETF is experiencing relatively symmetrical flows, the flow factor lies near the midpoint between 0 and 1, and the price of the ETF is centered within the bid/offer spread of the underlying bond portfolio (assuming a relatively small execution risk adjustment). Only a portion of the actual creation cost is reflected in the fund premium, because the broker/dealers who trade the ETF will not need to access the underlying bond market to support ETF trading activity.

- **Strong net inflows:** An ETF with demand that exceeds the available liquidity in the market will likely have a flow factor that approaches a value of 1. This results in the majority of the creation cost being reflected in the ETF premium. The ETF share price shifts toward the offer side of the underlying market, as the broker/dealer's cost reflects the underlying bond market execution costs of ETF share creation.
- **Strong net outflows:** An ETF that faces strong selling pressure will likely have a flow factor that approaches a value of 0. The ETF price shifts toward the bid side of the underlying bond market in anticipation of, or in response to, ETF share redemptions and the liquidation of bonds at the bid side of the market.

Figure 8 represents the behavior of the premium observed on HYG (the iShares iBoxx \$ High Yield Corporate Bond Fund) versus its flow factor (defined as the number of shares purchased divided by the sum of shares purchased and sold on a daily basis) over the 12-month period ending 12/31/09.<sup>5</sup> The premium has a directional relationship with the flow factor. The correlation between the level of the premium and level of the flow factor was approximately 0.38 over this time frame, with a t-statistic of approximately 6.5, indicating a high degree of statistical significance.

**Figure 7**

*ETF average premium versus estimated range of underlying market bid/offer*

Fixed income sector	Ticker	Average Prem/Disc (bps)	Est. underlying bid/offer for 2009 (bps)
Short-duration US Treasuries	SHY	2	1.5–3.5
Long-duration US Treasuries	TLO	6	10–20
Long-duration US Treasuries	TLT	5	10–20
Treasury Inflation Protected Securities	IPE	39	20–40
Treasury Inflation Protected Securities	TIP	39	20–40
Multi sector	AGG	52	25–75
Multi sector	BND	61	25–75
Multi sector	LAG	59	25–75
Investment-grade corporate	LQD	147	50–150
High yield	HYG	197	100–300
High yield	JNK	162	100–300
High yield	PHB	178	100–300

Source: BlackRock and Bloomberg, 1/1/09–12/31/09.

<sup>5</sup> Raw data was sourced from the New York Stock Exchange (NYSE Arca TAQ) and subjected to an algorithm to determine purchases versus sales.

## Execution risk adjustment

An ETF's execution risk adjustment represents the execution and liquidity risk that broker/dealers bear when executing trades and aggregating bond portfolios to facilitate share creation and redemption. Because the execution risk adjustment is a measure of execution risk, its magnitude is driven by the level of volatility and overall liquidity conditions in the market, while its direction is driven by whether the broker/dealer is creating or redeeming ETF shares (generally positive for creation, generally negative for redemption).

Recall that NAV represents a weighted average of the underlying bond bid-side prices and *does not* contemplate a simultaneous basket execution. In less liquid or less transparent markets, the theoretical bid/offer for a given bond can be highly tenuous, and may only apply to a very narrow size of execution. Accordingly, broker/dealers may encounter difficulty in sourcing or selling bonds to satisfy a specified creation or redemption basket for a certain size of transaction. The level of the execution risk adjustment reflects the uncertainty around price discovery and liquidity. In highly stressed markets, the execution risk adjustment may

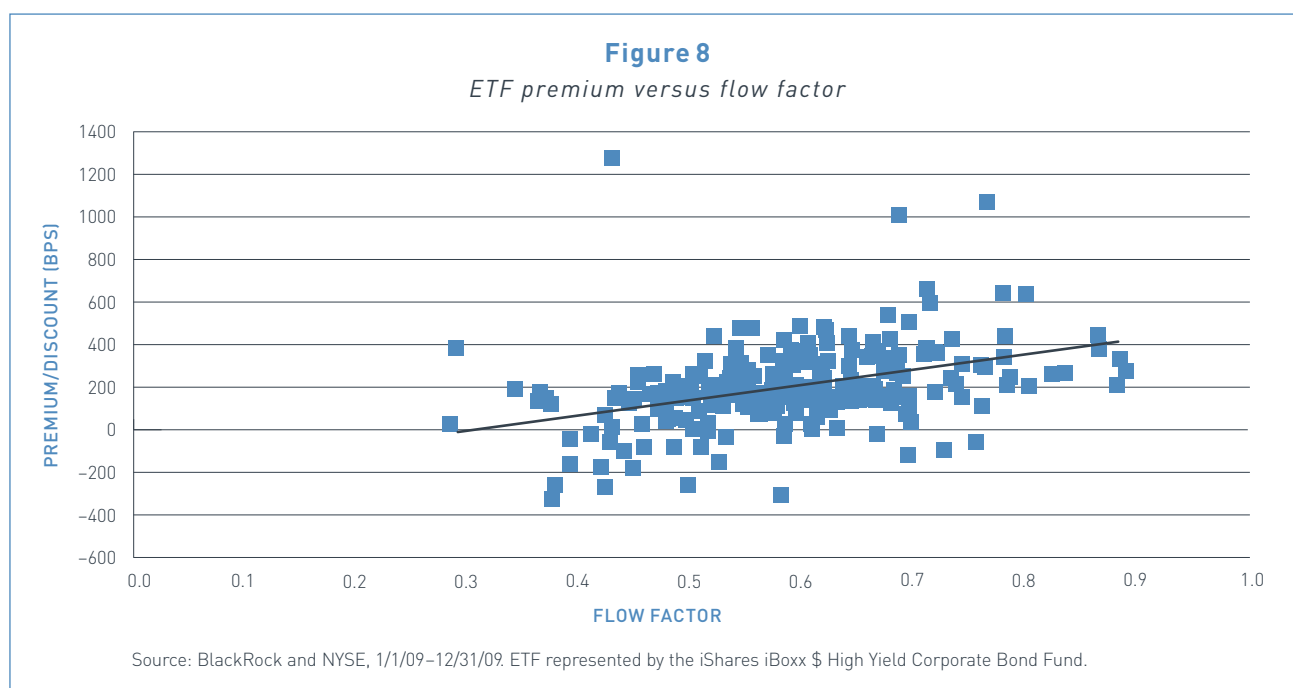
be significant, allowing for larger-than-normal premiums or discounts.

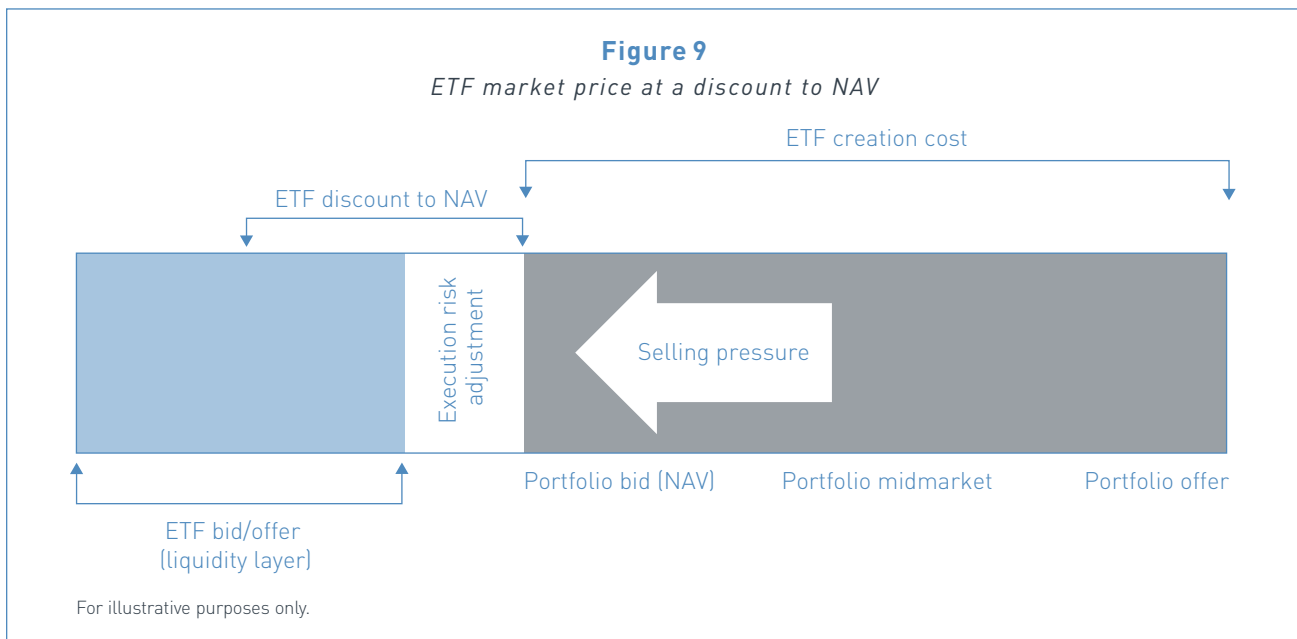
Figure 9 shows a situation in which market pressures have pushed the price of the ETF to a discount. Note that the ETF bid/offer is less than the theoretical bid side of the portfolio, indicating that the broker/dealer has determined that the true liquidation value received when redeeming shares lies below the theoretical bid side of the portfolio. The distance between them (the white area) is the execution risk adjustment.

### A CASE STUDY IN RISK: SEPTEMBER 2008

An example of a pronounced execution risk adjustment occurred at the peak of the credit crisis. Credit markets essentially froze, while fixed income credit ETFs continued to trade on the exchange. Exchange-traded funds offered a great benefit for fixed income market participants. In some instances, they were the only source of market exposure and price discovery.

Nonetheless, because the underlying market was impaired, ETFs were trading at a discount, as dealers struggled to mark positions and fund NAVs lagged the real time, intraday price discovery reflected in the ETFs.





This situation reversed itself going into year-end, as many investors attempted to reallocate exposure back into credit. Due to persistent and significant illiquidity, credit-based ETFs shifted to large premiums, as dealers continued to wrestle with price discovery and valuation of bonds that, in some instances, were not trading.

Because they are exchange-traded instruments, ETFs continued to trade throughout the crisis, providing price discovery in an underlying market that had become highly illiquid. As liquidity was gradually restored to the credit markets, the execution risk adjustment declined, and premiums reverted to more historic levels.

Stressed and illiquid markets may lead to an increase in the execution risk adjustment, which can cause larger pricing deviations from bid-side NAVs, as ETF prices tend to more fully reflect market risk premia and true execution costs.

During this volatile month, the iShares iBoxx \$ Investment Grade Corporate Bond Fund (LQD) functioned as a price discovery mechanism for the illiquid corporate credit markets (Figure 10). The blue line in the chart represents the sum of the last traded prices for the 100

individual corporate bonds in LQD at that time. Note that this does not indicate where the 100 bonds *would have traded* in a single basket transaction.

In normal markets, there is little difference between where bonds trade individually and where they trade as a basket. In markets of extreme volatility, however, significant differences can arise. What drives these price differences is that the underlying portfolio value is not an actionable value, while the price of the ETF is actionable. Consider the week of September 15. Due to the decline in market liquidity, many bonds did not trade on certain days. In some cases, only 70% of the underlying portfolio traded on a given day. Market participants who were transacting in LQD had to value the underlying bonds as well as the risk and transaction costs associated with trading bonds that had not recently traded.

The light blue band in Figure 10 represents the risk premium of the underlying assets due to market volatility. Prices of bonds in the underlying portfolio moved significantly and displayed wide trading spreads across short time periods. Market participants in LQD widened their spreads and changed prices in line with

where they could effectively make a market, considering their need to simultaneously hedge risk (i.e., the execution risk adjustment).

Using the fundamental underlying portfolio value as a starting point for fair value, and incorporating the additional risk premium due to volatility and market uncertainty (as shown by the light blue band), we see that LQD traded appropriately in the context of the market (as shown by the black line). The fund provided price discovery that reflected the level of market risk as well as investor sentiment at the time. Similar market dislocation and price discovery were observed in a number of other fixed income markets during this time, including high-yield corporates and municipal bonds.

#### **THE ARBITRAGE MECHANISM: A CHECK ON PREMIUMS/DISCOUNTS**

As discussed above, the ETF bid/offer should be anchored inside the underlying portfolio bid/offer (Figure 5); otherwise, arbitrage opportunities may exist. It is important to note that the level of liquidity and pricing transparency in the fixed income markets is generally lower than that of the equity markets. As a result, premiums and discounts on fixed income ETFs can persist for longer time periods than those on equity ETFs. For equity ETFs, a premium or discount can be identified relatively easily by anyone with access to exchange tick data. Executing the arbitrage requires only the ability to electronically trade a list of equities, which is available to a large number of market participants. Because of these equity market efficiencies, true premiums and discounts are generally quickly taken advantage of and corrected.

In the fixed income markets, pricing information is fragmented, and views of valuation often differ widely among market participants. There is no live tape of fixed income executed prices. Few sectors have reliable execution data available, and often at a delay; a limited portion of the fixed income market trades on any given

day. As a result, many fixed income securities are valued daily, using some form of algorithmic or matrix pricing scheme that creates an estimate of value based on the pricing behavior of those securities that have actually traded.

Fixed income ETFs trade on an exchange, but the underlying securities trade over the counter. Only the most liquid sectors offer electronic trading platforms. For many sectors, especially corporate and municipal bonds, trading a specific list of securities to execute a creation or redemption may take hours or even days. All of these factors make it difficult to identify whether an arbitrage opportunity exists. When an investor does identify an apparent opportunity, they may have further challenges in acting on it.

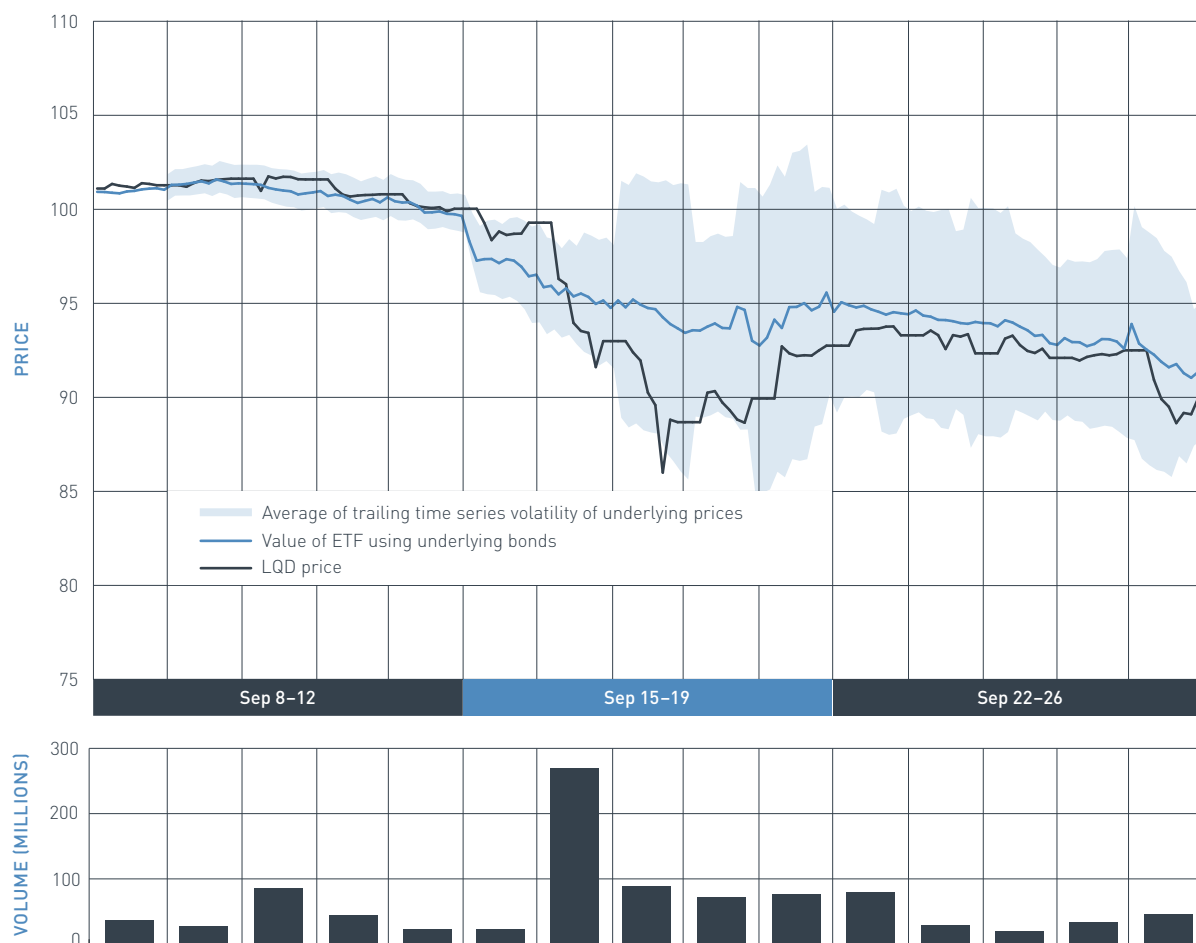
### Timing adjustments: NAV versus ETF valuation

The last factor that drives fixed income premiums and discounts is the timing difference between when a fund NAV is calculated and when the ETF trading day ends. For NAV calculations, the bond portfolio underlying a US fixed income ETF is valued at 3:00 pm eastern time, whereas the ETF continues to trade until the 4:00 pm equity market close. Significant market movements can occur between 3:00 and 4:00. Depending on the direction of these movements, large discrepancies can arise, resulting in the appearance of premiums or discounts to NAV. Although the impact of this factor is small under most market conditions, it does create pricing noise, which can obscure the dynamics discussed above.

As an example, consider TLT, the iShares Barclays 20+ Year Treasury Bond Fund. A rally in US Treasuries after 3:00 can result in the ETF's closing at a premium to NAV, as the ETF continues to trade until 4:00, while the NAV was set at 3:00.

**Figure 10**

*LQD price action and execution risk factor, September 2008*



Source: Bloomberg, TRACE, and BlackRock, as of 9/30/08. Past performance does not guarantee future results.

Figure 11 shows a strong directional relationship between changes in 30-year US Treasury yields (between the 3:00 and 4:00 market closes) and the premium/discount observed in TLT, from 12/31/09 to 2/26/10. The levels-based correlation over this time series was -0.91 with a t-statistic of -13.5, indicating a high degree of statistical significance.

This phenomenon does not exist in US domestic equity markets, because market trading hours for the underlying securities and the ETF are in sync. It does, however, occur with non-US equity market ETFs, in which the underlying market closes while the ETF continues to trade in US market hours.

## Understanding the factors

As with other types of exchange-traded funds, fixed income ETFs have an arbitrage mechanism that helps ensure they trade at a price consistent with their underlying portfolios, level of liquidity, and market risk. By understanding the factors that drive fixed income ETF pricing, investors can better evaluate and utilize these funds.

As a result of both structural and technical factors, fixed income ETFs generally trade at a premium to NAV. Premiums or discounts to NAV may appear to deviate more significantly than investors are

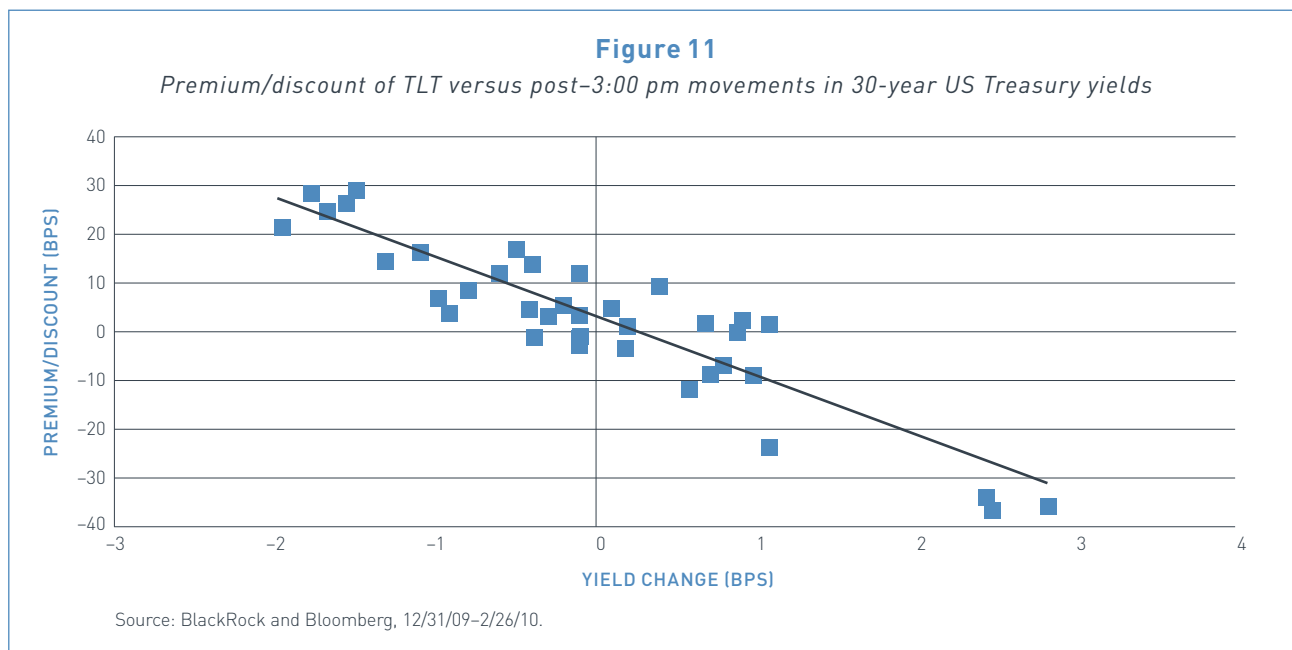
accustomed to observing in equity ETFs. When evaluating fixed income ETFs, it is important to keep two key points in mind: First, fixed income transaction costs are incurred irrespective of the investment vehicle utilized; second, fixed income markets exhibit illiquidity and volatility that becomes more visible through the lens of an exchange.

On the first point, investors must realize that regardless of whether they purchase bonds individually, through an ETF, or through a mutual fund, the cost to trade fixed income securities will be incurred eventually. What differentiates over-the-counter markets like fixed income from exchange-traded equity markets is that both sides of the market are generally not visible. As a result, investors may be unable to fully ascertain the true cost of their execution.

When accessing fixed income markets through a mutual fund or an ETF that employs a cash creation/redemption methodology, investors are theoretically able to purchase the portfolio at or near the NAV, but transaction costs are still incurred. Furthermore, these

costs are distributed among all investors in the fund, and are ultimately reflected in the fund's performance. Fixed income ETFs utilizing an in-kind methodology generally trade at larger premiums or discounts than comparable cash create/redeem ETFs (or mutual funds, which trade at NAV by definition). However, the presence of these premiums/discounts provides investors with transparency into the true costs they incur to access fixed income markets through the in-kind ETF structure. Investors in an in-kind structure are also shielded from subsequent transaction costs arising from the activity of other fund investors. This transaction cost transparency is a key benefit to ETF investors.

Second, liquidity in fixed income markets can be intermittent, and market prices often lack transparency. These are simply attributes of fixed income markets themselves. Bringing OTC bond markets to an exchange through the ETF structure makes market anomalies more visible to investors. These are not "problems" with fixed income ETFs; they are simply the normal dynamics inherent to fixed income markets which, heretofore, many investors have been unable to observe. ♦



## A CLOSER LOOK AT TWO DRIVERS OF PREMIUMS AND DISCOUNTS

How do the individual drivers of premiums and discounts combine to influence premium behavior? Taking a high-yield bond ETF (HYG) as an example, we can gauge the impact of certain factors.

For practical purposes, we isolate the two largest drivers of premium behavior: creation cost and flow factor. We exclude the execution risk adjustment from this analysis, because it is difficult to quantify and can vary across dealers (it is a function of both market risk premia and dealer positioning). Likewise, we exclude the timing adjustment, as intraday data in the OTC high-yield market is not broadly available.

Our analysis is based upon a monthly time series (from the launch of HYG on 4/11/07 to 12/31/09) and two independent variables:

- **Average monthly flow factor:** Average percentage of purchases relative to total purchases and sales each month.\*
- **Average creation cost:** Average bid/offer spread observed in the underlying securities each month.\*\*

These independent variables are regressed against a dependent variable—the fund's average monthly premium—to better understand their impact. Given limitations in the underlying data set, it was necessary to use a monthly time series instead of a daily series. And because our base conceptual model is multiplicative (i.e., average monthly premium = average monthly flow factor x average creation cost), it was necessary to use a log-based regression, which prohibits negative numbers. As a result, the one negative premium observation in the series was removed. This is consistent with a framework that employs only the average flow factor and average creation cost, assuming the flow factor is between 0 and 1, and bid/offer

spreads are always positive. Under such a framework, discounts to NAV (i.e., negative premiums) are not possible, as they could only exist as a function of the execution risk adjustment or timing adjustment. The table summarizes our results.

### Summary of regression analysis for HYG

R-squared	0.568
Correlation coefficient	0.753
F-statistic	19.038
Significance of F-statistic	0.00001
Average flow factor t-statistic	3.42
Average creation cost t-statistic	6.01
Observations	32

Source: BlackRock and NYSE 4/11/07–12/31/09.

Results indicate statistical significance, as evidenced by the R-squared, correlation coefficient, and the significance of F-statistic measures.† The individual t-statistics also indicate a high level of significance for each independent variable.‡ From this analysis, we may conclude that both the flow factor and the creation cost strongly influence the ETF's premium.

This analysis was designed to ascertain the significance of the flow factor and creation cost in driving premium behavior in HYG, rather than to form the basis for a predictive model of this behavior. If and when data becomes available to expand the model and include other variables—such as the execution risk adjustment and timing adjustment—we may gain even greater insight into observed ETF premiums and discounts, and possibly formulate a more predictive model.

\* Raw data was sourced from the New York Stock Exchange (NYSE Arca TAQ), and subjected to an algorithm to determine purchases versus sales.

\*\* Because bid/offer spreads in high-yield securities are difficult to observe and quantify, the Barclays Capital Liquidity Cost Score for the Barclays Capital U.S. Corporate High Yield Bond Index was used to proxy bid/offer spreads in the underlying high-yield market.

† R-squared measures "goodness of fit" and represents the percentage of total variation in the data explained by the statistical model. The correlation coefficient signifies the correlation of the behavior between the statistical model and the dependent variable. The F-statistic is the ratio of the variance in the data explained by the statistical model relative to the variance not explained by the model. The significance of F-statistic indicates the probability that the statistical model is irrelevant in explaining the behavior of the dependent variable.

‡ The t-statistic is a measure of an independent variable's ability to explain the behavior of a dependent variable. A value of approximately +/- 2.0 is generally considered to be significant under a normal distribution.

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