Commission-free Exchange-traded Funds - Are individual investors always better off?

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Authors

James DiLellio, PhD
Assistant Professor Decision Sciences
Graziadio School of Business and Management
Pepperdine University

Philip M. Goldfeder, PhD
Lead Faculty, Program in Predictive Analytics
School of Continuing Studies
Northwestern University

Contact

James DiLellio
Assistant Professor of Decision Sciences
Graziadio School of Business and Management
Pepperdine University
18111 Von Karman Avenue
Irvine, California 92612

Phone: 714-403-0085

Email: james.dilellio@pepperdine.edu

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Abstract

Competition amongst discount brokers for investment dollars continues, and in recent years has reached a point where many commission-free exchange-traded funds (ETFs) are now available. For both investors and advisors, minimizing costs is always of interest, so commission-free ETFs may seem an obvious choice over other ETFs that carry a nominal commission to buy and sell the security. Unfortunately, many other costs can play a role that can marginalize the perceived advantage of the commission-free ETFs, and in some cases, warrant the selection of an ETF that carries a commission. This study investigates how investment amount, account size, trading volume, holding period and other relevant factors can affect the cost calculus of commission vs. commission-free ETFs. The results of this study provide additional guidance to individuals and financial planners to clarify the conditions where selecting commission-free ETFs may not minimize total costs.

INTRODUCTION

The growth of ETFs continues, as the benefits for individual investors become more widely recognized. Discount brokers have taken notice, and chosen to begin offering commission-free ETFs since 2010, in hopes of retaining existing investors and attracting new ones (Maxey, 2010). The major players in offering commission-free ETFs are Fidelity, Schwab, Vanguard, and TD Ameritrade[1], with Fidelity recently more than doubling its number of offerings from 30 to 65. Unfortunately, the increase in commission-free ETFs offered by Fidelity has not always been seen as a positive by financial advisors (Grind, 2013).

This research paper addresses the question of cost minimization in light of the changing marketplace of commission-free ETFs. The objective is to determine under what conditions selecting a commission-free ETF is sub-optimal, as compared to paying the cost to purchase a similar ETF that carries a nominal commission. This challenge has been publicized for several years (see Randall (2010)), but existing academic literature on the topic is sparse. Due to the rapidly growing landscape of ETFs and continued competition amongst discount brokers, we feel these are important questions to address.

The drive to offer reduced or commission-free ETFs has also encouraged ETF providers to seek additional cost reductions. One cost reduction being sought includes reducing the licensing fees associated with the underlying index. So-called brand name indexes are slowly being replaced, as discussed in Bogart (2013), allowing ETF expense ratios to continue to shrink.

This research paper attempts to uncover under what conditions commission-free ETFs would not lead to minimizing total costs. We examine this question for a range of investor characteristics, and identify when statistical significance occurs under a naive asset allocation assumption and

[1] http://www.advisorone.com/2013/03/01/top-4-commission-free-etf-platforms

periodic rebalancing. We chose the naive investment strategy, which weights each of *n* investments equally at 1/*n* at periodic rebalancing intervals. The naive strategy has also received considerable attention due to its simplicity and potential performance over other more complex strategies (DeMiguel et al, 2009).

COST MODEL BASICS

The general form of our *total cost* model is

$$\textit{total cost} = \textit{holding costs} + \textit{buy/sell costs}. \quad (1)$$

The first term represents the ongoing costs of holding the ETF within an investment portfolio, and the second term accounts for periodic rebalancing of a portfolio. The *holding costs* in Equation (1) is defined as

$$\begin{aligned}\textit{holding costs} &= \textit{investment amount} * \textit{holding period} * \textit{expense ratio} \\ &+ \textit{index replication costs}. \end{aligned} \quad (2)$$

The first term in Equation (2), the product of the investment amount, holding period and expense ratio, is widely known and expected to be more significant than the index replication costs. This is largely due to the fact that ETFs are most often structured as regulated investment companies, which can lend shares, reinvest dividends, and optimize portfolio holdings to match, and thus efficiently replicate, their underlying indices.

The second term in Equation (1) is defined as

$$\textit{Buy/ sell costs} = \textit{bid-ask spread costs} + \textit{commission costs}. \quad (3)$$

The first term, *bid-ask spread costs,* was chosen to cover the impact of less liquid assets, which typically come from ETFs with fewer assets. Thus, the bid-ask spread model used here includes the ability of the ETF pricing to track its Net Asset Value (NAV), and is similar to the market impact cost discussed by Justice and Rawson (2012). The second term, *commission costs*, captures the costs paid directly to the brokerage firm to conduct the trade. Lastly, neither short nor long term capital gains taxes are considered within the model assumed above. Thus, we have assumed the investments are held in a tax-deferred or tax-exempt account.

DATA SOURCES AND MODEL REFINEMENT

The model proposed in the previous section drew information from two primary sources. The first source of information was each brokerage firm's website, where expense ratios were found to estimate the annual holding costs, which are costs passed from the ETF provider to the investor. The second source of information was from the Center for Research in Security Prices

(CRSP) database for each commission-free ETF offered[2]. It included the daily returns, volume, shares outstanding, price and bid-ask spread data. This data covered approximately 5 ½ years, from January 1, 2007 to June 30, 2013. The analysis of this data is described further in the following section.

Exhibit 1 shows the expense ratios for each of the four brokerage firms, listed in alphabetical order. Since ETFs are passively managed securities, the expense ratios found are all much less than the 1% or more expense ratios typically encountered in actively managed mutual funds.

Exhibit 1
Sample size and Expense Ratios as of June 30, 2013 for commission free ETFs covering fixed income, domestic equity, and international equity asset classes. Values are as of September 2013.

Aggregate	***Ameritrade***	***Fidelity***	***Schwab***	***Vanguard***
sample size	94	59	83	40
mean expense ratio	0.29%	0.33%	0.37%	0.12%
median expense ratio	0.20%	0.25%	0.32%	0.12%
Fixed Income ETFs	***Ameritrade***	***Fidelity***	***Schwab***	***Vanguard***
sample size	33	25	37	15
mean expense ratio	0.22%	0.26%	0.33%	0.13%
median expense ratio	0.15%	0.20%	0.30%	0.12%
Domestic Equity ETFs	***Ameritrade***	***Fidelity***	***Schwab***	***Vanguard***
sample size	31	15	21	17
mean expense ratio	0.19%	0.25%	0.28%	0.10%
median expense ratio	0.15%	0.20%	0.25%	0.10%
International Equity ETFs	***Ameritrade***	***Fidelity***	***Schwab***	***Vanguard***
sample size	30	19	25	8
mean expense ratio	0.46%	0.48%	0.50%	0.16%
median expense ratio	0.53%	0.50%	0.46%	0.16%

In Exhibit 1, the aggregate listings are for commission-free ETFs that covered the three asset classes of fixed income, domestic equity, and international equity. We selected to remove zero-commission ETFs that did not fall into these categories so that a direct comparison of major asset class ETFs could be performed. This approach captured the vast majority of commission-free ETFs offered. It removed the funds that covered assets such as real estate, commodities,

[2] "From 1992 on, Bid and Ask were set to 0 when CRSP determined that the available quote was unrepresentative of trading activity, pending further research." Source: CRSP help page.

currencies and sector-specific equities which, in most cases, were not offered by every discount broker.

At the aggregate level, the $0 commission ETFs from Vanguard have the lowest expense ratios, followed by Ameritrade and Fidelity. Schwab has the highest, with a median expense ratio 20 basis points higher than Vanguard's. This ranking from lowest to highest expense ratios persists for ETFs in the fixed income and domestic equity asset classes. For international equity ETFs, Vanguard's $0 commission ETFs have the lowest expense ratios, but the next lowest is now Schwab, followed by Fidelity. Ameritrade has the highest expense ratios for international ETFs.

SELECTION CRITERIA FOR NAIVE PORTFOLIOS

To select candidate ETFs to compare in a naive portfolio, we applied a correlation threshold of 90% on daily returns similar to Arshanapelli (2010) in order to create a diversified portfolio. When two ETFs satisfy this threshold, the ETF with higher volume is selected to reduce liquidity risk. We also imposed the criteria that the ETFs had a return history of at least 6 months, which provided 124 daily returns, daily volumes and typical daily spreads. Arguably, this is a fairly loose restriction on time history. Nevertheless, given the rapid growth and diversification benefit potentially offered by new ETFs, we believe the short return history is necessary to provide sufficient breadth of information in the forthcoming portfolio analysis and simulation.

Using these criteria, we identified ETFs that should support a diversified portfolio, and also reduce the transaction costs for periodic rebalancing of the naive portfolio. Exhibit 2 shows the results of applying this selection criterion to the number of portfolio holdings. The full details of correlation tables can be obtained from the authors upon request.

Exhibit 2
Reduced sample size to create a diversified portfolio

	Ameritrade	***Fidelity***	***Schwab***	***Vanguard***
Fixed Income sample size, $r \leq 0.90$, $n_T \geq 124$*	30	23	35	12
Domestic Equity, sample size, $r \leq 0.90$, $n_T \geq 124$*	5	2	4	1
International Equity, sample size, $r \leq 0.90$, $n_T \geq 124$*	7	8	11	2

* Minimum period chosen to include funds traded for > 6 months

Based on Exhibit 2, it appears that Schwab may offer the greatest degree of fixed income diversification, while Vanguard may offer the least. This trend of providing greater potential diversification also holds for diversification within the international equity asset class, where Schwab appears to offer the most diversification and Vanguard the least. Diversifying within domestic equity ETFs is different, with Ameritrade having a slight potential diversification advantage over the other discount brokers. Perhaps most surprisingly, the diversification benefit trend that appears in Exhibit 2 reverses the order of preference in the selection of a discount brokerage by a rational investor. For example, higher expense ratio funds also provide greater

diversification potential, while lower expense ratio funds appear to offer less of a diversification benefit.

SINGLE FACTOR BID-ASK SPREAD MODELS

The last data-driven portion of the model remaining is the bid-ask spread. Here, we attempt to refine the empirical bid-ask spread cost model previously developed by DiLellio and Stanley (2010), which provided estimates across all asset classes and all fund companies available at the time. Given that we are attempting to predict costs for ETFs with underlying assets drawn from different asset classes, we felt it prudent to revisit this cost relationship. Additionally, the previous study by DiLellio and Stanley (2010) used data that was time-averaged on volume, and then sorted into bid-ask spread deciles. We took a different approach below. Here, we examined the bid-ask spread on a daily basis and allowed the single factor regression model to accommodate the noise in the data. Figure 1 shows the scatter plot, under a natural log transformation, of the bid-ask spread versus market capitalization for the Fidelity fixed income ETFs identified above for a diversified portfolio. Figure 2 shows a similar scatterplot, but for Vanguard fixed income ETFs found earlier to define a diversified portfolio. Here, the relationship between bid-ask spread and volume now appears.

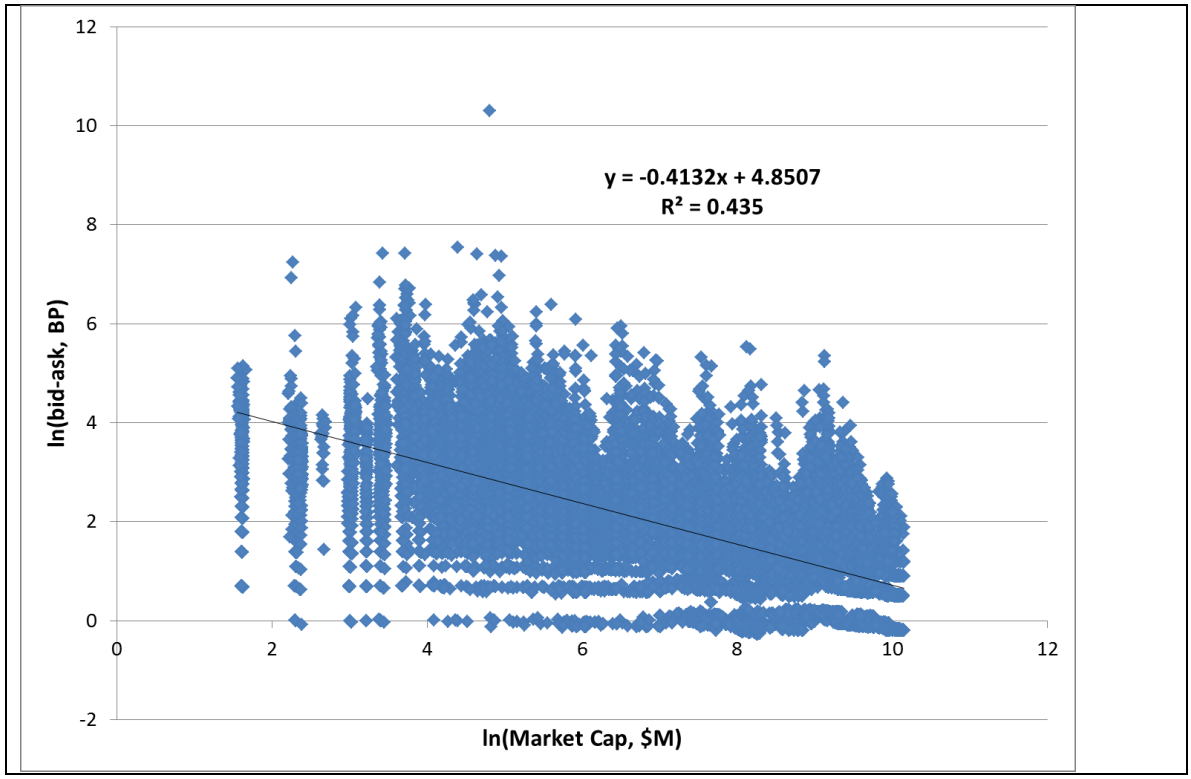

Figure 1 Fidelity fixed income diversified portfolio's bid-ask spreads versus market capitalizations

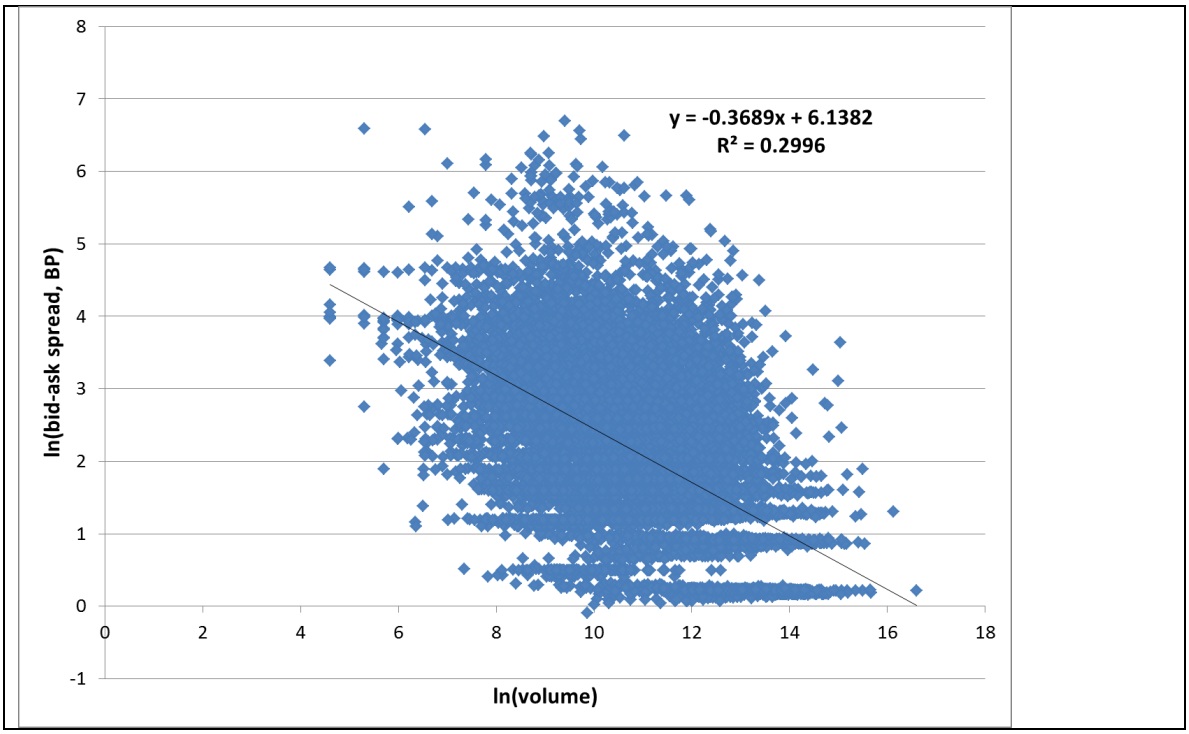

Figure 2 Vanguard fixed income diversified portfolio bid-ask spread versus daily volume

Figures 1 and 2 illustrate that while the bid-ask spread obtained from CRSP is quite noisy, it does exhibit the inverse relationship one would expect. That is, as market capitalization or volume increases, the average bid-ask spread decreases.

To more completely assess the bid-ask spread, we examined three different factors: volume, shares outstanding and market capitalization. For each of the diversified portfolios identified in Exhibit 2, we determined the coefficient of determination, R^2, and the results appear in Exhibit 3. In all cases, a natural log transformation was performed to more accurately model the expected nonlinear behavior of the bid-ask spread for small values of the variables investigated. A nonlinear specification of bid-ask spread versus volume was also previously reported in DiLellio and Stanley (2011).

Exhibit 3

Goodness of fit for single factor models of bid-ask spread from each diversified portfolio

Fixed Income ETFs	***Ameritrade***	***Fidelity***	***Schwab***	***Vanguard***
ln(volume)	22.1%	43.6%	9.0%	30.0%
ln(shares outstanding)	14.9%	44.0%	11.5%	12.7%
ln(market capitalization)	22.0%	43.5%	16.4%	11.3%
Domestic Equity ETFs	***Ameritrade***	***Fidelity***	***Schwab***	***Vanguard***
ln(volume)	51.6%	64.5%	0.1%	4.8%
ln(shares outstanding)	70.1%	78.5%	1.1%	20.3%

ln(market capitalization)	67.7%	80.4%	2.2%	23.5%
International Equity ETFs	***Ameritrade***	***Fidelity***	***Schwab***	***Vanguard***
ln(volume)	16.7%	10.7%	27.7%	25.4%
ln(shares outstanding)	20.7%	21.6%	32.9%	24.7%
ln(market capitalization)	30.5%	29.7%	34.8%	27.0%

In almost all cases, market capitalization appeared to be the best predictor, within a fraction of a percent, of the three factors identified to estimate the bid-ask spread. This can be explained because market share, defined by *shares outstanding * daily closing price*, provides a good proxy for market demand of the ETF. As demand increases, the firm providing the ETF to the market issues additional shares, which increases liquidity and should decrease the bid-ask spread. This explanation is also supported by price momentum, so that as price goes up, more investors will seek to capture expected future gains. As a result, the increased demand also increases the likelihood of additional shares being issued by the ETF provider, thereby increasing the liquidity.

There are two notable exceptions to the best single factor model results. The first are the Vanguard Fixed Income ETFs, which appear to be best explained by volume. We reconcile this difference possibly due to the unique relationship Vanguard ETFs have with their equivalent Vanguard mutual funds. Interestingly, this relationship does not persist for either the Vanguard domestic or international equity ETFs, suggesting other fundamental issues may be at play. The second exception is the Ameritrade domestic equity ETFs. This result could be reconciled by the shares outstanding being more incrementally released to the financial markets.

COST MODEL REFINEMENT

Our cost model defined in (1)-(3) above can be simplified into an annualized cost rate, as follows:

Annualized cost rate = portfolio expense ratio
+ (portfolio bid-ask spread) * (portfolio annual turnover rate)
+ (no. rebalances per year)*commission*n/(investment amount) (4)

The term *turnover rate* in (4) depends directly on (i) the volatility of the 1/n portfolio and (ii) the frequency of re-balancing the portfolio back to 1/n weights. The expected turnover rate for a naive portfolio can be determined via simulating each investment in the portfolio's price as geometric Brownian motion. We assumed long-term average annual returns for each of the asset categories, with an anticipated long-term mean reversion. To simulate the price volatility, we utilized the available ETF price histories in the diversified portfolios previously identified. We maintained the correlation amongst the simulated ETF prices by using the Cholesky decomposition of the correlation matrix of daily returns. Please see van den Berg (2012) for details of this methodology.

Exhibit 4 shows the results of simulating the diversified portfolio of fixed income ETFs across the four different discount brokers. Not surprisingly, since we have already eliminated highly correlated ETFs to produce a 1/*n* portfolio, portfolios with larger values of *n* have lower sampled portfolio standard deviations, but not always lower turnover. Most importantly, all the turnover rates are low, suggesting that relative to the expense ratio, managing a fixed income portfolio with a naive strategy is mostly unaffected by the bid-ask spread costs.

Exhibit 4
Turnover Rates for the 1/n portfolio with periodic rebalancing, assuming Brownian motion for price and 1,000 Monte Carlo trials.

Fixed Income Portfolios	n	Annualized mean return (assumed)	Portfolio Standard Deviation, Annualized (sampled)	Number of Rebalancing Periods Per Year				
				1	2	4	6	12
Ameritrade	30	4%	3.1%	2.4%	3.3%	4.6%	5.6%	7.8%
Fidelity	23	4%	3.2%	2.0%	2.8%	3.9%	4.7%	6.6%
Schwab	35	4%	2.4%	1.7%	2.4%	3.4%	4.1%	5.7%
Vanguard	12	4%	4.2%	2.1%	2.9%	4.0%	4.8%	6.7%

RESULTS

Figure 3 shows the annualized cost of managing the 1/*n* diversified portfolio of fixed income ETFs, assuming that $0 commissions are applied. Note that the curves corresponding to 0% annual turnover represent a buy-and-hold strategy, and that the 1/*n* diversified fixed income portfolios would all be less than 10%, as seen in Exhibit 4. This point on the curve is also dominated by the expense ratio previously reported, and Vanguard appears to provide the lowest cost option. Moving to the right on Figure 3, representing a higher turnover rate, reflects a more active management strategy. By increasing turnover, the effect that the bid-ask spread is clearly seen on the total annualized cost rate. The steepness of the curves reflects the magnitude of the bid-ask spread prediction on the total annual cost rate.

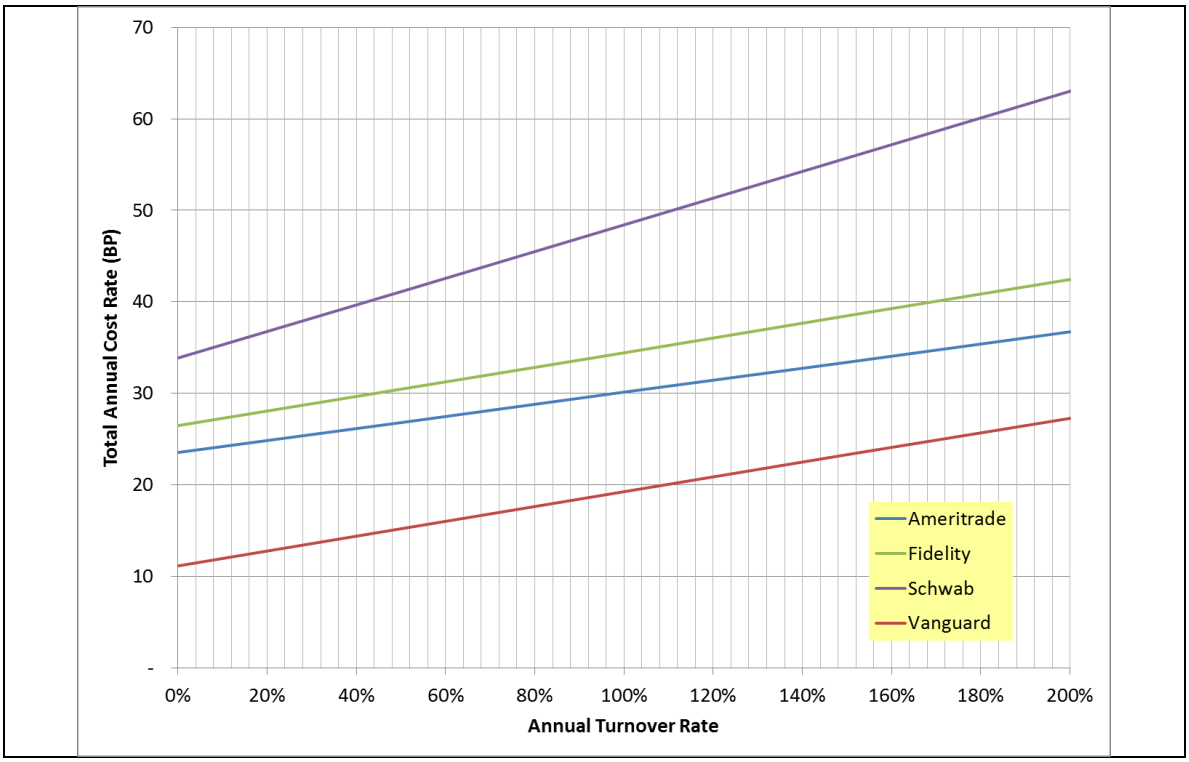

Figure 3 Annualized cost of managing fixed income investments with varying turnover rates. Assumes $0 commissions.

The results above suggest that the Vanguard fixed income diversified portfolio will produce the lowest costs. But, as a final assessment, and perhaps quite relevant to non-Vanguard customers, is the question of whether to simply pay for the Vanguard funds through their existing discount broker. By doing so, will the total cost, including commissions, still keep Vanguard at the lowest annualized cost? This question is important because other considerations not addressed here may be motivating individuals and advisors to use a particular broker. Exhibit 5 evaluates this hypothesis for four different investment amounts.

Exhibit 5 Annualized Cost, including $7 commissions, for the Vanguard Fixed Income Diversified Portfolio

Number of Rebalancing Periods Per Year	**Investment Amount**			
	$100,000	$200,000	$500,000	$1,000,000
1	19.7	15.5	13.0	12.2
2	28.2	19.8	14.8	13.1
4	*45.1*	28.3	18.2	14.8
6	*62.0*	*36.8*	21.6	16.6
12	*112.5*	*62.1*	*31.9*	*21.8*

These results suggest the following, based on a reference point of approximately 25 basis points, which was selected because it is where the non-Vanguard $0 commission ETFs costs begin.

1. For investors with a $100,000 investment, investors can pay a brokerage fee of $7 a trade and make annual re-balancing, while still having a lower annual cost than using the other $0 commission discount brokers. But, more frequent re-balancing would negate this benefit.
2. For investors with more than $100,000 to invest, they can continue to spend $7 to trade Vanguard ETFs and still have lower annualized costs than using the other $0 commission discount brokerages. The more invested, the more frequent periodic re-balancing can occur while keeping the annualized cost lower than competitors offering $0 commissions.
3. For a $200,000 investment, rebalancing can occur up to two times per year. For a $500,000 investment, rebalancing can occur up to four times per year. For a $1,000,000 investment, rebalancing can occur up to six times per year.

Conclusions

This study evaluated the total costs associated with $0 commission ETFs offered by four major discount brokerages. For fixed income investments managed using a naive rebalancing strategy, we found that through simulation, portfolio turnover had a minimal effect, relative to the expense ratio. Overall, we found that Vanguard offers the lowest cost fixed income diversified portfolio. This persisted for a portfolio rebalanced up to monthly, and included the effect of turnover and bid-ask spread, in addition to expense ratios, on total costs. For investors willing to incur a nominal trading commission, the cost benefit of Vanguard's low expense ratios could quickly rise above its competitors, depending on the investment amount and frequency of trading.

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