

ETF Total Cost Analysis in Action

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Exchange Traded Funds carry a number of advantages over traditional funds, such as lower average expense ratios. While the advantages are clear, the disadvantages can be difficult to quantify. These disadvantages include trading costs and tracking risks. While clearly ETFs cost less on average, poor trade execution or poor ETF selection can actually negate the expense ratio advantage.

In this paper, we will discuss proprietary Morningstar ETF data points, which can serve as tools to measure the true cost of ETF ownership. These data points help quantify the investor experience of owning an ETF and allow for better fund selection. Selecting the right ETF involves more than just picking the cheapest fund within a category. At the same time, combining all of these factors to determine the best ETF can be overwhelming. This is why we have begun quantifying the ETF investor experience.

Key Conclusions

ETFs with 4- and 5-star ratings tend to outperform their expense ratio, delivering even lower estimated holding costs than one would predict given their expense ratio. They also tend to have lower tracking volatility and market impact costs than lower-rated funds.

ETFs issued prior to 2005 have lower estimated holding costs, lower tracking volatility, and lower market impact than newer ETFs. They also have more assets and are more likely to have a higher Morningstar Star Rating for Funds. ETFs issued since 2008 on average have a tracking volatility nearly 5 times greater than those issued prior to 2005.

Even after controlling for their higher expense ratios, ETFs in higher expense ratio categories tend to have higher costs, both in tracking volatility and in market impact costs.

Methodology and Inputs

The total cost of ETF ownership is built off a number of factors, including estimated holding cost, tracking volatil-

ity, and market impact cost, each of which are described below. All data are as of May 25, 2012. The study includes 651 ETFs that have all of the required data to calculate the data points, and Morningstar must have the data on the underlying index that the ETF tracks. Active ETFs are excluded. A minimum of 13 months worth of daily return data is required.

Estimated Holding Cost

Estimated holding cost represents the realized cost of replicating an index. Smaller or even negative costs indicate that the ETF is doing a better job matching or beating its index while minimizing costs. It is calculated as the geometric difference between the index return and the fund return over the past year. The biggest factor influencing estimated holding cost is the fund's expense ratio, but other index replication costs can have an impact. Indexes with high turnover, for example, can be harder to replicate as can international indexes that track countries with high-dividend withholding tax rates. On the other hand, costs can be reduced through share lending revenue. It is important to remember that this is a historical number, not a forward-looking number, but the factors influencing it tend to be stable over time, so it can be used to forecast future holding costs. Another way to think about the estimated holding cost is akin to an alpha. While the calculation of estimated holding cost is different than the regression-based alpha, the result is approximately the same, particularly for index products where we expect a beta of 1.

To illustrate how estimated holding costs can differ from expense ratio, we compare four funds, three of which track the S&P 500 (SPY, IVV, VOO) and one which tracks a similar large-cap index (SCHX).

1. Estimated Holding Cost

Name	Net Assets USD Mil	Prospectus Net Expense Ratio %	Estimated Holding Cost %
SPDR S&P 500 SPY	98,090	0.09	0.15
iShares S&P 500 Index IVV	28,229	0.09	0.08
Vanguard S&P 500 ETF VOO	4,288	0.05	0.06
Schwab U.S. Large-Cap ETF SCHX	832	0.08	0.07

Data as of 05/25/12. Source: Morningstar, Inc.

Clearly, the expense ratio is not the sole determinant of how well a fund will perform relative to its index. Both SPDR S&P 500 SPY and iShares S&P 500 Index IVV have an explicit expense ratio of 0.09%. However, SPY has underperformed the index by 0.15% over the past year, while IVV has managed to underperform its benchmark by merely 0.08%, better than its expense ratio by 1 basis point.

What explains the relatively poor performance of SPDR S&P 500 SPY? As the first U.S. ETF, SPY is organized as a unit investment trust and is thus prohibited from engaging in share lending, reinvesting cash dividends, and holding securities outside of the index. This makes it more difficult for the fund to minimize index replication costs. On the other hand IVV, VOO, and SCHX are regulated investment companies that can engage in share lending, reinvest dividends, and have more freedom to optimize portfolio holdings to match the index efficiently. Because of these structural advantages, most modern ETFs are organized as open end investment companies rather than UITs.

Tracking Volatility

Tracking volatility measures the uncertainty with which an ETF tracks an index. If estimated holding cost is similar to the alpha from a returns-based regression, then tracking volatility is the standard error of the regression. This concept is sometimes called tracking error but in our definition we include a moving average error term to account for lead lag effects in fair value estimation. A higher tracking volatility indicates a wider confidence interval for the estimated holding cost. ETFs with large tracking volatilities are

more likely to beat or to underperform their index by a wide margin. Some investors, particularly institutions, expect their ETF to hew tightly to an index. While any persistent drag on an ETF's performance relative to its benchmark is measured by the estimated holding cost, tracking volatility is the appropriate metric with which to judge the uncertainty with which an ETF tracks its index.

Of the four funds highlighted above, SPY, IVV, and VOO each did an excellent job tracking the index, and each had a tracking error of around 4 basis points, which is truly remarkable. Given the large flows into and out of these funds on a daily basis, tracking volatility this low reflects the tremendous advantage of the ETF vehicle for indexing. SCHX was more volatile with tracking volatility of roughly 8 basis points. While higher on a relative basis, a tracking volatility of 8 basis points is still incredibly low.

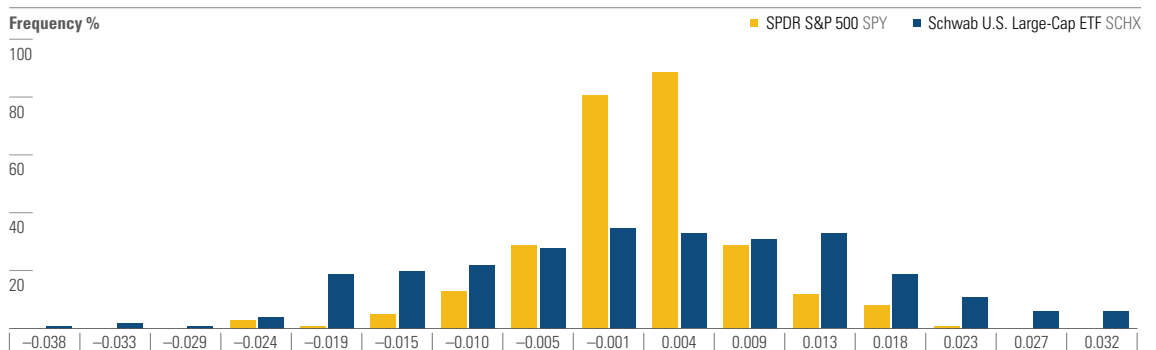
2. Tracking Volatility

Name	Tracking Volatility %
SPDR S&P 500 SPY	0.04
iShares S&P 500 Index IVV	0.04
Vanguard S&P 500 ETF VOO	0.04
Schwab U.S. Large-Cap ETF SCHX	0.08

Data as of 05/25/12. Source: Morningstar, Inc.

Another useful way to think about tracking volatility is as the standard deviation of the time series of periodic excess returns of an ETF compared to its index. SPY has a tracking volatility of just 0.04% while SCHX has a tracking volatility

3. Schwab U.S. Large-Cap ETF Has a Wider Dispersion of Returns



Data as of 05/25/12. Source: Morningstar, Inc.

of 0.08%. Plotting their daily excess return over their respective indexes in a histogram shows that the returns in SPY are much more tightly spread around zero and thus close to its index, while SCHX returns can be expected to fall in a wider range, leading to a higher tracking volatility. In the long run, it is the estimated holding costs that matter most, but tracking volatility can be used to develop a degree of confidence in predicting estimated holding cost. Additionally, asset managers are often concerned with tracking an index precisely by mandate or for hedging purposes. For these purposes, tracking volatility is an important data point to monitor.

Certain asset classes are harder to track than others. For example, foreign stocks often trade when the U.S. market is closed, making it harder for the ETF arbitrage mechanism to work and causing higher tracking volatility.

Market Impact Cost

Market impact cost represents the average market price movement in percent caused by a \$100,000 trade in the ETF. It is based on residual volatility unexplained by movements in net asset value and the previous day's premium or discount scaled by dollar volume traded. If an ETF's market price tracks its NAV well, it is likely to have a small market impact. On the other hand, if the market price is more volatile than the fund's NAV, a large order could move the price before a market maker would be willing to step in and close that gap, leading to higher market impact costs.

Estimates of market impact are notoriously difficult to quantify, and the issue is even more complex for ETFs where the liquidity of both the ETF and its underlying assets matter. While no approach is perfect, the one we

follow has several advantages: it is intuitive based on the nature of the ETF arbitrage mechanism, it is straightforward compared with other methods, and it yields liquidity comparisons that are relatively correct. While in terms of exact dollar amounts, these are estimates based on only one year's worth of end-of-day data, we feel that they are approximately correct.

The results for SPY are not surprising. It trades on average over \$20 billion a day, making it the most liquid ETF. A \$100,000 trade will move the market less than 0.001 of 1 basis point. IVV, on the other hand, has a market impact of almost 0.1 of a basis point. Although they hold the same stocks and IVV in its own right is incredibly liquid, IVV trades about \$400 million per day compared with \$20 billion in SPY. VOO trades much less, at about \$30 million a day. Here, a \$100,000 trade placed on the market is likely to move the price by about 0.3 basis points.

5. Market Impact Cost

ETF	Market Impact Cost %
SPDR S&P 500 SPY	0.0001
iShares S&P 500 Index IVV	0.0009
Vanguard S&P 500 ETF VOO	0.0029
Schwab U.S. Large-Cap ETF SCHX	0.0077

Data as of 05/25/12. Source: Morningstar, Inc.

The larger, more heavily traded the fund and the more liquid the underlying securities, the lower the market impact cost is likely to be. To illustrate one of these factors, we grouped funds by size. Funds with more than \$1 billion in assets had an average market impact of just under 4 basis points. Small funds with less than \$100 million in

4. Morningstar Categories With Lowest and Highest Tracking Volatility

Category	Tracking Volatility %	Number of ETFs	Category	Tracking Volatility %	Number of ETFs
US ETF Short Government	0.05	5	US ETF Volatility	6.55	6
US ETF Large Value	0.09	24	US ETF Equity Precious Metals	4.29	5
US ETF Large Blend	0.10	25	US ETF Global Real Estate	3.24	8
US ETF Real Estate	0.11	10	US ETF Foreign Large Blend	2.77	11
US ETF Intermediate Government	0.12	5	US ETF Diversified Emerging Mkts	2.55	25

Data as of 05/25/12. Source: Morningstar, Inc.

assets had a median market impact of 56 basis points. For many of these funds, volume is very low with block trades rarely occurring.

6. Market Impact Cost Related to Size

ETF Size	Average Assets USD	Average Market Impact Cost %
Over \$1 Billion	6,976,281,745	0.0376
\$100 Million–\$ 1 Billion	355,245,428	0.1609
Under \$100 Million	42,530,342	0.5657

Data as of 05/25/12. Source: Morningstar, Inc.

Total Cost

Total Cost combines the above measures to gauge how well an ETF tracks and index and how liquid it is.

Total Cost = Holding Component + Market Impact Component

Holding Component = $IA^1 \times HP^2 \times ((EHC^3 + TV^4 / \sqrt{(250)} \times 1.96) / 100$
Market Impact Component = $2 \times IA \times \sqrt{(IA / 100000)} \times (MIC^5 / 100)$

(1) Investment Amount; (2) Holding Period, in Years; (3) Estimated Holding Cost;
(4) Tracking Volatility; (5) Market Impact Cost

There are two components to the total cost of an ETF. The first component is the holding cost component; which is based on the investment amount, the holding period, and the 95th percentile confidence level of the estimated holding cost. As discussed above, the biggest factor influencing the estimated holding cost is the expense ratio.

The second component is the market impact, or trading cost component. This number is doubled due to the assumption of a purchase and sale. Market impact depends on the amount invested, but it does not depend on the holding period. Because market impact is calculated based on an assumed \$100,000 trade, the number has to be rescaled for the investment amount—hence the $\sqrt{(IA/100,000)}$ term. Brokerage commissions are ignored because these vary by platform and investor.

7. Cost for Two S&P 500 Funds

ETF	Estimated Holding Cost %	Tracking Volatility %	Market Impact Cost %
SPDR S&P 500 SPY	0.15	0.04	0.0001
Vanguard S&P 500 ETF VOO	0.06	0.04	0.0029

Data as of 05/25/12. Source: Morningstar, Inc.

As an example of the formula, assume a \$150,000 investment held for three years. The total cost of this investment for SPY and VOO are as follows:

8. \$150,000 Investment Amount, Held for Three Years

ETF	Market Impact Cost %	Holding Cost USD	Total Cost USD
SPDR S&P 500 SPY	0.48	714.88	715.36
Vanguard S&P 500 ETF VOO	10.55	284.84	295.38

Data as of 05/25/12. Source: Morningstar, Inc.

Over longer holding periods, estimated holding costs are a more important contributor to total cost than are market impact costs, particularly for the buy-and-hold investor. Over the three-year holding period, VOO's lower estimated holding costs trumps the market impact cost advantage of SPY, resulting in a lower total cost for VOO and making VOO the better choice in this circumstance. While the \$150,000 three-year investment might be typical of a financial advisor or wealthy individual, a larger investment held for a shorter period might be typical of an institutional trade. For example, an institution might want to stay fully invested in the market when transitioning to a new asset manager. To simulate this scenario, we run the numbers again for a \$1 million investment held for three weeks.

While VOO still has a lower holding cost, in this case, SPY is the more efficient investment because the holding period is so short that market impact is the more important factor.

9. \$1 Million Investment Amount Held for Three Weeks

ETF	Market Impact Cost %	Holding Cost USD	Total Cost USD
SPDR S&P 500 SPY	8.22	91.65	99.87
Vanguard S&P 500 ETF VOO	181.51	36.52	218.03

Data as of 05/25/12. Source: Morningstar, Inc.

Star Ratings and Costs

While it is not surprising that 4- and 5-star ETFs tend to have lower expense ratios than 1- and 2-star ETFs, 4- and 5-star ETFs tend to outperform that expense ratio, delivering even lower estimated holding costs. They also tend to have lower tracking volatility and market impact costs than lower-rated funds, leading to lower total cost of ownership and a better overall investor experience.

Costs by Inception Date

When we sort ETFs by inception date, a clear pattern emerges. Older ETFs have lower estimated holding costs, tracking volatility, and market impact costs. They also have attracted more assets and earned a higher average star rating. As we found when sorting by star rating, older ETFs perform better than expected given their expense ratios, again leading to lower total costs and a better investor experience.

Costs by Category

It is more expensive to gain access to certain asset classes and categories than others. For example, U.S. stock and taxable bond asset classes are generally cheaper than the alternative asset class.

ETFs in high-cost categories tend to underperform on costs, while ETFs in low-cost categories tend to cost even less than their expense ratio. For example, the 37 ETFs in the trading-leveraged equity category had an average expense ratio of 0.98%. However, their average holding costs was 1.49%. ProShares Ultra S&P 500 SSO had an estimated holding cost of 1.35% compared with an expense ratio of 0.92%. Direxion Daily Financial Bull 3X Shares FAS had an estimated holding cost of 2.85% compared with an expense ratio of 1.10%. This is in sharp contrast to low expense ratio categories such as the large blend category, which had an average expense ratio of 0.19% but an average estimated holding costs of 0.17%.

Costs by Legal Structure

The vast majority of ETFs covered in this study were open-end investment companies, and there were too few ETFs organized as unit investment trusts, grantor trusts or partnerships to draw meaningful conclusions. However,

it is clear that uncollateralized debt instruments, also known as exchange traded notes, or ETNs, had relatively higher costs.

Cost by Index Type

Index strategy maps allows investors to differentiate among index strategies based on how securities are selected—passive, screened, or quantitative—and how they are weighted—fixed, fundamental or capitalization. Passive security selection replicates a financial market or sector of that market. Screened security selection filters out securities from a particular market segment. Quantitative security selection relies on mathematical models to choose securities. Fixed weighting assigns a set weighting to each security in an index or to each industry in an index. Fundamental weighting utilizes qualitative factors and/or financial information to allocate securities. Capitalization weighting bases the allocation on the relative market value of each security in the index.

One would expect to find the lowest costs in the “Passive-Capitalization” weighted segment. However, 27% of the funds in that segment are from the higher-cost international stock asset class. The costs of the “Passive-Fixed Weighting” are raised by the large number of alternative and commodity ETFs in that segment. If we look just within the U.S. stock asset class, ETFs in the “Passive-Capitalization” have the lowest total costs for the retail investor.

Tables detailing these findings are on the following pages.

10. Higher Rated Funds Have Lower Costs

Star Rating	Estimated Holding Cost %	Tracking Volatility %	Market Impact Cost %	Average Assets USD	Expense Ratio %	Average Star Rating
4 and 5	0.33	0.11	0.04	442,261,043	0.40	4.21
3	0.35	0.14	0.05	403,225,303	0.43	3.00
1 and 2	0.50	0.37	0.13	164,497,018	0.50	1.68

Data as of 05/25/12. Source: Morningstar, Inc.

11. Older Funds Have Lower Costs

Inception Date	Estimated Holding Cost %	Tracking Volatility %	Market Impact Cost %	Average Assets USD	Expense Ratio %	Average Star Rating
Before 2005	0.21	0.07	0.03	1,076,144,455	0.33	3.24
2005–2008	0.59	0.19	0.06	170,740,548	0.56	3.04
2008–4/2011	0.55	0.39	0.10	102,311,138	0.57	2.82

Data as of 05/25/12. Source: Morningstar, Inc.

12. Commodity and Alternative Asset Classes Have Higher Costs

	Estimated Holding Cost %	Tracking Volatility %	Market Impact Cost %	Average Assets USD	Average Expense Ratio %	Star Rating	Number of ETFs	Average Inception Date
U.S. Stock	0.23	0.20	0.11	2,850,696,857	0.30	3.51	137	05/07/05
Taxable Bond	0.26	0.58	0.08	2,796,892,444	0.23	2.75	66	06/05/08
Municipal Bond	0.54	0.51	0.45	442,476,622	0.28	3.09	15	08/26/08
International Stock	0.56	2.08	0.62	1,651,286,664	0.55	2.95	124	11/11/05
Sector Stock	0.57	1.24	0.29	546,361,769	0.51	2.91	173	08/15/06
Commodities	0.99	1.39	0.53	3,044,401,406	0.67	3.4	30	11/22/07
Alternative	1.62	1.02	0.10	269,913,233	0.96	3.5	100	05/24/08

Data as of 05/25/12. Source: Morningstar, Inc.

13. High Expense Ratio Categories Tend to Have Higher Total Costs, Low Expense Ratio Categories Tend to Have Lower Total Costs

	Estimated Holding Cost %	Tracking Volatility %	Market Impact Cost %	Average Assets USD	Average Expense Ratio %	Number of ETFs in Category
High Expense Ratio Categories						
US ETF Trading-Leveraged Equity	1.49	0.64	0.13	216,730,291	0.98	37
US ETF Trading-Inverse Equity	1.77	0.61	0.06	238,211,881	0.98	39
US ETF Volatility	1.28	6.55	0.17	390,214,615	0.95	6
US ETF Commodities Agriculture	1.29	1.00	0.43	95,382,029	0.75	8
US ETF Commodities Industrial Metals	1.39	1.95	1.16	45,625,485	0.75	5
Low Expense Ratio Categories						
US ETF Large Blend	0.17	0.10	0.07	7,001,256,198	0.19	25
US ETF Short-Term Bond	0.28	0.18	0.03	3,639,917,885	0.18	6
US ETF Long Government	0.37	1.28	0.16	1,397,582,120	0.16	7
US ETF Intermediate Government	0.15	0.12	0.02	766,551,643	0.15	5
US ETF Short Government	0.11	0.05	0.01	2,843,556,126	0.13	5

Data as of 05/25/12. Source: Morningstar, Inc.

14. ETNs Have Higher Costs

Fund Legal Structure	Estimated Holding Cost %	Tracking Volatility %	Market Impact Cost %	Average Assets USD	Expense Ratio %	Star Rating	Number of ETFs	Average Inception Date
Grantor Trust	0.44	0.57	0.07	12,160,874,933	0.43	N/A	7	12/7/07
Open Ended Investment Company	0.61	0.99	0.27	1,264,778,858	0.50	3.1	594	9/25/06
Partnership (3C1)	1.98	0.67	0.08	371,335,237	0.90	3.5	10	1/2/09
Uncollateralized Debt Instrument	1.01	2.70	0.56	355,257,375	0.78	3.2	33	6/30/08
Unit Investment Trust	-0.01	0.12	0.11	21,151,084,129	0.23	3.6	7	3/5/99

Data as of 05/25/12. Source: Morningstar, Inc.

15. Costs by Index Strategy

	Estimated Holding Cost %	Tracking Volatility %	Market Impact Cost %	Average Assets USD	Expense Ratio %	Star Rating	Number of ETFs	Average Inception Date
Passive - Capitalization	0.41	0.92	0.26	2,448,944,499	0.35	3.06	327	9/17/05
Passive - Fixed Weight	1.39	0.46	0.17	411,648,513	0.82	3	125	1/19/08
Passive - Fundamental	0.92	1.34	0.40	1,196,154,960	0.52	3.36	12	10/13/06
Quantitative - Capitalization	0.08	5.33	2.58	14,857,756	0.77	1.67	3	6/3/08
Quantitative - Fixed Weight	0.71	1.58	0.17	140,156,139	0.68	3.24	46	10/6/06
Quantitative - Fundamental	0.52	0.60	0.32	80,120,934	0.53	2.7	13	10/18/07
Screened - Capitalization	0.42	1.90	0.29	938,073,782	0.54	3.1	71	1/12/09
Screened - Fixed Weight	0.94	1.80	0.14	1,483,498,667	0.68	2.56	17	6/26/07
Screened - Fundamental	0.31	1.39	0.75	916,983,308	0.57	3.3	37	12/17/06

Data as of 05/25/12. Source: Morningstar, Inc.