

NBER WORKING PAPER SERIES

EXCHANGE TRADED FUNDS 101 FOR ECONOMISTS

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Working Paper 24250  
<http://www.nber.org/papers/w24250>

NATIONAL BUREAU OF ECONOMIC RESEARCH  
1050 Massachusetts Avenue  
Cambridge, MA 02138  
January 2018

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NBER Working Paper No. 24250  
January 2018  
JEL No. G0,G12,G2

**ABSTRACT**

Exchange-traded funds (ETFs) represent one of the most important financial innovations in decades. An ETF is an investment vehicle that trades intraday and seeks to replicate the performance of a specific index. In recent years ETFs have grown substantially in assets, diversity, and market significance. This growth reflects the rise in passive asset management where investors seek to track a benchmark index rather than outperform the market as a whole. As a consequence, there is increased attention by investors, regulators, and academics seeking to assess and understand the implications of this rapid growth. This article explains the key drivers of ETF growth and their implications for economists and policy makers.

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Exchange-traded funds (ETFs) represent one of the most important financial innovations in decades. As such, they are of considerable interest to economists, but the literature on ETFs is, as we shall see, still at an early stage. An ETF is an investment vehicle, with an architecture shown in Figure 1 (to be discussed), that typically seeks to track the performance of a specific index, like an index mutual fund does. But an ETF is not a mutual fund. The first US-listed ETF, the SPDR, was launched by State Street in January 1993 and seeks to track the S&P 500 index. It is still today the largest ETF by far with assets of \$178 billion as of September 2017. Following the introduction of the SPDR, new ETFs were launched tracking broad domestic and international indices, and more specialized sector, region, or country indexes. In recent years, ETFs have grown substantially in assets, diversity, and market significance, including substantial increases in assets in bond ETFs and so-called “smart beta” funds that track certain investment strategies often used by actively traded mutual funds and hedge funds. These trends have the potential for dramatically reshaping the broader investment landscape, as we discuss below. Globally, assets of exchange-traded funds under management are \$4.3 trillion in September 2017 (exceeding the hedge fund industry) in roughly 6,300 investment vehicles (according to the *BlackRock 2017b*). These totals should be viewed against the global total market value of equity and fixed income securities in excess of \$160 trillion.

In this paper, we begin by describing the structure and organization of exchange-traded funds. We offer a number of contrasts with mutual funds, which are close relatives of exchange-traded funds, describing the differences in how ETFs operate and their potential advantages in terms of liquidity, lower expenses, tax efficiency, and transparency.

We then turn to concerns over whether the rise in ETFs may raise unexpected risks for investors or greater instability in financial markets. Some of the potential issues include what happens when an ETF is delisted; risks when ETFs lend their securities to short-sellers; concerns about ETFs that trade intraday but are based on infrequently traded assets; and whether ETF flows could lead to price distortions or additional volatility. While concerns over financial fragility are worth serious consideration, some of these concerns are overstatements, and for others, a number of rules and practices are already in place that offer a substantial margin of safety.

The conclusion of the article offers some suggestions for future research in this growing field. For more comprehensive treatments of ETFs and related investment vehicles, interested readers might start with Hill, Nadig, and Hougan (2015) and Madhavan (2016).

### **Structure and Ecosystem: Comparing Exchange-Traded Funds and Mutual Funds**

Most economists are familiar with mutual funds, so it is useful to describe how ETFs function by comparing them with mutual funds (for a survey of the literature on mutual funds, see Elton and Gruber 2013).<sup>1</sup>

#### *Who Creates and Trades Shares?*

A mutual fund holds the underlying assets: for example, an S&P 500 index fund holds a portfolio of stocks that makes up the S&P 500 index. The manager of a mutual fund will contract with a pricing provider to determine a “net asset value” (NAV) of the fund based on the last recorded prices of the component securities.<sup>2</sup> In a mutual fund, all transactions occur at the end of the day and at net asset value. If this index fund experiences a net in-flow of investment at the end of the day, the mutual fund itself will purchase more shares of stock.

An exchange-traded fund also holds a portfolio of assets; however, in contrast to a mutual fund, it does not interact with capital markets directly. Instead, the ETF manager (or

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<sup>1</sup> In particular, we focus here on “open-end” mutual funds, in which the number of “shares” in the fund, and hence its size, can expand and contract. In a closed-end mutual fund, by contrast, the fund’s shares, once issued, are fixed in supply and they trade on the open market at prices that could be quite different from net asset value. There is typically a discount on closed-end funds, which represents a puzzle for economists because, in theory, a substantial discount should mean that the fund could benefit its investors by liquidating and returning the proceeds. There is a large literature on the nature and properties of the closed-end fund discount (in this journal, see Lee, Shleifer, and Thaler 1990; see also Lee, Shleifer, and Thaler 1991; Elton, Gruber, and Busse 1998; Berk and Stanton 2007).

<sup>2</sup> For international mutual funds, net asset value is often adjusted, or “fair valued,” based on market movements in other markets (for example, by adjusting valuations in emerging markets based on US futures market movements) to prevent gaming. Similarly, bond fund valuations may also be adjusted by the pricing provider because component securities might have traded days, even weeks, ago. Grégoire (2013) finds evidence that mutual funds do not fully adjust their valuations to reflect fair value, and returns remain predictable.

sponsor such as Vanguard or State Street) enters into a legal contract with one or several “Authorized Participants” (APs), typically large financial institutions or more specialized market-makers, who in turn interact with the markets (see Figure 1). In particular, the ETF manager can issue or redeem shares with Authorized Participants in large blocks, known as creation units, in exchange for a basket of securities and/or cash. This mechanism, by which the shares of the ETF are adjusted in response to supply and demand, is known as the creation/redemption mechanism. Here, “creations” refer to increasing the supply of ETF shares; “redemptions” refer to a decrease in the shares outstanding of the ETF.

Both current fund holdings and the basket of securities that the ETF will accept for creations or redemptions on the next business day are published at the end of each trading day. The transactions between an ETF manager and an Authorized Participants are typically either for cash or “in-kind” where the Authorized Participants delivers or receives a basket of securities identical (or very similar) to the ETF’s holdings. Like other investors, Authorized Participants can buy or sell ETF shares in the secondary market exchange, but they also can purchase or redeem shares directly from the ETF if they believe there is a profit opportunity. The process of ETF share creation or redemption for an ETF is illustrated in Figure 1, where we show the “in-kind” exchange of securities for ETF shares. The process of a cash creation (not typical) is similar.

Early ETFs were almost exclusively seeking to track broad value-weighted equity indices (for example, the S&P 500) but ETFs today track a wide variety of equity and fixed-income indices. There are also active ETFs that are akin to active mutual funds in that they seek to outperform a benchmark index, but to date they are still a small fraction of total ETF assets.

### *How is the Price of Shares Determined?*

Managers of exchange-traded funds are, like mutual funds, required by the Securities and Exchange Commission (SEC) to publish a “net asset value” for their funds. In contrast to mutual funds, investors in exchange-traded funds mostly do not trade the fund directly. Instead, they deal with each other on an exchange, or with Authorized Participants and other liquidity providers. Investors can buy and sell shares in ETFs through a broker, just as they buy and sell shares of publicly listed companies. This secondary market trading does not lead to transactions

in the underlying securities, which greatly reduces the transaction costs that arise when investors redeem from the fund. The secondary market (exchange-traded) trading volume for most ETFs is typically a multiple of the volume of creation/redemption activity by the Authorized Participants. According to Investment Company Institute statistics for 2014, this ratio is about 4:1 over all ETFs.

Although shares of exchange-traded funds can be created or redeemed at the end of each trading day, the Authorized Participants will typically lock in any profits intraday. For example, when an ETF is trading at a premium to an Authorized Participant's estimate of value (which need not be the net asset value of the fund), the Authorized Participants may choose to deliver the creation basket of securities in exchange for ETF shares, which in turn it could elect to sell or keep. The creation/redemption mechanism works through arbitrage to help keep the price of an exchange-traded fund close to the intrinsic value of an ETF's holdings in the underlying market.

In the context of an exchange-traded fund, deviations of price from the announced net asset value do not necessarily imply the existence of arbitrage opportunities, especially for international funds and for funds whose constituents may be difficult to value because of infrequent trading. As noted above, the ETF sponsor contracts with market data vendors (or other third parties) to calculate and publish net asset value based on past prices. Vendors also provide an Intraday Indicative Value that is disseminated at regular intervals during the trading day, typically every 15 seconds. This value is usually based on the most recent (possibly stale) trade. Thus, if the exchange-traded fund holds Japanese stocks, say, the closing price (or quote) from Tokyo is used throughout the US trading day and a foreign exchange adjustment is made for any change in the yen/dollar relationship since the Tokyo markets are closed. For fixed-income funds, the provider of the Intraday Indicative Value may not necessarily fully update the prices of securities that do not trade, or include adjustments for accrued fees or liabilities that vendors usually reflect in their end-of-day net asset value.

Madhavan and Sobczyk (2016) develop and test a model of exchange-traded fund price dynamics where arbitrage corrects deviations between the price of ETFs and the underlying value of the basket. In their model, the actions of arbitrageurs reduce these deviations over time, yielding a metric for the speed of price discovery. The model explains why premiums and discounts to net asset value need not necessarily constitute mispricing or the existence of arbitrage opportunities, as well as why ETF returns may be more volatile than the returns of the

benchmark index. They empirically estimate the model for the universe of US-listed exchange-traded funds and find that, on average, the speed of price discovery (measured by the half-life to correct any given deviation of price from basket value) is shortest for US equity-focused funds and greatest for international-bond funds, which is consistent with the observed pattern of liquidity.

Ultimately, the intraday tradability of exchange-traded funds is really a by-product of having the price of the fund determined by the market through the interaction of buyers and sellers, unlike an open-ended mutual fund where liquidity is offered only at the close and only at net asset value. As such, ETFs can serve as important vehicles for price discovery when the underlying markets are stressed or illiquid. International funds provide daily examples of this point.

#### *Transaction Costs: Externalized*

An important difference from a mutual fund structure is that transaction costs in an ETF are “externalized.” Consider a hypothetical mutual fund with assets of \$100 million and one million shares outstanding. The average bid–ask spreads of the underlying assets are for illustrative purposes assumed to be 0.20 percent, and so one-way transaction costs are 0.10 percent. Suppose on a given day there are \$5 million of inflows (subscriptions) and \$20 million of outflows (redemptions) for a net outflow of \$15 million. Say also that fundamental values remain constant over the day. In the traditional open-ended mutual fund example, subscriptions and redemptions occur at the net asset value of \$100, and the fund manager must sell \$15 million of the underlying assets. These sales will tend to occur at the bid price of the underlying assets, and hence an average discount of 0.10 percent to net asset value. At the start of the following day, net asset value is—assuming no change in fundamentals—equal to \$84,985,000, which is calculated as the original \$100 million, minus the \$15 million in sold assets, and also minus the transaction costs of selling. In other words, remaining investors in the mutual fund bear the transaction costs incurred by the participants who redeemed or subscribed.

In contrast, in exchange-traded funds, the sellers of the fund will transact directly with buyers at a market determined price. Net selling does not require the ETF manager to interact with the capital markets, meaning that in this example, fund investors who do not sell will hold a fund whose assets are valued at \$85 million.

Moreover, in exchange-traded funds the distribution fees are externalized. In a “compensation model” for financial advisers, which is increasingly common worldwide, financial advisers are paid directly by the client for their services typically based on the amount of assets managed. For these professional advisers, ETFs are attractive because distribution, account servicing, or maintenance fees are not included in the expense ratio. Mutual fund managers often pay financial advisers a commission, called a “retrocession,” for selling their products to clients. In Europe, the recent trend towards eliminating these payments (through laws that state that advisers should act in their clients' interests) puts ETFs and mutual funds on par in terms of compensation, from the perspective of a financial advisor. That change should also increase incentives for advisers to offer their clients ETFs as an element of portfolio construction.

### *Other Considerations*

Compared to active mutual funds or to hedge funds, ETFs offer greater transparency because their investment strategies are specified in advance and their holdings are listed daily versus quarterly. The ETF structure also enables lower fees than traditional active mutual funds. Since mutual funds interact directly with investors (Antoniewicz and Heinrichs 2014; Hill, Nadig, and Hougan 2015) they accrue distribution and record-keeping costs. Indeed, mutual funds may levy fees (such as transfer agency fees or 12b-1 fees that compensate the fund for distribution and service) that ETFs do not, raising the cost to own mutual funds.

An investor in ETF shares, unlike a traditional mutual fund investor, can short shares, lend shares, and can buy on margin, as with stocks. (With short sales, an investor faces the potential for unlimited losses as the security’s price rises. There are special risks associated with margin investing. As with stocks, an investor may be called upon to deposit additional cash or securities to their account, there is no guarantee that there will be borrower demand for the ETF, and a short sale may or may not be recalled.)

Relative to open-ended index mutual funds, exchange-traded funds can potentially offer significant tax advantages that derive from the ability to use in-kind transfers to reduce capital gains distributions, as explained in detail in Poterba and Shoven (2002). The ability to trade ETFs intraday also makes them attractive to hedge funds and other institutions seeking to hedge risks or gain exposure based on macroeconomic and other news events.



## *Potential Issues for ETFs*

One potential issue for ETFs is that some investors may not have the financial sophistication to distinguish between the types of ETFs (for example, funds that are levered or that are based on unsecured debt) in the absence of a common classification scheme. A second issue is that, intraday liquidity might induce “too much” trading. Barber and Odean (2000) show that individual investors who trade actively in individual stocks suffer lower returns than investors who trade less. The liquidity of ETFs might lead to a similar effect relative to less-liquid mutual funds. Finally, the proliferation of indices, some custom and others concentrated, pose challenges for ordinary investors. Asset managers may create indices that are designed to do well in backtesting but might not do well going forward. We will address potential concerns about the growth of ETFs in more detail later in the paper.

## **The Size and Types of Exchange-Traded Products**

Equity-based exchange-traded funds still dominate the ETF landscape, accounting for over 78 percent of the \$4.3 trillion in exchange-traded product assets, but other asset classes (including fixed income, which is 17 percent of assets) have become more important recently (according to *BlackRock* 2017b).

Distinguishing among different kinds of exchange-traded products is useful given that regulatory concerns about the possible disruptive effects of ETFs often focus on a relatively small subset of the universe of exchange-traded products. For example, *exchange-traded notes* are senior, unsecured (either collateralized or more likely uncollateralized) debt securities that are exposed to the credit risk (solvency) of the issuer, typically an investment bank. Only 2.3 percent of global assets in all exchange-traded products are held in exchange-traded notes. A small subcategory of exchange-traded notes includes ETFs that are not backed by publicly traded holdings; ETFs backed by bank loans are about \$7 billion or 0.2 percent of total assets in exchange-traded products. *Exchange-traded commodity funds* are funds that hold physical commodities such as silver or gold. *Leveraged and inverse exchange-traded products*, which

represent 1.3 percent of global assets in exchange-traded products, hold the individual index stocks as well and thus have elements of physical-backing (Madhavan 2016).

Table 1 shows the assets under management (AUM) of broad categories of exchange-traded funds, including equity, fixed income, commodity, currency, and alternative/asset allocation ETFs. The vast majority of ETFs, representing 92.5 percent of global assets of nondebt funds are traditional ETFs that typically hold a portfolio of securities (stocks or bonds) that closely resembles, but need not necessarily fully replicate, their benchmark index (Madhavan 2016). These funds seek to provide one-to-one exposure to the index, usually broad market gauges offered by index providers. Beyond helping investors distinguish among exchange-traded products, a sensible classification scheme could help speed up the regulatory process for "plain vanilla" funds comprised of stocks/bonds that do not use leverage, swaps, and other financial tools.

Table 1 also shows the number of different indices tracked by ETFs for a variety of different asset classes. Exchange-traded funds track 130 US large cap indices, the largest ETF sector. In addition to these broad market indices, ETFs seek to track 208 sector indices and hundreds of other more specialized indices. ETFs also span 180 indices across different fixed-income markets as well as 126 commodities and 22 currency indices.

### *Equity Exchange-Traded Funds*

Table 2 takes a closer look at equity ETFs.

The growth of ETFs is linked to a broad shift from actively managed mutual funds to passive investment vehicles. During the period from 2007 to 2015, over \$425 billion flowed into passive mutual funds and \$730 billion into exchange-traded funds, while actively managed mutual funds lost \$835 billion in assets under management (Investment Company Institute 2016). It is also worth noting that until the advent of electronic data delivery and cheaper computing technology, it was quite costly to manage an index portfolio of several hundred or thousand constituents relative to a concentrated active portfolio of, say, 50–70 stocks. Indeed, it was only in the 1970s that it became cost effective to manage an index fund. ETFs succeeded in the 1990s as a result of regulation that saw them as a way to provide market stability after the crash of 1987 without portfolio trading of individual stocks (as reported in Balchunas 2016).

Yet despite the shift into index vehicles, considerable room for growth remains. The global investable universe for equities—the value of all publicly traded company stocks—is an estimated \$68 trillion (according to BlackRock 2017a). Traditional open-end mutual funds, index and active, hold approximately 15.2 percent and 4 percent, respectively, of the investable equity universe. (Among open-end mutual funds, index funds represent 7.4 percent of the equity universe.)

Fee differentials and the difficulties of beating a benchmark may explain some of the movement from active to passive indexing, including exchange-traded funds. The management fees for mutual funds have declined in recent years: in 2000, management fees of active mutual funds on average were 106 basis points, about 80 basis points higher than fees of index mutual funds. By 2015, average fees of active funds declined by about 20 basis points while average fees of index funds have declined by 16 basis points (Investment Company Institute 2016). Average fees of bond mutual funds have declined by a comparable margin. The fees for exchange-traded funds are typically lower than actively traded mutual funds but higher than those for passive index mutual funds. The majority of mutual funds have not outperformed their benchmarks once fees are taken into account (for example, Carhart 1997; Grinblatt and Titman 1992; Elton, Gruber, and Blake 2011).

On Table 2, the second category of equity ETFs (after the market-cap-based ETFs) is the sector exchange-traded funds, which typically seek to track market-weighted capitalization benchmarks for each sector. The main sectors that are represented by ETFs, each with about \$10–\$13 billion in assets under management, are (from larger to smaller) natural resources, real estate, financial services, health, technology, and consumer goods. It is interesting to note that the shares of these specific sectoral funds among the total for all sectoral funds are similar to the corresponding sector weights in the S&P 500 index.

The third category of equity ETFs on Table 2 is so-called “smart beta” or factor exchange-traded funds. These ETFs follow weighting schemes that differ from traditional market cap-based indices and are primarily driven by the desire to outperform the market portfolio by focusing on certain factors that have been linked to stock returns. Smart beta ETFs blur the lines between traditional active versus passive investment strategies. On the one hand, these ETFs offer exposure to risk factors that traditionally have been exploited by active mutual funds and hedge funds. On the other hand, smart beta ETFs track specific indices in a transparent and rule-

based manner, and there is no active money manager who “picks” stocks. Consequently, the expense ratios of factor ETFs are typically lower than those of comparable active mutual funds and hedge funds. These ETFs have become more popular recently, but as Table 2 shows, factor/smart beta ETFs accounted for about 25 percent of total equity assets under management. The importance of factor/smart beta ETFs is expected to grow as investors seek to capture factor premia.

What are some of the common factors that smart beta funds seek to capture? The largest factor ETF category focuses on “value stocks” and “growth stocks,” a categorization that goes back to Graham and Dodd (1934). Growth stocks tend to have high ratios of stock prices to fundamentals, such as earnings, sales, and book values. In contrast, value stocks have low price-to-earnings and high book-to-market ratios. A large academic literature has investigated the risk and returns of value and growth stocks going back to Ball (1978) and Basu (1983), as summarized by Bali, Engle, and Murray (2016). The key finding is that value stocks have outperformed growth stocks, and this “value premium” cannot be explained by traditional risk models, such as the classic single-factor Capital Asset Pricing Model. Before the advent of factor ETFs, investors had two options to gain exposure to value/growth stocks: either they had to purchase individual stocks directly from a broker or they invested in actively managed value/growth mutual funds. Both options carry significant transaction costs and/or management fees. Factor ETFs enable investors a similar objective at significantly lower cost.

While growth/value ETFs represent by far the largest fraction of factor ETFs, many ETFs track other “factors” such as dividend yield or momentum. For example, long–short factors discussed in Fama and French (2015) include: “high minus low,” which is a long–short portfolio that invests in high book-to-market value stocks and shorts high book-to-market growth stocks; “small minus big,” which is long in small stocks and short in large stocks; “up minus down,” which is a momentum factor that is long in stocks that have had high return over the previous year and short in stocks that had low returns; “robust minus weak,” which is the difference between returns of profitable firms and unprofitable firms; and “conservative minus aggressive,” which is the difference between returns of firms that invest a lot and firms with low investment rates. Unlike the long/short factors used in academic research, most ETF factor funds are long-only. Factor ETFs are low-cost investment vehicles for investors who seek long-only exposure to

well-known factor risks with lower fees than active mutual fund and hedge fund managers.<sup>3</sup> Some recent “smart beta” ETFs combine multiple factors to exploit diversification and correlations across factors, and seek exposure to risk premia (for example, exchange-rate risk) beyond just equities.

In 2008, the Securities and Exchange Commission adopted new guidelines for listing of active ETFs. These ETFs have a benchmark index, as passive ETFs, but allow the ETF manager discretionary portfolio decisions with the goal of outperforming the benchmark. Unlike active mutual funds and hedge funds, active ETFs are required to disclose their portfolio holdings daily. Active ETFs, while still a fraction of total assets, further blur the lines between active and passive investment management. The complexity of mutual funds and ETFs requires careful research and financial sophistication on the part of potential investors.

#### *Fixed Income and Commodity Exchange-Traded Funds*

Fixed income exchange-traded funds (going back to Figure 1) have grown dramatically in recent years. Initially, these were typically portfolios of investment grade and government bonds; more recently, bond ETFs have been created based on high-yield bonds and even bank loans. As of September 2017, bond ETFs account for about 17 percent, or \$740 billion, of total assets invested in ETFs.

What explains this rapid growth in bond exchange-traded funds? Investors in individual bonds face a number of challenges. First, many corporate bonds are traded primarily in the opaque, dealer (“over-the-counter”) market. By contrast, bond EFTs trade intraday on electronic exchanges, many with low bid–offer spreads compared to the underlying bonds (for example, Hendershott and Madhavan 2015). Second, unlike individual bonds, fixed income ETFs offer a high degree of transparency, meaning that bid and offer quotes are readily available. Third, many individual bonds are illiquid and trade infrequently. Bid–ask spreads in bond markets can be significantly higher than spreads in equity markets, while exchange-traded bond funds typically offer greater liquidity and diversification. Fourth, keeping the maturity of a bond portfolio

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<sup>3</sup> The Appendix includes calculations of how the returns to actively managed mutual funds compare with the returns from a portfolio based on these kinds of factors, along with sector funds.

constant requires constant trading, but a bond ETF can be designed to do this without the need for ongoing attention and trading.

Bond exchange-traded funds are attractive to individual bond buyers—either retail or institutional—in the context of these challenges. Pension funds have started to embrace the concept of passive investing in fixed income assets because of low cost, diversification, and transparency. Other investor types, such as hedge funds or large institutions, may use bond ETFs as exposure vehicles or ways to invest cash.

There has also been considerable interest in commodity-based exchange-traded funds, often viewed as a hedge against inflation or a source of diversification, although the role of commodity ETFs has declined since 2013 when prices of many commodities fell dramatically. Commodity ETFs for the most part must invest indirectly via futures contracts, with the exception of certain precious metals (including gold), because the physical costs of storage of commodities would push the expenses of a commodity ETF far too high (Madhavan 2016). Because ETF commodity funds offer exposure via futures contracts (including those on esoteric asset classes such as volatility), they need not always reflect spot returns.<sup>4</sup>

## **Concerns and Misconceptions**

An investor can lose money with exchange-traded funds, of course, just as an investor can lose money with mutual funds, hedge funds, or any of the underlying assets. The salient question here is whether there may be certain kinds of risks with exchange-traded funds that make them riskier than commonly perceived—either for individual investors, or for financial markets, or even for the economic system as a whole. We will argue that while certain concerns do exist with regard to ETFs, as they do for other financial markets, the concerns are often based on misconceptions. We begin with concerns for individuals and then move to questions of the broader impact of index investing on the markets and the macro economy.

### *Fund Closures, Shorting, and Counterparty Risk*

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<sup>4</sup> Madhavan (2016) shows the impact of the futures forward curve for volatility, where the normal upward slope of the curve implies negative returns on average to an investor who rolls from near to far contracts to gain exposure to spot volatility.

Individual investors often worry about the risk of losing their entire investment. Closures of exchange-traded funds, like the closures of mutual funds, are not uncommon. Anywhere from 50 to 80 exchange-traded funds close each year (Madhavan 2016).

While the closure of an ETF can attract attention, it does not create investment risk in itself (unlike a firm's bankruptcy), as the fund's underlying assets should not be affected. When an ETF closes, its price should converge to its net asset value. A plain-vanilla unlevered fund is just a pool of assets, and should the fund be redeemed in full, the assets can potentially simply be returned in kind. Of course, investors in a fund to be closed may experience unanticipated capital gains taxes and, for a time, a possible lack of liquidity.

For other exchange-traded products, these risks may be greater. In 2008, Lehman Brothers had issued exchange-traded notes that were unsecured debt obligations. When Lehman Brothers declared bankruptcy, there were no underlying assets to be returned to investors. This case highlights our earlier remarks regarding the need for a classification scheme to help investors distinguish between the various types of exchange-traded products. There can also be counterparty risk, when certain synthetic exchange-traded funds enter into swap positions with investment banks. However, the risk that any given counterparty might fail is mitigated by diversification rules that spread the risk across multiple swap counterparts. It is unlikely that such losses could exceed the assets of an exchange-traded fund, because even a leveraged fund is collateralized with cash and securities.

Let us turn now from fund closures to other concerns that could lead to significant individual investor losses, and possibly larger impacts on the financial system. Specifically, one possible concern is that when exchange-traded funds are sold short, the aggregate long and synthetic long positions can exceed the total actual number of outstanding ETF shares (for example, Bradley and Litan 2010). If many investors simultaneously redeem their shares in an ETF at the same time, some argue that this could theoretically "bankrupt" the fund, as redemptions would exceed available assets to be redeemed. However, institutional details around ETF settlement make this scenario remote. On the settlement day, ETF managers only release redemption proceeds against actual delivery of the ETF shares. An *attempt* to redeem by a party that does not actually physically have ETF shares to deliver (say, because they have lent their shares to a short seller) will simply fail to settle. It is possible that the failure of a large number

of such attempted “redemptions” could itself result in market disruption, but this scenario seems remote.

A closely related set of concerns involves securities lending and counterparty risk. Securities lending is the temporary transfer of a security by its owner (for example, a pension fund) to another party (for example, a hedge fund), typically for the purposes of a short-sale. The lender remains the owner of the security, and hence is exposed to any security price movement over the life of the loan. The borrower usually provides collateral (typically in excess of the security’s value ranging from 102–112 percent) to compensate the lender in the rare case that the borrower fails to return the borrowed security.

Can securities lending by an exchange-traded fund pose a threat to investors? First note that in the United States there is presently a 50 percent aggregate statutory limit on the extent to which exchange-traded funds can lend their underlying securities. Moreover, other safeguards on lending include the ability to recall loans from borrowers and possibly even the liquidation of the borrower’s collateral. Securities lending may help enhance ETF returns when safeguarded in these ways. From a market perspective, securities lending can help improve liquidity and price efficiency by reducing the costs of expressing negative views through short-selling, helping to keep asset bubbles from forming. Although securities lending is prevalent and economically significant, the academic literature on securities lending is nascent.

### *Flash Events and Systemic Risk*

Another issue that concerns both individuals and regulators concerned with the broader markets are “flash events,” marked by sharp price movements and subsequent reversals in compressed time intervals). In the “Flash Crash” of May 6, 2010, the Dow Jones Industrial Average dropped almost 1,000 points in 20 minutes. Many well-known stocks briefly traded at clearly unreasonable prices, including some that traded at pennies.

Exchange-traded funds were disproportionately represented among the securities most affected (for discussion, see Borkovec, Domowitz, Serbin, and Yergerman 2010), with prices diverging widely from their underlying net asset values, which led some commentators to draw a



connection from the sharp market moves on May 6 to the pricing and trading of these instruments (for example, Wurgler 2011).<sup>5</sup>

Madhavan (2012) also describes some market structure issues, including increased market fragmentation and the proliferation of new venues, which could be factors in a flash event. He also finds evidence that aggressive “order-sweeping” trades—that is, a large trade executed all at once at whatever range of prices are being offered at the moment, rather than spread out over time in an attempt to get the best possible price—were related to the market dislocation, as opposed to structural problems with ETFs. A similar flash event in August 2015 has led many industry participants, including asset managers, brokers, and exchanges, to organize and implement many important changes to market structure.

Flash events have taken place in other asset classes since 2010, including US Treasury bonds and currencies, where ETFs are minor. On October 15, 2014, the yield on the 10-year US Treasury note fell to 1.86 percent before reversing to 2.13 percent within a 15-minute time interval. A Joint Staff Report (US Department of the Treasury et al. 2015) by staff of US Treasury, the Federal Reserve, and financial regulators found that the intraday yield change was eight standard deviations greater than normal and noted: “For such significant volatility and a large round-trip in prices to occur in so short a time with no obvious catalyst is unprecedented in the recent history of the Treasury market.” This report found that speed and size of the yield changes seems to trace back to the evolving structure of the Treasury market, including the role of automated trading. As another example, the value of the UK pound sterling dropped by more than 6 percent against the US dollar in just a few minutes on October 6, 2016, falling to a record low of \$1.1378 (as reported in McDonald 2016). These recent flash events highlight that the need for further research on liquidity gaps in increasingly fast markets.

### *Liquidity Mismatch*

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<sup>5</sup> Ramaswamy (2011) examines the operational frameworks of exchange-traded funds and relates these to potential systemic risks. The role of leveraged ETFs has also been discussed (for example, Cheng and Madhavan 2009) in the context of end-of-day volatility effects.

Liquidity is often described as the ability to buy or sell without causing substantial price changes. In the case of exchange-traded funds, liquidity concerns can arise at several levels. Liquidity in the *primary* market, where the underlying securities trade, refers to the ability of Authorized Participants to acquire the underlying assets and transfer them in-kind (or vice versa) to the ETF provider for shares in the fund or vice versa. The key role of Authorized Participants in adjusting the ETFs shares outstanding to reflect supply and demand has often given rise to questions of systemic risk if they should “step away” in a crisis. But if a particular Authorized Participants ceased its activities in a certain ETF, other Authorized Providers seem highly likely to provide liquidity. A comprehensive analysis of 931 US exchange-traded funds covering \$1.8 trillion of assets under management by the Investment Company Institute (Antoniewicz and Heinrichs 2015) shows that the largest ETFs—those of most concern from a systemic risk viewpoint—have an average of 38 Authorized Participants. These issues are unlikely to be a concern for ETFs with many Authorized Participants (which is most ETFs) since it is an unlikely event that all Authorized Participants jointly cease their activities at the same time, but may be relevant for smaller niche ETFs with just a few Authorized Participants. If all Authorized Participants were to withdraw, the ETF would likely trade like a closed-end mutual fund (that is, a fund with a fixed number of shares) with possibly wider premiums or discounts.

A second set of concerns relate to the so-called secondary markets, the venues where shares of exchange-traded funds actually trade. The liquidity (measured by dollar volume) in the secondary market can be many times that of the primary market, as discussed earlier. In that sense, the ETF liquidity in the secondary market (via the creation/redemption mechanism of arbitrage) is generally greater than or equal to the liquidity of the underlying assets. The trading of ETF shares on exchanges in the secondary market does not directly drive buying and selling of the underlying stocks but rather reflects changes of ownership of the ETF. Purchases and sales of stocks driven by the ETF creation and redemption process account for only 5 percent of all US stock market trading. In other words, the existence of ETFs can add a layer of incremental liquidity to the financial markets. From a financial stability viewpoint, this buffer is additive.

### *Impact on Underlying Markets*

Some commentators have raised questions about the effect of index investing—including index mutual funds and exchange-traded funds—as a potential distortion of the prices of

underlying securities. From an academic perspective, the implications of the introduction of a “basket” security like a diversified index mutual fund or ETF are not clear. Individual investors can reduce their own costs of trading with informed agents by using basket securities as their asymmetric information costs will be lower (Kyle 1985). To the extent that “noise traders migrate to the basket market, liquidity in the underlying stocks or bonds may decline. However, the creation of a low-cost diversified basket instrument may also open up access to new liquidity investors who were previously unable to access the market due to cost or other constraints. This means that the impact of a basket security on liquidity of the underlying market bonds is an empirical question (for arguments that ETF trading adds additional volatility, see Dannhauser 2017; Ben David, Franzoni, and Moussawi 2017.)

But in practical terms, the scale of index investing is still relatively small. Index investing overall represents less than 20 percent of global equities (BlackRock 2017b). Index funds and ETFs together represent just over 12 percent of the US equity universe, and 7 percent of the global equity universe. Also, focusing on the dollar size of indexed assets diverts attention from the real issue, namely the turnover by fund managers. Specifically, if we look more closely at US equities, the majority of the assets in funds are actively managed, and active fund managers have significantly greater turnover than passive index funds or ETFs.

As previously noted, there is general agreement on the private benefits of indexing as an efficient way to invest in lieu of paying for security selection. Questions and concerns have increasingly shifted to the impact of index investments on pricing in financial markets (that is, social impact), and some commentators have suggested that the growth of indexing can cause prices to decouple from value. Index trackers are typically based on market capitalization weighted schemes, so some argue that pricing errors in underlying stocks might feed on themselves; a bubble in, say, tech stocks is reinforced by the mechanical action of index funds who are price takers. Could ETF flows distort prices? Index funds are price-takers, not price-makers. They invest, proportionally at whatever price is determined by the buying and selling of active participants. So index assets are a proportional slice of the overall market—that is, a slice of the aggregate value of all securities. The value of all active and other, non-indexed assets is just the overall market less all index assets. Therefore, the money coming into index funds/ETFs must come from the pool of non-indexed/active assets, which (from above) is a slice that is proportional to the overall market, at all points in time.

For index flows to distort prices, one would have to argue that despite having an origin in a pool proportional to the overall market, the desire for index exposures is manifested very differently in characteristics such as capitalization, sector, and so on. While this is possible, there is no evidence that this is true. What about smart beta and other tilts that systematically deviate from capitalization weights? They are still tiny relative to the overall market (Ang, Madhavan, and Sobczyk 2017).

Now consider the arguments about the impact of index inclusion on return correlations and comovement of stocks. As many studies have shown, the average pairwise return correlation between any two stocks has increased since 2000, a period of rapid growth in ETF and index assets, but this trend followed a dramatic decline in pairwise correlations from the 1970s to the late 1990s (Campbell, Lettau, Malkiel, and Xu 2001). Moreover, cross-stock correlations were higher in the 1930s before the advent of indexing (Madhavan 2016). Comovements among currencies—an area with no meaningful index penetration—have similarly risen in the past decade, again a reflection of the importance of central bank policy and a macro-driven environment. Correlations have diminished significantly since 2013 despite significant increases in ETF and index assets (as of March 2017).

The success of active fund management has more to do with the dispersion of returns than correlations. When common factors explain a large fraction of return movements relative to security-specific return, correlations will by definition be large, and the opportunities for professional managers will be correspondingly lower. Moreover, active bets are zero sum irrespective of the correlation environment. That is not to say that active managers cannot profit from active bets by other investors who may hold active positions for behavioral or other reasons (like tax reasons or desire for stock in a certain company). Our point is that the share of active and passive management is determined in a self-regulating manner. Markets will reach an equilibrium when security selectors as a group break even after taxes and fees (Berk and Green 2004; Pástor, Stambaugh, and Taylor 2015).

## Conclusions

Exchange-traded products provide exposure to a wide range of asset classes (for example, equities, fixed income commodities, and currencies), strategies (for example, passive index, model-based, and active), and regions. Exchange-traded funds have grown substantially in diversity and size in recent years along with the rise of passive, index investing. Equities still account for over 78 percent of assets under management in ETFs as of 2017 (but there is rapid growth in all asset classes, and fixed income in particular, with assets now in excess of \$740 billion or 17 percent of the total in all exchange-traded products (according to *BlackRock* 2017b).

The discussion in this paper has suggested a number of reasons behind this growth. First, there are the traditional advantages of exchange-traded funds in terms of liquidity, low fees, transparency, and potential tax advantages. Second, the universe of ETFs has been expanding beyond the traditional equity-based funds, including funds providing access to fixed income, commodities, currency, volatility, multi-asset class structures, and “smart beta” or factors. Many of these new ETFs represent a blurring of the traditional line between active and passive management. Third, the investor base of ETFs has also been expanding. As bank balance sheets shrink in the new regulatory environment after the 2008–2009 financial crisis, ETFs are being used by institutional investors as a substitute for futures, credit derivatives, swaps, and individual bond trading. Professional financial advisers and hedge funds are making greater use of ETFs in a number of ways. Model portfolios using ETFs and the rise of robo-advisors are also longer-term trends that favor ETF use and adoption.

There is little evidence of pressures or flaws that have uniquely affected ETFs compared to other equity investment vehicles. Is turnover excessive? Do ETFs encourage overtrading? These are valid questions that also arise for other low-cost vehicles for broad market price discovery such as futures or swaps. Indeed, US futures trade approximately \$250 billion a day, with a high concentration of volume in S&P 500 and Russell 2000 portfolios; by contrast, ETFs are traded in far more diverse portfolios including domestic and international equity, commodities, fixed income, and alternatives. Moreover, the advent of discount brokerages has dramatically reduced the cost of participating in financial markets. While such decreasing cost of trading can be a double-edged sword (allowing broader participation in financial markets while encouraging excessive trading), there is no evidence that financial markets have become less

efficient. In modern well-developed financial markets there are many vehicles for correcting mispricing at the individual security level—for example, trading by individuals or sovereign wealth funds, along with share repurchase and issuance, trading of stock options, and the ability to take companies private/public.

This paper also surveyed potential concerns for individuals as well as markets as a whole, echoing the increased scrutiny of exchange-traded funds in the media and by regulators. A problematic aspect of this discussion is that not enough attention is paid to the diversity of the ETF landscape. There is no single “ETF.” Instead, potential concerns apply to some ETF types but not to others. The vast majority of market share is invested in traditional passive, unlevered, cap-based ETFs, which share many features of index mutual funds. It seems important to take a more nuanced view that distinguishes the various ETF types in the same way we assess the pros and cons of mutual fund types differently. From the perspective of an individual investor, the increased variety and complexity of investment options, while providing more opportunities, requires more financial sophistication. ETFs are part of this trend with advantages and possible disadvantages.

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## APPENDIX

### Factor Exposure of Active Mutual Funds

In what ways do exchange-traded funds, which are passive by nature, compete with *active* mutual funds? Active mutual funds typically have higher fees than factor ETFs, but of course, the higher fees might be justified if active mutual funds can outperform passive ETFs after fees are taken into account. Moreover, active mutual funds might offer investment strategies that are not spanned by combinations of passive factor ETFs.

A passive mutual fund that tracks a broad market index will move with the market very nearly on a one-to-one basis. An actively managed mutual fund must, by its nature, not invest in the market portfolio. An active mutual fund that has a very high  $R^2$  correlation with the overall market is sometimes called a “closet indexer” since most of its return can be closely replicated by investing in the market; such a fund can also be identified because its holdings rarely depart from market weights, implying a very low active share as defined by Cremers and Petajisto (2008). The top left panel of Figure A1 shows the histogram of the  $R^2$  for the 2,407 funds and the left column of Table A1 reports percentiles. The median active mutual fund has an  $R^2$  of 84 percent and 90 percent of all active mutual funds have an  $R^2$  of at least 72 percent. Thus, the total returns of most active mutual funds can be mimicked to a significant degree by investing only in the market portfolio.

Consistent with a large body of academic literature (for example, Ang 2014), we use Fama-French factors as a proxy for passive long/short portfolios that are constructed to yield exposure to well-known factors, such as value/growth, size, and momentum. It is important to understand that the Fama-French factors – like indexes – are not directly investable (and ignore transaction costs and shorting costs) but there are long-only ETFs and passive mutual funds that attempt to provide exposure to similar factors. The mutual fund data is from the Center for Research in Security Prices. After applying some standard screens, we have data for 2,407 active mutual funds domiciled in the United States. The sample is from January 1980 to December 2014.

Let  $R_i$ ,  $R_m$  and  $R_f$  be the returns of mutual fund  $i$ , the CRSP value-weighted index (a proxy for the broad market portfolio) and the 30-day Treasury rate, respectively. For each active mutual fund  $i$  on CRSP, we run the CAPM regression

$$R_{it} - R_{ft} = \alpha_i + \beta_m(R_{Mt} - R_{ft}) + \epsilon_t.$$

The  $R^2$  of this regression is the part of the variance of the excess return of the mutual fund that is due to exposure to the market return.

Next, we add Fama-French factors to the regression. HML (high minus low) is a long-short portfolio that invests in high book-to-market value stocks and shorts high book-to-market growth stocks. SMB (small minus big) is long in small stocks and short in large stocks and UMD (up minus down) is a momentum factor that is long in stocks that have had high return over the previous year and short in stocks that had low returns. This model is known as the four-factor model and the corresponding regression is

$$R_{it} - R_{ft} = \alpha_i + \beta_m(R_{Mt} - R_{ft}) + \beta_h HML_t + \beta_s SMB_t + \beta_u UMD_t + \epsilon_t.$$

The histogram of the  $R^2$  is in the top right panel of Figure A1 and percentiles are reported in the second column of Table A1. The median  $R^2$  is 90 percent and 90 percent of active mutual funds have an  $R^2$  of at least 83 percent. We can add other passive factor portfolios to further increase the  $R^2$ .

Fama and French (2015) construct two additional long-short portfolios: RMW (robust minus weak) is the difference between returns of profitable firms and unprofitable firms and CMA (conservative minus aggressive) is the difference between returns of firms that invest a lot and firms with low investment rates. This six-factor is estimated using the regression

$$R_{it} - R_{ft} = \alpha_i + \beta_m(R_{Mt} - R_{ft}) + \beta_h HML_t + \beta_s SMB_t + \beta_u UMD_t + \beta_r RMW_t + \beta_c CMA_t + \epsilon_t.$$

Finally, we add 12 industry factors to the six-factor model. The corresponding histograms of the  $R^2$ s are in the bottom panels of Figure A1. Adding in passive factors further increases the  $R^2$ s of most active funds.

In fact, the 94 percent of the return of the median fund can be replicated by exposure to passive factors. These results are very similar to those reported by Kahn and Lemmon (2014)

based on their analysis of fund performance data. Given these findings, it is not surprising that passive factor ETFs have become more popular while active mutual funds have experienced significant asset outflows.

How about the performance of active funds? Figure A2 shows the histogram of mean excess returns across all mutual funds. The average equity mutual fund earned an average annualized return of 5.70 percent over the sample period. For comparison, the mean return of the CRSP-value weighted index was 7.79 percent, although we repeat our caveat that one cannot directly invest in an index. Thus, the average fund underperformed the market by 2.09 percent net of fees and 85 percent of all mutual funds had a lower net return than the market index.

Figure A3 shows the histogram of  $\alpha_i$ 's for the four-factor model that includes the market excess return, HML, SMB and UMD as regressors. Following Jensen's seminal work, a mutual fund  $\alpha_i$  measures the return of the fund after subtracting the part that is due to the exposure to the (passive) market, value/growth (HML) and size (SMB) factors. The mean alpha of active mutual funds is -0.66 percent per year and in the sample about two-thirds of all mutual funds produced a negative alpha.

These results do not necessarily imply that mutual fund managers have no skill (Berk and van Binsbergen 2015). For example, Cremers and Petajisto (2009) show that mutual funds that deviate more from their benchmark have on average better performance than funds that mimic their benchmark more closely. One simple measure of factor mimicking is the  $R^2$  in the factor regressions above (Kahn and Lemmon 2014). Funds with higher  $R^2$ s are following static factors more closely than funds with lower  $R^2$ s. To see whether mutual funds alphas are related to factor  $R^2$ s of the four-factor model, we run the regression

$$\alpha_i = \gamma_0 + \gamma_1 R_i^2 + e_i$$

Figure A4 shows the corresponding scatter plot. The estimated coefficient  $\gamma_1$  is equal to -1.1 with a t-statistic of -2.53. While the coefficient is statistically significant the effect of the  $R^2$ s on fund  $\alpha_i$ s is economically small. A mutual fund with an  $R^2$  of 0.95 has an estimated  $\alpha_i$  of -0.75% compared to an  $\alpha_i$  of 0.47% of a mutual fund with an  $R^2$  of 0.7.

To summarize, returns of active mutual funds can, to a significant degree, parallel the returns to theoretical long/short passive factors, but without transaction costs. Further, the majority of mutual funds have not outperformed the overall market or passive index benchmarks.

Factor ETFs might be useful low cost investment vehicles for equity investors who seek long only exposure to well-known factor risks with lower fees than active mutual fund and hedge fund managers.

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**Table 1: ETF Overview**

	# of Distinct Benchmarks	AUM (\$M)
Equity		
Global Equity	92	35,750
US Large Cap/Total Cap	130	383,987
US Mid Cap	46	59,715
US Small Cap	56	61,751
US Sector	204	158,923
US Dividend Preferred	23	68,358
US Alpha Strategy	14	2,109
Developed Europe	36	18,000
Developed Asia Pacific	28	32,202
Emerging/Frontier	158	155,249
International/Other	115	105,418
Fixed Income		
Broad Market	16	63,687
Emerging Markets	11	13,417
High Yield	16	32,835
Investment Grade	32	60,037
Securitized	4	7,029
Municipals	29	13,690
Sovereign	17	4,867
US Government	55	58,595
Commodities	126	91,865
Currency	22	4,488
Alternatives/Asset Allocation	87	8,311

Source: Investment Company Institute (2016).

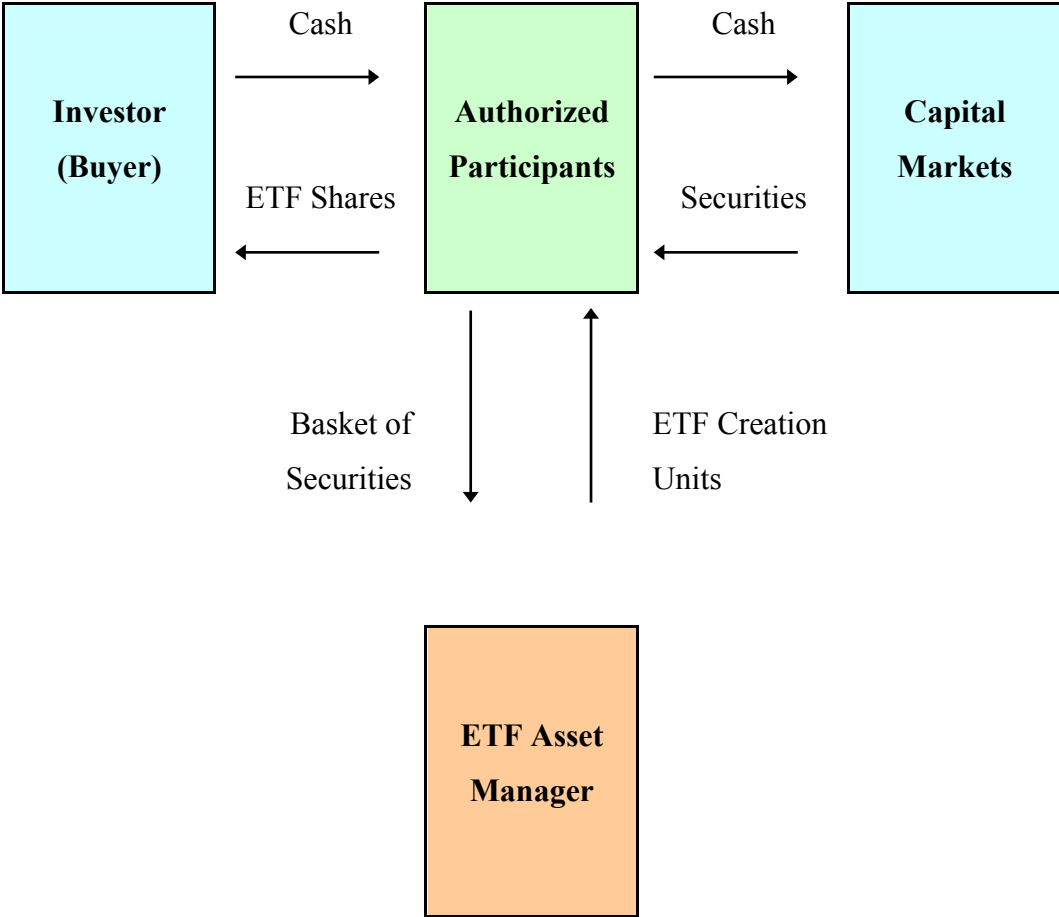


**Table 2: Equity ETF Types**

	2015 AUM (\$m)
Market cap based	1,007,059
Total market	446,615
Large cap	414,979
Mid cap	70,935
Small cap	74,529
Sector	273,753
Factor/Smart beta	435,701
Growth/Value	230,529
Dividend	92,367
Equal weight	28,918
Low volatility	23,810
Multi factor	42,246
Single factor	17,830
Momentum	3,840
Quality	2,474
Value	2,068
Size	4,463
Other	4,985
Other	11,527
<b>Total</b>	<b>1,728,040</b>

Source: Investment Company Institute (2016).

**Figure 1: The ETF Architecture**



**Table A1:  $R^2$ 's of Active Mutual Funds Factor Regressions**

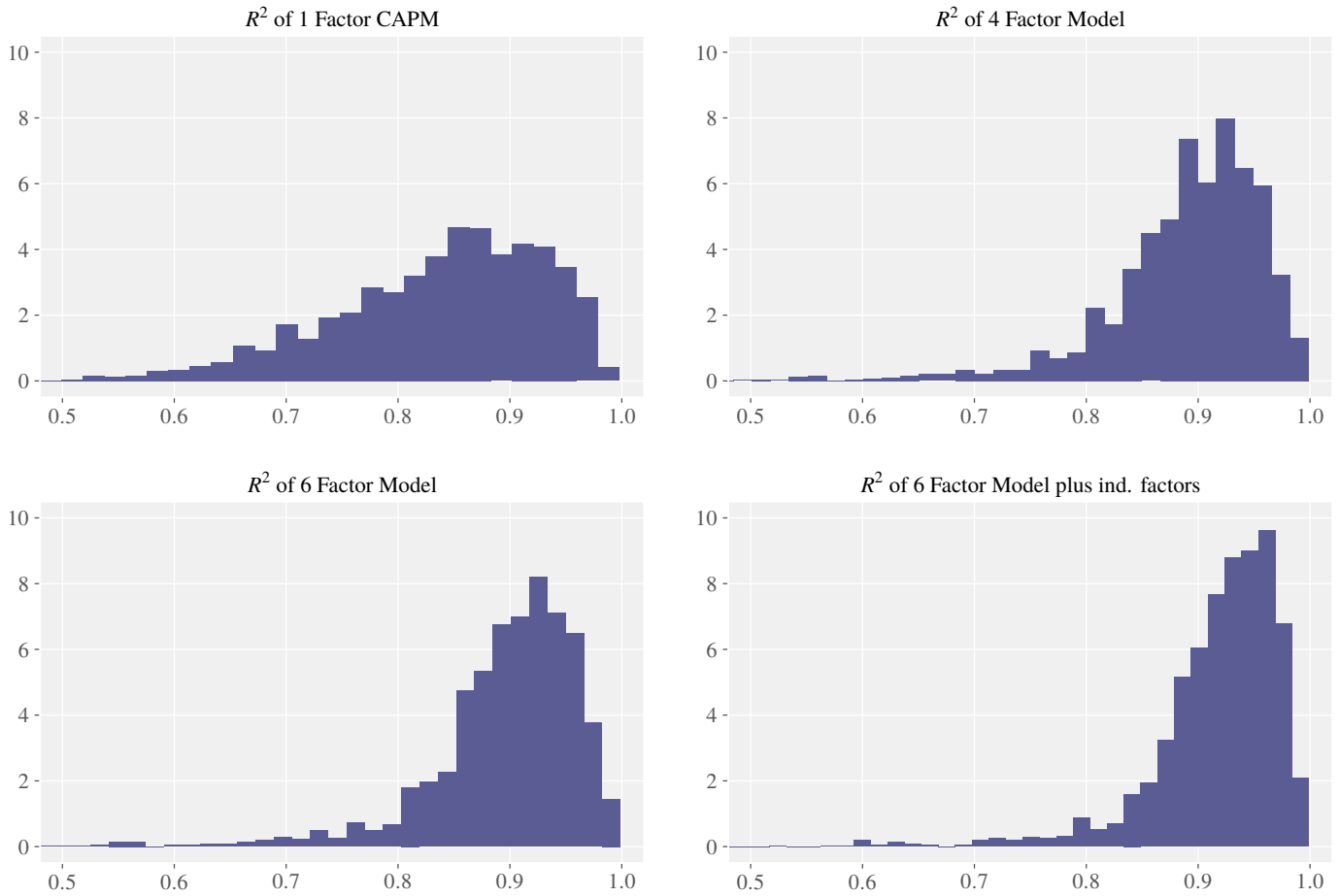
	CAPM	4 Factors	6 Factors	6 Factors + 12 Industry
Mean	0.83	0.89	0.89	0.92
Quantiles				
10%	0.70	0.81	0.82	0.85
25%	0.78	0.86	0.87	0.89
50%	0.85	0.90	0.91	0.93
75%	0.91	0.94	0.94	0.96
90%	0.95	0.96	0.96	0.97

Notes: This table reports  $R_i^2$ 's of time series regressions of returns of mutual fund  $i$ ,  $R_{it}$  on factors  $\mathbf{F}_t$ :

$$R_{it} - R_{ft} = \alpha_i + \beta_i' \mathbf{F}_t + \epsilon_t,$$

where  $R_{ft}$  is the 3-month T-bill rate. For the CAPM  $\mathbf{F}_t = (R_{Mt} - R_{ft})$ , for the 4-factor model  $\mathbf{F}_t = (R_{Mt} - R_{ft}, HML_t, SMB_t, UMD_t)'$ , for the 6-factor model  $\mathbf{F}_t = (R_{Mt} - R_{ft}, HML_t, SMB_t, UMD_t, RMW_t, CMA_t)'$ . The 6 Factor + 12 Industry model adds 12 industry portfolio returns to the 6 factor model. The factor and industry returns are from Kenneth French's website. Mutual fund returns are from CRSP. The sample is monthly from January 1980 to December 2014.

**Figure A1:  $R_i^2$ 's of Active Mutual Fund Factor Regressions**

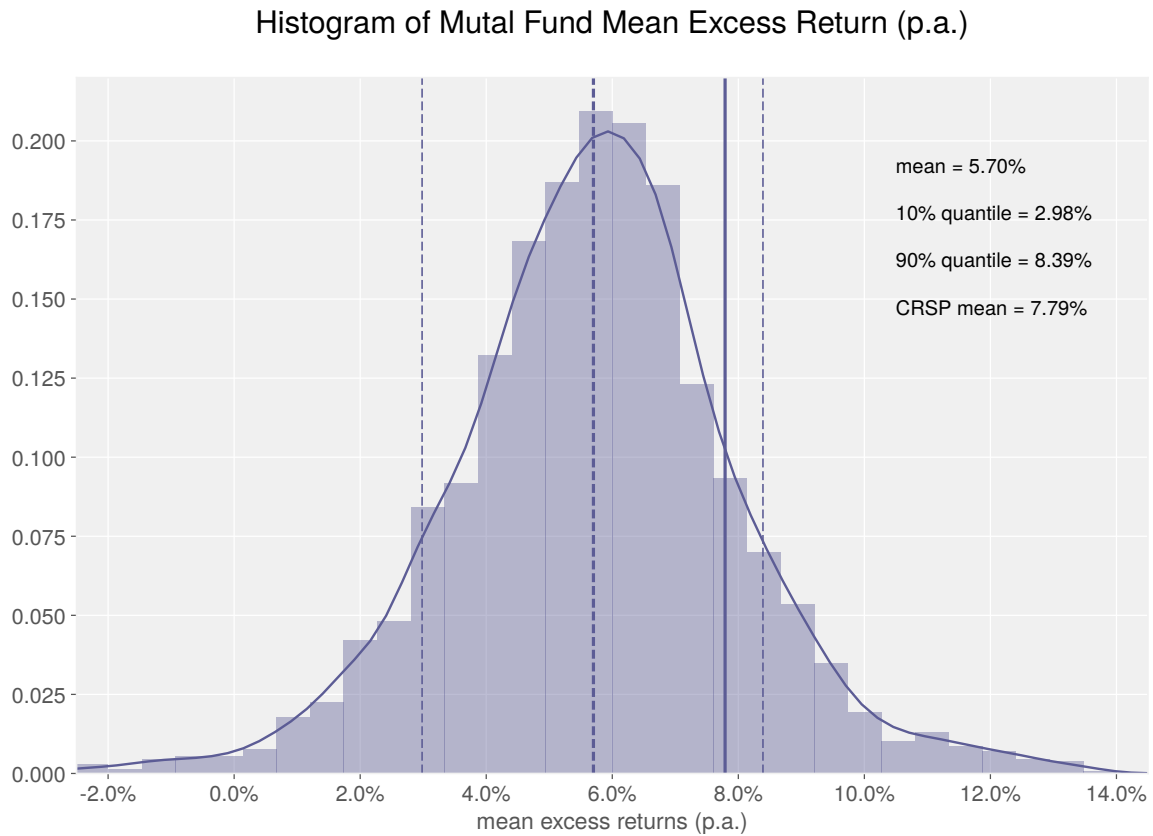


Notes: This figure shows histograms of  $R_i^2$ 's of time series regressions of returns of mutual fund  $i$ ,  $R_{it}$  on factors  $\mathbf{F}_t$ :

$$R_{it} - R_{ft} = \alpha_i + \beta_i' \mathbf{F}_t + \epsilon_t,$$

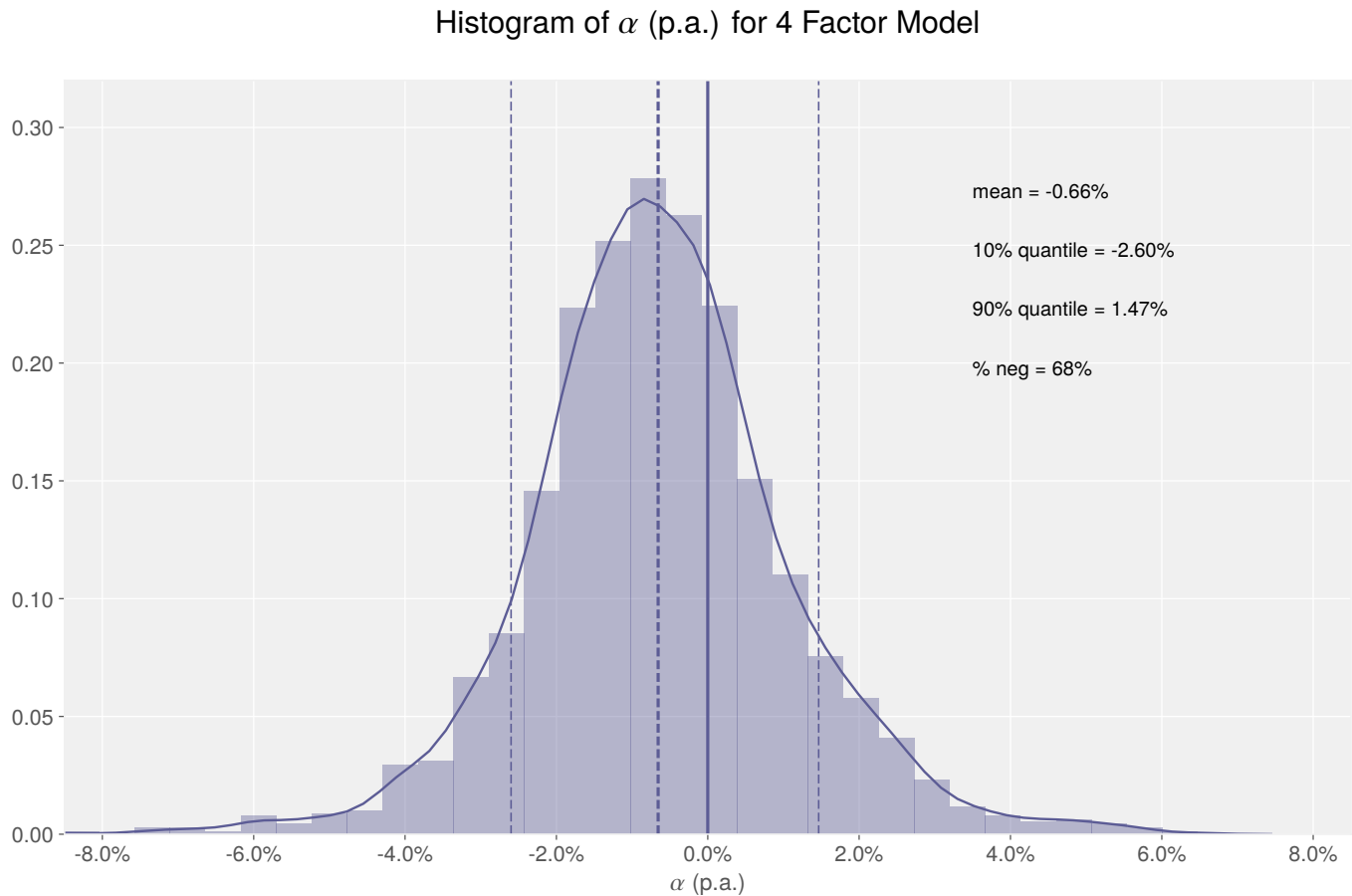
where  $R_{ft}$  is the 3-month T-bill rate. For the CAPM  $\mathbf{F}_t = (R_{Mt} - R_{ft})$ , for the 4-factor model  $\mathbf{F}_t = (R_{Mt} - R_{ft}, HML_t, SMB_t, UMD_t)'$ , for the 6-factor model  $\mathbf{F}_t = (R_{Mt} - R_{ft}, HML_t, SMB_t, UMD_t, RMW_t, CMA_t)'$ . The 6 Factor plus industry model adds 12 industry portfolio returns to the 6 factor model. The factor and industry returns are from Kenneth French's website. Mutual fund returns are from CRSP. The sample is monthly from January 1980 to December 2014.

**Figure A2: Histogram of Mutual Fund Mean Excess Return**



Notes: This figure shows the histogram of average mutual returns in excess of the 3 month T-bill rate. Returns are net of fees. Mutual fund returns are from CRSP. The sample is monthly from January 1980 to December 2014.

**Figure A3: Histogram of  $\alpha_i$  for 4 Factor Model**

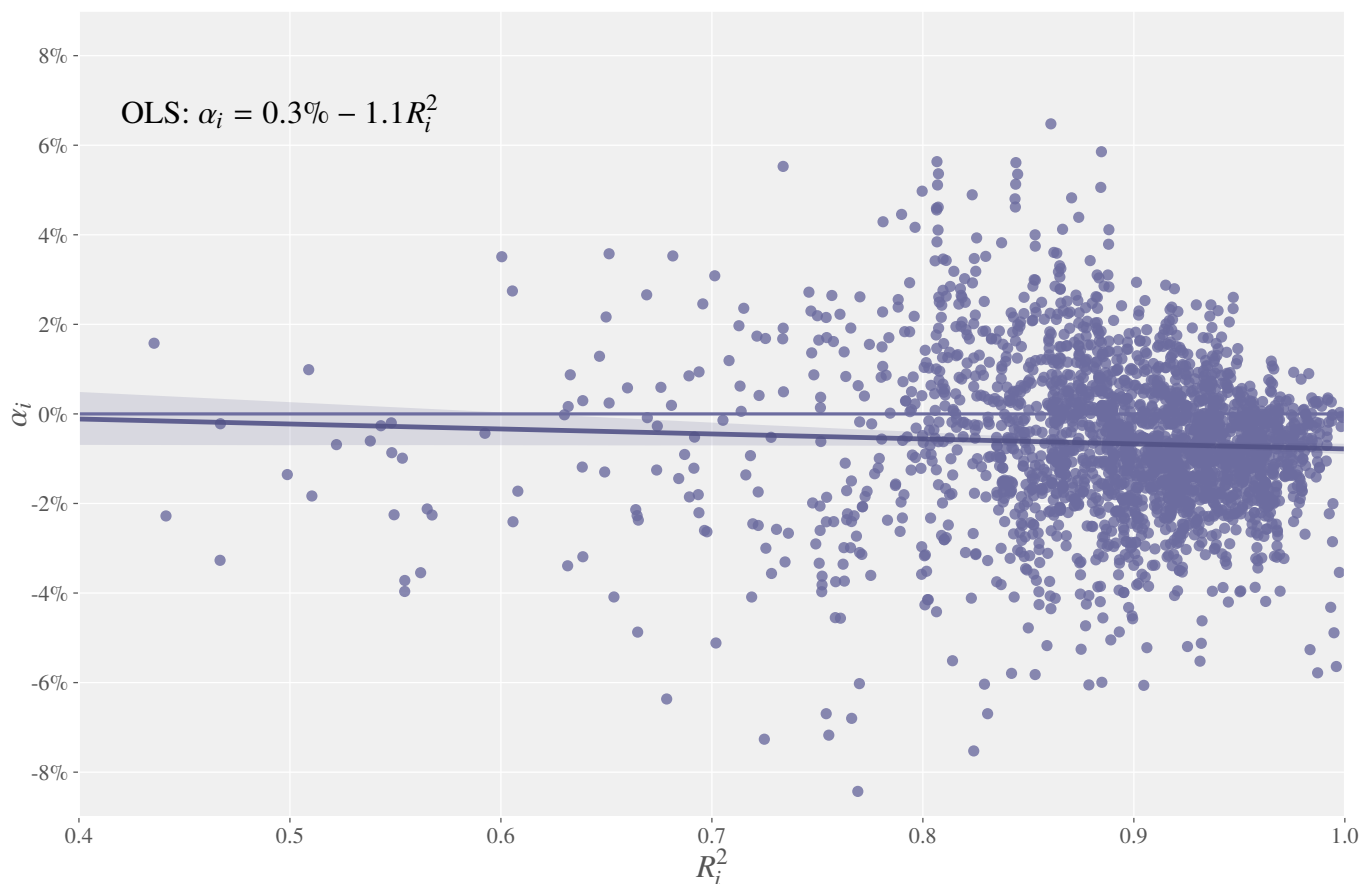


Notes: This figure shows the histogram of  $\alpha_i$ 's of time series regressions of returns of mutual fund  $i$ ,  $R_{it}$  on factors  $\mathbf{F}_t$ :

$$R_{it} - R_{ft} = \alpha_i + \beta' \mathbf{F}_t + \epsilon_t,$$

for the 4-factor model with  $\mathbf{F}_t = (R_{Mt} - R_{ft}, HML_t, SMB_t, UMD_t)'$ . The factor returns are from Kenneth French's website. Mutual fund returns are from CRSP. The sample is monthly from January 1980 to December 2014.

**Figure A4: Mutual Fund  $\alpha_i$  and  $R_i^2$  in 4 Factor Model**



Notes: This figure shows a scatter plot of  $R_i^2$ 's on the  $x$ -axis and  $\alpha_i$ 's on the  $y$ -axis.  $R_i^2$ 's and  $\alpha_i$ 's are from time series regressions of returns of mutual fund  $i$ ,  $R_{it}$  on factors  $\mathbf{F}_t$ :

$$R_{it} - R_{ft} = \alpha_i + \beta_i' \mathbf{F}_t + \epsilon_t,$$

for the 4-factor model with  $\mathbf{F}_t = (R_{Mt} - R_{ft}, HML_t, SMB_t, UMD_t)'$ . The figure also shows the fitted line from a linear regression with 95% confidence intervals (shaded). The factor returns are from Kenneth French's website. Mutual fund returns are from CRSP. The sample is monthly from January 1980 to December 2014.