



## **Actively Managed Exchange Traded Funds: Risk Modeling As An Enabling Technology**

### **ABSTRACT**

#### **BACKGROUND**

Mutual funds allow investors to trade in a variety of assets in a single investment vehicle. For example, a mutual fund may comprise shares of stocks of many different companies. Mutual funds may also be comprised of one or more types of financial instruments – stocks, bonds, options, futures, etc. – and may involve securities from diverse industries. Mutual funds provide the benefit of investment diversification without requiring investment expertise or extensive knowledge about the underlying assets. Furthermore, investors can benefit from professional experience when they hold actively managed funds (“AMFs”), in which expert fund managers apply their knowledge of markets to select assets to buy for and sell from the funds they manage.

Managers of AMFs keep secret their day to day trading of fund assets and the identities and quantities of the underlying assets (portfolios) of the funds they manage. Fund secrecy prevents others from “free riding” – benefiting from managers’ expert knowledge without investing in their funds and without paying fund management fees. Secrecy also prevents “front running” – observing fund trading trends to benefit from increasing or decreasing stock prices resulting from the fund’s acquiring or selling off shares of the stock. While periodic reporting of fund assets is required, the reporting periods are long enough (e.g., quarterly or semi-annually with a 45 day lag) to prevent information about the AMF holdings to be sufficiently current to enable free riding or front running.

Current market regulations do not allow intra-day market trading of AMFs. Instead, investor orders to buy or sell AMFs received during the day are processed after market close, with the price based on the net asset value (“NAV”) of the fund. The NAV is conventionally calculated for the current trading day after market close based on the

assets held in the fund at the close of the previous trading day and the value of those assets at the close of the current trading day. One difficulty with implementing a system for intra-day market trading of AMFs is that investors have insufficient information on which to base negotiated trading prices because they currently have no way of knowing either the specific assets in the AMF portfolio or their NAV.

Another difficulty with implementing a system for intra-day market trading of AMFs is that many market participants, and especially market specialists and market makers, who match buy orders with sell orders or buy and sell stocks themselves to keep markets orderly and liquid, must be able to hedge their trading risks. Throughout this abstract, market makers, market specialists, and any other market liquidity providers will be referred to as “liquidity providers.” When liquidity providers receive more orders to sell a stock than to buy it, they may buy the stock themselves and wait for more buy orders for that stock. Meanwhile, they risk the possibility that the value of the stock they hold will fall while they are holding it. They may hedge against this risk by making some trade that offsets the risk. But if the orders were to involve AMFs, then the liquidity providers would lack knowledge of the underlying assets, and thus would lack sufficient information to be able to effectively hedge this risk. Their inability to effectively hedge would result in an unacceptably wide spread between bid and offer prices, which in turn would inhibit trading.

In 1993, the American Stock Exchange (“AMEX”) introduced a class of funds that can be traded intra-day on public stock exchanges. These exchange-traded funds (“ETFs”) are generally based on some recognized index and thus have publicly known and published holdings. Like AMFs, ETFs provided investors with convenient diversification, but they also provided convenient trading platforms in secondary markets such as stock exchanges. For example, ETF index funds consist mostly of shares of the stocks in the same proportion as those used to calculate stock market indices, and have market values that vary with those indices. Well-known exchange traded funds include the SPDR Trust (“SPY”), which tracks the S&P 500 Index, the Nasdaq 100 Trust (“QQQ”), which tracks the Nasdaq 100 Index, and the Diamonds Trust (“DIA”), which tracks the Dow Jones Industrial Average. Information sufficient to accurately estimate the compositions of these funds is publicly available on a day-to-day and intra-day basis,

and estimates of the intra-day values of these funds can be computed during intra-day trading based on the intra-day values of their underlying assets at the start of the trading day. Market liquidity providers can hedge in situations in which there is a short term oversupply or over-demand of these funds because they know exactly which stocks comprise the funds. Current ETFs may be considered “passively managed” funds, because the fund managers do not use forecasting expertise to decide investment strategies, but rather simply maintain portfolios that reflect the compositions of the indices they are intended to track.

The AMEX obtained exemptions from certain securities regulations that allow its ETFs to function successfully while maintaining fair investment practices. One such exemption allows intra-day trading of ETFs by allowing trading at negotiated prices rather than the NAV of the underlying assets. Another exemption encourages trading of ETFs on secondary markets by allowing the fund company to issue and redeem ETF shares only in large aggregations called “creation units” of many thousands of ETF shares. Creation units are purchased with “portfolio deposits” equal in value to the NAV of the ETF shares in the creation units. The compositions of portfolio deposits are published by ETF fund managers daily, and usually reflect the proportionate assets in the ETF portfolio. Investors must redeem ETF shares only in creation unit aggregations. The fund presents an investor redeeming a creation unit with a “redemption basket.” The compositions of redemption baskets are also published by ETF managers daily, and also usually reflect the proportionate assets in the ETF portfolio. After a creation unit is purchased, the ETF shares can be traded individually on secondary markets, but individual ETF shares may not be redeemed with the fund company itself.

The securities regulations exemptions enjoyed by ETFs are justified because the transparent, open-ended creation/redemption structure allows negotiated prices of ETF shares on secondary markets to be kept substantially in line with the intra-day value of the underlying assets by arbitrage. If the price of ETF shares is significantly less than the value of the underlying securities, then arbitrageurs can purchase enough ETF shares to assemble a creation unit, redeem the creation unit with the fund for a redemption basket, and simultaneously sell the underlying securities in the redemption basket (or futures contracts representing the underlying securities), thus realizing a profit. This additional

demand for ETF shares tends to bring their price up to the intra-day value. If the price of ETF shares is significantly greater than the intra-day value, on the other hand, then arbitragers can purchase the underlying securities to assemble a portfolio deposit and purchase a creation unit, and simultaneously sell the ETF shares on the secondary markets at a profit. The additional supply of ETF shares tends to bring their price down to the intra-day value. The substantial equivalence of ETF share prices in transactions with the fund company and on secondary markets resulting from arbitrage ensures that larger institutional investors are not favored over smaller individual investors.

Investors have embraced many ETFs for their convenient diversification in a single investment instrument and the trading flexibility they allow. Because of the success of current ETFs, there has been significant interest in allowing more management freedom than is currently possible in ETFs. But part of the value of any actively managed fund is in portfolio secrecy, which obstructs pricing evaluation (because the intra-day value is unknown), hedging (because the portfolio is unknown), and arbitrage (because to preserve portfolio secrecy, creation/redemption baskets may not be representative of the fund holdings). There is, therefore, a need for systems and methods to allow intra-day trading of AMFs by providing a creation/redemption structure that promotes arbitrage and providing information equivalent to the intra-day values and portfolios of AMFs without disclosure of the specific assets of the funds.

## **SUMMARY OF PROCESS**

In order to provide the necessary information for pricing and arbitrage, a process is used which involves deriving a second portfolio (the Intra-Day Indicative Value (IIV) portfolio) that substantially tracks the returns of the actual fund over the course of a trading day. In this way, the IIV portfolio serves as a proxy for the actual fund, and market participants use the IIV portfolio to price and hedge a position taken in the actual fund without knowing the composition of the actual fund.

In order to provide the necessary information for pricing and arbitrage, a process is used which involves deriving each day, through the use of a risk modeling technique (described below) and the actual fund's associated risk characteristics, a second portfolio (the Intra-Day Indicative Value (IIV) portfolio) whose performance closely approximates

the performance of the actual fund on an intra-day basis. The contents of this IIV portfolio can be published without disclosing what is in the actual fund and, in this way, the IIV portfolio serves as an accurate proxy for the actual fund. Thus, the IIV portfolio can be priced at intervals all during the trading day, providing accurate intra-day prices and market participants can use the IIV portfolio to create hedge positions, all without knowing the composition of the actual fund.

The risk modeling technique used in this process is Principal Component Analysis (PCA). PCA is a classical multi-variate statistical technique that originated with Pearson (1901) and has since been applied to many areas of the natural and economic sciences. Introductions may be found in the books by Muirhead (1982), Anderson (1984) Jolliffe (1986) and Flury (1988), these last two being devoted entirely to PCA and its extensions. A good survey of applications of PCA to financial markets may be found in Alexander (2001).

Each day, after the market close, a risk model will be estimated by the Amex utilizing PCA. In particular, the model will be based on the fund's Selection Universe, a set of securities designated by the fund manager to represent the kinds of securities the fund might hold<sup>1</sup>. Utilizing very high frequency (intra-day) return history over a relatively short historical period, the PCA process will estimate a set of risk factors for that Selection Universe. The purpose of the model is to capture the systematic common factor effects currently at work within the Selection Universe. So its design recognizes that, while there are some factors whose presence is more or less continuous (such as the market itself), there will be other, more transient factors (such as the bubble in internet stocks) that are only temporary.

This risk model is therefore significantly different in concept from the commercial risk models used by institutional portfolio managers. The most important consideration is that this model should be able to price ETFs effectively, while being able to interpret the risk characteristics of each ETF in intuitive economic terms is of no real importance. It therefore follows that basing the model strictly on current finance theory

---

<sup>1</sup> It is not a requirement that each holding in the actual fund be included in the Selection Universe.

such as the Arbitrage Pricing Model is not of primary importance. Choosing factors on the basis of statistical analysis, in this context, is just as useful as their economic foundations.

Once a risk model has been estimated for a particular day, then the specific risk characteristics of the actual fund (as of the close of that day) relative to that risk model can be determined through ordinary least squares regression analysis. These risk characteristics are, in fact, the regression coefficients (betas) of the current actual fund relative to each risk factor. With these risk characteristics, the Amex can then determine a set of securities from the Selection Universe weighted in such a way that that set has the same risk characteristics as the actual fund itself. This set of securities, typically made up of the vast majority of the securities in the Selection Universe, is the IIV portfolio that will be distributed and utilized the following day.

**Figure 1**  
**The Active ETF Process**

