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Design of a financial portal

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Financial institutions may need to expand the idea of index stocks to survive in the new economy.

The Internet is changing the way business is done, making previously viable business models obsolete and opening the doors to newcomers with innovations. Nowhere is this more pronounced than in the finance industry. Online banking is becoming the norm, pushing us toward paperless transactions. Barriers between commercial and investment banking are crumbling. Online trading is increasing at a fast pace with securities industry giants like Merrill Lynch coming under heavy fire from new entrants like E*Trade that offer lower transaction costs [1, 9]. Financial markets themselves are in a transformation with electronic communications networks, or ECNs, the quasi-stock exchanges that electronically collect, display, and automatically execute customer orders already accounting for 30% of all Nasdaq trading volume, with several ECNs announcing plans to become full-fledged exchanges to compete with both Nasdaq and the NYSE. Amidst all this, one thing is certain: market survivors will have to adapt to the changing environment and find ways to offer valuable services to their customers. Successful companies of the future will not simply reengineer today's processes using new technologies, but rather will rethink and revolutionize their whole businesses to capitalize on new developments.

In this article, we outline a model for the future of financial institutions. In our model, a competitive financial institution of the future will use market research to develop proprietary indices that focus on individual and small-business customer needs. The institution will then use the Internet to provide its customers with proprietary financial instruments on these indices, including a tool for selecting customized optimal portfolios, and a bundle trading mechanism [4, 5] to help establish and rebalance portfolios as needed. The business model we propose resembles that of an Internet portal (see Figure 1), much like an AOL of the financial services industry. Exclusive access to an integrated set of proprietary products and services as well as links to partners that offer complementary financial services and access to any other financial products available through the Internet will help establish a potentially large customer base. The right selection of indices and the right technology to help investors build and rebalance their portfolios will form the basis for a successful financial portal and a competitive financial institution. This strategy is particularly appropriate for existing financial institutions and mutual fund families with established resources, and will help them transform themselves to compete successfully in the new financial environment.

Current Investment Options

Today's investors may invest in individual securities through discount or full-service brokers, invest in mutual funds, or hire financial consultants for customized investment advice. While all investors would benefit from customization, high costs of professional financial planning currently puts this outside the reach of most investors. By building on modern portfolio theory, e-commerce, and the concept of bundle trading [4, 5], we propose an alternate channel for investors that will provide them with portfolios customized to meet their investment objectives and enable them to trade these portfolios at low cost.

Recent advances in electronic trading have given individual investors more control, allowing them to inexpensively purchase individual stocks and bonds. However, many investors lack the resources to make appropriate investment choices, and even fewer are sophisticated enough to determine their optimal asset allocation by analyzing how their individual holdings fit together. Such advice, while available from financial planners, is too costly for most investors.

Mutual funds simplify investing for the average investor. By investing in mutual funds, investors achieve instant diversification, professional portfolio management, and simplified record-keeping. However, using mutual funds results in loss of control over specific stock selection and introduces additional layers of costs, minimum investment requirements, and tax inefficiencies. In addition, open-end mutual funds are traded at market-closing net asset values (NAVs) calculated once each business day. As a result, investors trade these funds without knowing precisely which assets are being bought or sold, at a price determined at the end of the day. Inefficiency of this process has been attracting attention in the popular press and Fidelity Investments, one of the largest mutual fund families, has announced plans to move toward posting hourly NAVs.

Over 90% of mutual funds are actively managed, although index funds tracking certain major indices have gained popularity in recent years. Actively managed fund managers try to outperform the market (or their appropriate benchmark) through market timing and stock selection while index funds use passive investment strategies, tracking certain indices by holding assets that closely resemble the components of those indices. About 70% of the money in index funds is concentrated in funds tracking the S&P 500 index. Vanguard 500, the most popular such fund, has assets approaching $100 billion, or about 30% of all index fund assets [8].

Mutual fund expenses take the form of one-time loads, sales charges, redemption, exchange and maintenance fees, and annual operating expenses including management, marketing, and other expenses. Transaction and fund expenses for actively managed funds are much higher than those for index funds since maintaining an index fund is much simpler. For example, Vanguard 500 boasts a low expense ratio of 18 basis points (0.18%) per year while the expense ratios for actively managed funds commonly exceed 150 basis points. Despite higher costs, actively managed funds have historically been unable to beat index funds consistently [3], leading many to claim indexing is a superior and underutilized alternative to investing in actively managed funds.

Other index-based investment alternatives have surfaced recently. Just as funds track certain indices, unit trusts now issue stock based on index values. For example, investors who purchase shares of the Nasdaq 100 index tracking stock actually buy into the Nasdaq 100 Trust, a unit investment trust holding a portfolio consisting of Nasdaq100 index securities. Similar vehicles include the Standard & Poor's Depository Receipts (SPDRs or "Spiders"), which track certain S&P indices; DIAMONDS, which track the Dow Jones Industrial Average; and World Equity Benchmark Shares (WEBS), which track certain country-specific indices.

Among the index tracking stocks, the various types of SPDRs are the most popular. Plain vanilla SPDRs tracking the S&P 500 composite stock price index are the most common. Other variants include the MidCap SPDRs tracking the S&P MidCap 400 index, and the Select Sector SPDRs, which carve up the S&P 500 stocks in different ways. Technically, SPDRs give the investor an ownership interest in a Trust established by AMEX where stocks purchased with the investor's money are held. While most SPDR holders purchase and sell them in the secondary markets, SPDRs are initially created by large investors and institutions in block-size "creation units" of 50,000 SPDRs. Investors wishing to create SPDRs need to deposit stocks closely approximating the composition of the S&P index as well as a specified amount of cash representing accumulated dividends into the SPDR Trust. Redemption of these blocks takes place the same way by reversing this transaction.

The SPDRs and other index stocks have certain advantages over mutual funds. They can be priced continuously during the day, traded and margined at any brokerage firm, and shorted even on a downtick, for example. In addition to the trading commissions, SPDRs incur additional operating expenses due to the operation of the trust, which varies from an annual 18 basis points for the plain vanilla SPDRs to 25 and 65 basis points for MidCap and Select Sector SPDRs, respectively. Recognizing the increasing importance of index stocks, Barclays Global Investors recently filed to trade as many as 45 indices [6], and we expect this trend to continue.

↑ Future Directions

We extend this idea to develop our financial portal model and alternate investment mechanism. A major problem with the investment alternatives available today is that except for the rare case when the investor can afford to hire a financial consultant, determining the appropriateness of the investments and their fit within the overall portfolio is left entirely to the investor. Developments in e-commerce can now enable customization of investor portfolios at relatively small costs. The financial innovation we propose involves two parts: the creation of periodically updated indices covering a wider spectrum of asset classes than currently available and the creation of financial instruments to track these indices, which will allow investors and small businesses to diversify and hedge their portfolios to a much larger extent than is possible with today's investment vehicles. These instruments can be used to create optimal portfolios for investors by collecting information and recommending the appropriate asset allocation. Again, liquidity is provided to rebalance portfolios as needed.

Creating tradable indices. Our aim in creating indices is to span as much of the market as possible with minimum overlap of securities within each index. Issues to be addressed include the creation of the indices and the financial instruments tracking these indices; liquidity, pricing, hedging, and taxation concerns for these financial instruments; the mechanics for trading these instruments; and the periodic update procedures for the indices.

We envision forming stock, bond, currency, and commodity indices as well as others to track measures such as medical, travel, education, housing, and construction costs. Market research is crucial to determine the kinds of indices that will be beneficial to individuals and small businesses. Since the financial instruments tracking these indices will determine investors' portfolios, with changing asset allocations over time, providing liquidity in these instruments is essential. In order to enhance liquidity, the components of the indices need to be chosen to satisfy certain capitalization and liquidity constraints. This will also enhance accurate pricing of the financial instruments tracking the indices and reduce the tracking errors. To provide adequate liquidity, a dealer may stand ready to make a market with these instruments. An alternative when adequate liquidity does not exist to provide continuous pricing is to carry out an hourly call auction.

A related issue is to keep the index price in line with the sum of the prices for the underlying components when such components exist. In order to ensure this, a trading program may be put in place that kicks in immediately when a price discrepancy occurs, and uses arbitrage principles to move the prices back to equilibrium. As these financial instruments gain popularity, the price stabilization can be left to the sophisticated market participants who will quickly drive prices back in line by capitalizing on any significant arbitrage opportunities.

Selling financial instruments based on indices means having short positions in the assets within these indices, which then need to be hedged. Hedging can be done at the micro or macro level. Using micro-hedging, the net open position in each index may be hedged individually. On the macro level, the risk of all the open positions on all indices may be netted out and hedged accordingly. While some indices may have to be hedged at the micro level, it is likely that economies of scale will dictate a macro level risk management policy. Using an approach similar to that used to determine appropriate investor portfolios, all the outstanding positions for the financial institution can be treated as one large portfolio, which can then be hedged at the macro level.

Tax issues will also become relevant as investors change their asset allocations. Investors' overall portfolios will need to be reviewed periodically, perhaps quarterly, to make adjustments to their allocations based on changes in their goals or the marketplace. In addition, periodic updates to the indices themselves will need to be reflected in investors' portfolios, and their tax consequences need to be addressed.

For stock indices, each index can be limited to 15–25 stocks, a range large enough to diversify away non-systematic risk without losing the index focus. The core stock indices may cover categories similar to those covered by mutual funds: growth, value, and income stocks, each of which can further be divided into small, medium, and large capitalization stocks, with indices created for most major sectors and countries, creating focused non-overlapping indices.

Many alternatives exist to hedge these stock indices at the micro level, the most straightforward but costly way being to establish the exact opposite position in the underlying assets. For example, if $100,000 worth of small-growth technology stocks have been sold, the 15–25 stocks that make up this index can be bought with the proceeds to establish a perfect hedge. Alternate ways of hedging include establishing futures positions or using options when available. In addition, just like SPDRs and other index-tracking stocks, trusts can be established where large investors are allowed to create these index stocks in relatively large blocks and then sell them in secondary markets. This would pass on any associated risk to these large investors, who will then need to deal with the hedging issues themselves.

Optimizing investor portfolios. We propose two alternate ways of optimizing investor portfolios. The first approach draws heavily on modern portfolio theory and uses the mean-variance optimization [2, 7]. The second approach involves a scenario analysis in matching investors' cash flow needs with expected cash flows from the investments (see Figure 2 and the sidebar "Mean-Variance Framework").

In mean-variance optimization, investors will be provided with proprietary input data consisting of expected returns, standard deviations, and correlations of returns for the indices created. The optimizer will then determine the efficient frontier, taking into account any restrictions, such as minimum or maximum allocations to certain indices, placed by the investor. Combining this information with the applicable borrowing and lending rates, the optimizer will then be able to come up with a single optimal portfolio for the investor. As a last step, the investor may then decide how much borrowing or lending is to be done to achieve the final asset allocation. The appropriateness of these portfolios (or bundles of indices) will have to be verified periodically and adjusted as needed.

Portfolio optimizing using the mean-variance criteria is not a new idea. Simple electronic financial advisors that make asset allocation suggestions using the universe of stocks and mutual funds are currently available. All of these tools aim to help investors make better investment decisions. While the tool we envision starts out with the same goal, it goes beyond what is currently available. By allocating investors' assets to our proprietary indices, we can better span the market and move toward a truer sense of a diversified portfolio as opposed to a portfolio of stocks and bonds.

Our second approach to optimizing investor portfolios involves a scenario analysis. Examining an investor's current investable wealth and future income and obligations (such as mortgage payments and college costs) under different scenarios, this approach tests different combinations of indices to maximize the discounted value of net cash inflows under various scenarios (see Figure 2). The investor may then choose among the most appropriate alternatives.

↑ Bundle Trading

Once portfolio allocations are made, investors must be able to trade these bundles to revise their allocations as conditions change, which can be done using the bundle trading concept. In bundle trading, investors buy or sell

bundles of securities (in this case bundles of indices) by specifying a price for the bundle they want to trade. When all components of the bundle can be matched with other outstanding orders, the bundle executes. At that point, prices for the individual bundle components can be imputed. An experimental financial bundle trading system (FBTS) has been designed and tested at the Center for Research in Electronic Commerce at The University of Texas at Austin. This system uses a distributed object model based on Java RMI (remote method invocation) and supports interactive communication between trading applications and the market. The FBTS architecture is illustrated in Figure 3 and is explained in detail in [4] and [5].

The main advantages of bundle trading is the ability to accept conditional orders, provide simultaneity of transactions, and reduce transaction costs—see the sidebar "Financial Bundle Trading System (FBTS)." To illustrate, assume we want to rebalance our portfolio by selling 200 shares of the technology index (T) and 100 shares of the financial index (F) while buying 150 shares each of the retail (R) and utility (U) indices (see Table 1). If we believe the previous day's close prices are fair values for all four indices, and we place limit orders based on the prices as displayed in column (ii), only the buy order for T will get executed according to the next day's trading ranges for these indices (column (iii)). Using individual limit orders, we will end up with a portfolio that includes only F instead of the intended portfolio of R and U. However, using bundle trading we could place a limit order price of $0 (row (a)) for the whole basket of orders, which would have been executed with certainty, since the highest cost of the bundle based on the worst prices of the assets during the next day (highest price for buys and lowest for sells) would have been $0 (row (b)).

Conclusion

With the rapid pace of technological change and associated innovations, financial institutions must rethink how they do business or risk obsolescence. In recent years, full-service brokerages have started to see tremendous competition from online discount brokers. Today, online discount brokers such as Schwab have market values exceeding those of well-established full-service brokers such as Merrill Lynch. Mutual funds have also chipped away profits from full-service brokerages because investors can now achieve diversification by holding a smaller number of instruments. However, mutual funds also have their share of problems. Over 90% of the actively managed mutual funds where fund managers expand considerable resources in trying to make profitable stock selections and time the market get beaten by passive strategies of holding the S&P 500 index over a span of five years [3]. In addition, mutual fund holdings are not disclosed in a timely manner so managers don't lose their informational advantages, and mutual funds are sold inefficiently with prices determined only once at the close of each day—it is almost puzzling why investors are putting so much of their wealth into mutual funds.

Despite such problems, mutual funds are currently the best available investment alternative, but technology advances may improve matters. In this article, we proposed a financial portal model and a new investment mechanism we believe serves the needs of investors better than the currently available alternatives. Our business model is particularly appropriate for existing financial institutions with established resources and will help them transform themselves to compete successfully in the new financial environment. Today's leaders in the financial industry need to adjust their focuses to be tomorrow's survivors.

References

1. Anders, G., McGeehan, P. and Kranhold, K. Milestones hit by Schwab and E*Trade. *Wall Street Journal* (Dec. 29, 1998).

2. Elton, E.J. and Gruber, M.J. *Modern Portfolio Theory and Investment Analysis*. Wiley, New York, 1995.

3. Evans, R.E. and Malkiel, B.G. *Earn More (Sleep Better): The Index Fund Solution*. Simon and Schuster, New York, 1999.

4. Fan, M., Stallaert, J., and Whinston, A.B. Creating electronic markets. *Dr. Dobb's Journal* (Nov. 1998), 52–57.

5. Fan, M., Stallaert, J., and Whinston, A.B. A Web-based financial trading system. *IEEE Computer* (Apr. 1999), 64–70.

6. Greenberg, H. Is Barclays about to turn the fund world upside down? TheStreet.com, June 8, 1999.

7. Gupta, F. and Eichhorn, D. Mean-variance optimization for practitioners of asset allocation. In F.J. Fabozzi, Ed., *Handbook of Portfolio Management*, Frank J. Fabozzi Associates, New Hope, Pennsylvania, 1998

8. Israelsen, C.L. Indexed for elation: Investors are opting for index funds because of recent high returns, but the real advantage is tax efficiency. *Financial Planning*, June 1, 1999.

9. Spiro, L.N. and Baig, E.C. Who needs a broker? *Business Week* (Feb. 22, 1999), 113–118.

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Figures

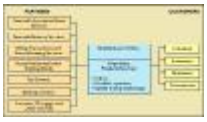


Figure 1. A financial bundling portal.

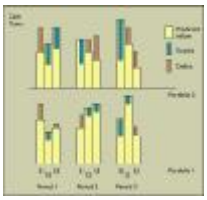


Figure 2. Scenario analysis comparisons of two different portfolios for three periods (S1: scenario 1; S2: scenario 2; S3: scenario 3).

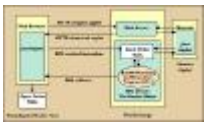


Figure 3. FBTS architecture.

Tables



Table 1. A bundle trading example.

Sidebar: Mean-Variance Framework

Modern portfolio theory has its foundations in Markowitz's mean-variance framework introducing the trade-off faced by investors between expected returns and standard deviations of those returns. Assuming asset classes have normally distributed returns, Markowitz cast the investor's portfolio selection problem in terms of expected returns, standard deviations and correlations among those returns, and argued that any optimizing investor would hold a mean-variance efficient portfolio. A portfolio is mean-variance efficient if it has the maximum expected return among all other portfolios that have the same standard deviation of returns, and has the minimum standard deviation of returns among all those that have the same expected return. A mean-variance optimizer needs the set of expected returns and standard deviations for all available asset classes and the correlations among them as its inputs. These are generally based on historical values and may then be modified in some way. This data is then input into optimizing software that searches for and finds all mean-variance efficient portfolios, forming the set of optimal portfolios or the efficient frontier. At this stage, investors also have the choice of constraining allocation to certain asset classes when they have reasons to do so. Once the efficient frontier is determined for a given investor, the optimizer can then come up with a single optimal portfolio by taking into consideration the borrowing and lending rates that apply to the investor.

Sidebar: Financial Bundle Trading System (FBTS)

The financial bundle trading system uses a fully automated order matching and execution system. The automated matching program does the matching by solving the following mathematical programming problem:

$$\max \boldsymbol{px} \qquad (1)$$

Subject to:

$$\boldsymbol{Bx} \le 0 \qquad (2)$$

$$0 \le \boldsymbol{x} \le \boldsymbol{u} \qquad (3)$$

The vector $\boldsymbol{p}$ denotes the limit price for each bundle submitted by traders. The vector $\boldsymbol{x}$ represents the proportion of the matched trade, and each element of $\boldsymbol{x}$ should be positive (constraint (3)). The matrix $\boldsymbol{B} = [\boldsymbol{b}_1, \boldsymbol{b}_2, \ldots \boldsymbol{b}_n]$ contains n vectors. Each vector represents the composition of a particular bundle submitted for trade. For example, suppose we have only three indices to trade, then $\boldsymbol{b}_1' = [2, 1, 1]$ means the bundle contains 2 units of index 1, and one unit each of indices 2 and 3. A positive number in the bundle vector means buy and a negative number means sell. Constraint (2) means that for a bundle to be matched, each buy order in the bundle should be matched with a sell order of the same index from another bundle or bundles. Constraint (3) is the condition for the trade quantity. The vector $\boldsymbol{u}$ is the trade quantity submitted by the trader. See [4] and [5] for more detail on FBTS.

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