Comparing Risk-Adjusted Performance of ETF Portfolios vs. S&P 500 Index

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Abstract

This empirical study compares the performance of portfolios consisting of Exchange-Traded Funds (ETFs) with that of the S&P 500 Index during 2006. The ETF portfolios were constructed according to Modern Portfolio Theory (MPT) developed by Markowitz in 1952. The study concludes that several of the ETF portfolios performed better than the S&P 500 Index when performance is measured using the Sharpe ratio, i.e., the return per unit of risk.

1. Introduction

The rationale for this study arises from the current trading and cost limitations of mutual funds; the recent SEC regulations intended to eliminate flaws in corporate governance (e.g., late trading and market timing); and the various studies demonstrating inefficiencies in typical mutual fund portfolios. The article's conclusions provide insight into the choice of investing in portfolios made up of ETF securities as compared to passive instruments linked to the broad market, such as the S&P 500 Index.

Portfolio management, also known as investment or money management, is a disciplined process supported by a scientific methodology of selecting, weighting, and constantly rebalancing assets. According to Fabozzi and Markowitz (2002), "an investment management process requires five steps: a) set the investment objectives; b) establish an investment policy; c) select an investment strategy; d) define the specific asset classes; and e) measure and evaluate the investment performance"(p. 3).

Investors, portfolio managers, and hedge fund managers have traditionally allocated investments in mutual funds for the purpose of diversification, aiming at increasing expected returns and/or decreasing the portfolio's risk. Investments in the mutual fund industry have grown significantly during the last twenty years, achieving total assets in excess of US$ 11.4 trillion in May 2007. However, the lack of trading flexibility; the high transaction and management costs (Berk & Green, 2004); the tax inefficiencies of mutual fund investments (Bernard, 2005); and the new SEC regulations, prompted by the late trading and market timing scandals of the early 2000s (Carroll, 2004), have slowed the growth of the mutual fund industry. Additionally, since Jensen's 1968 paper on mutual fund performance, studies have shown little evidence that mutual fund managers outperform passive benchmarks. These limitations of mutual funds have stimulated the growth of a new type of indexed asset, the Exchange Traded Fund (ETF).

The concept of ETFs is rooted in the portfolio trading or program trading of the late 1970s and early 1980s. In 1993, the first ETF was registered and launched; it was the Standard & Poor's Depositary Receipt (SPDR), which tracks the S&P 500 index. An ETF represents shares of ownership in a fund, depository receipts, or unit investment trusts that hold a pool of investments

which usually track the performance of specific indices. These indices may represent the broad market, specific industries, investment styles, or non-equity instruments (bonds, REITs, high-yield bonds, precious metals, currencies, and commodities). Their scope may be limited to the United States, or they may be international or global. Approximately 25 percent of all ETFs are investments in securities traded on foreign markets (Jares & Lavin, 2004).

According to Curcio et al. (2004) an ETF provides the following benefits for shareholders: a) it can be traded using the order and portfolio management techniques; b) it is not subject to the "up-tick" rule[1]; c) it can be a very cost-effective way to construct a portfolio, creating a hedging position, or achieving a targeted exposure to specific sectors; c) it is tax efficient, as the in-kind redemption allows the fund to transfer out high-tax basis securities for redeeming investors, minimizing their potential capital gains.

However, ETFs also have limitations in market liquidity, differences in the bid-asked spread, and possible mispricings when market prices are at a premium or discount relative to Net Asset Values (NAVs)(Ryan, 2005); although market liquidity and the bid-asked spread tend to improve with the growth of an ETF's assets and trading volume. Despite these limitations, ETFs' favorable characteristics have attracted the attention of investors and managers of portfolio and hedge funds, who desire to diversify their portfolios, increase expected returns, minimize risks, hedge positions, or use ETFs as portfolio insurance. This strong market demand has increased the number and types of ETFs. As of June 30, 2007, there were approximately 526 ETFs, and their number grows steadily. Investments in ETFs are currently increasing at around 50 percent a year and have already reached total assets of US$ 431 billion (Salisbury, 2007).

The present article is based on an empirical study applying Markowitz (1952) Modern Portfolio Theory (MPT) to ETFs, in which the performance of several ETF portfolios was tested against that of the S&P 500 Index.

2. MPT and ETF Portfolios

Exchange-Traded Funds are usually indexed securities comprising many categories: market capitalization, investment style, industries, regions and countries. Due to their nature and composition, these securities could potentially provide the most effective and least costly method of achieving the diversification required by MPT to attain the most efficient portfolios along the Markowitz efficient frontier. Quantitative techniques have also penetrated investment management through the creation of index funds. These funds are a direct outgrowth of Sharpe's (1964) assumption of market efficiency and Fama's (1991) Efficient Market Hypothesis EMH). Index funds account for 38 percent of institutional assets invested in U.S. equities (Chernoff, 2002).

The purpose of this research is to determine whether an ETF portfolio, constructed according to MPT, provides higher return per unit of risk than the S&P 500 index The outcome of both strategies is examined and the question of whether investors should diversify their portfolios with ETF securities, using MPT to increase return per unit of risk, or simply invest in a market

[1] As of July 6, 2007 the "up-tick" rule was eliminated by the SEC.

asset tied to the S&P 500 Index is addressed. The conclusions shed light on the value of diversification of assets with low correlations, validating MPT.

The objective of portfolio management is the combination of diversified assets to maximize expected return and/or minimize risk, consistent with investors' level of risk tolerance. The analyses presented here are based on Markowitz's MPT, first published in 1952, and later in his book, *Portfolio Selection: Efficient Diversification of Investments,* in 1959.

Since its formulation, MPT has revolutionized the investment world by allowing managers to quantify investment risk and expected return. The earlier focus on individual asset risk has therefore shifted to the risk of the entire portfolio. According to Fabozzi and Markowitz (2002), MPT provides a scientific and objective analysis of risks and returns, complementing the subjective art of investment management.

The MPT's primary innovation was to recognize that risk must be measured, not in terms of each security, but by how the risk of each security relates to those of other securities in the portfolio (Chernoff, 2002). Markowitz used a quantitative definition of risk to provide a means of calculating the price of that risk, or the amount of additional risk that must be borne in exchange for an increase in a portfolio's expected return. An appropriate portfolio diversification allows investors to: a) maximize return and minimize risk; b) maximize return for the same level of risk; and c) minimize risk for the same level of return (Fabozzi & Markowiz, 2002). Diversified portfolios are called efficient portfolios, because they optimize the combination of input (risk) per unit of output (return) and their combination forms the efficient frontier (Markowitz, 1991).

According to MPT, the expected return of a portfolio is the sum of the weighted expected returns of all securities in the portfolio. Each weight is represented by the market value of the security relative to the market value of the portfolio (Markowitz, 1999). The calculation of the expected return for each security according to MPT is dependent on an underlying index that measures the performance of the market. The expected return of a security can be determined by using the first asset-pricing model derived from economic theory, the capital asset pricing model (CAPM), which was independently developed by Sharpe (1964), Lintner (1965), and Mossin (1966). The CAPM is based upon the assumptions of MPT and adds two additional capital market assumptions: a) there is a risk-free asset rate, and investors can borrow or lend any amount at this rate; and b) capital markets are completely competitive and without transaction costs or impediments that interfere with the supply and demand for an asset (Fabozzi & Markowitz, 2002). According to Merton (1972), the CAPM, with the risk-free asset assumption, changes the efficient frontier to the capital market line. Portfolios on the capital market line represent a combination of borrowing or lending at the risk-free rate and are the optimal market portfolios.

One of the pillars of MPT is the EMH (Stewart, 2006). According to Bernstein (2006), "the intensity of portfolio managers in their quest for excess return is precisely what makes the market efficient" (p. 1). This leads to a great paradox, as all investors would prefer to track an index or to adopt other kinds of passive strategies. If all investors follow this path, however, the market would become less efficient, creating opportunities for alpha hunters (Bernstein, 2006). Today's investors are engaged in alpha-beta separation (Hill, 2006). The desire to increase exposure to alpha and active risk is growing. "The beta, or sensitivity to a market portfolio, is the

most important driver of investment performance and stock price differentials" (Hill, 2006, p. 25). Hill (2006) also comments that "a significant implication of Sharpe's dissertation was that an equity index fund, managed very efficiently and cheaply, is the most rational approach to capturing the returns of equity exposure"(p. 25)

On capital asset pricing, Sharpe (1964) defined two components of a security's return. The first component is the "price of time" represented by the risk-free rate, and the second is the "price of risk", determined by the additional expected rate of return per unit of risk. The security's price of risk is calculated by dividing its expected return, net of the risk-free rate, by its standard deviation. This price of risk is known as Sharpe's ratio and is the performance measurement used in this article.

These observations indicate that investing in diversified index funds which carry low management and transaction fees is, according to MPT, the most efficient investment strategy (Malkiel, 2003). ETFs could, therefore, be a contemporary and timely asset solution. An ETF is an important financial product for individual investors since it combines the advantages of indexing with those of stock trading. The research described herein has confirmed that ETFs exhibit a higher tracking accuracy to their underlying index compared with traditional index mutual funds. The study also found that, on a risk-return basis, investors achieve greater performance and diversification gains by employing ETFs rather than traditional index mutual funds. The ETFs' benefits of cost effectiveness, tax efficiency, liquidity, and transparency have made ETFs a fast-growing segment of the financial market. The analyses used ETF information that is historical, accurate, and publicly available from reliable financial sources. As of January 31, 2007, there were 460 ETFs with assets of $431 billion, compared with 203 ETFs with assets of $292 billion at the end of 2005 (Forsyth, 2005). The growing number of choices provides more flexibility in tailoring clients' portfolios and therefore allowing the separation of alpha from beta. In other words, some ETFs can deliver market return (beta), while others might be used in attempts to add alpha value.

3. Methodology

The analyses consisted of constructing distinct ETF portfolios, as an ETF mirrors an index fund in its asset class and carries very low administrative costs. ETFs were selected based upon the following maturity and liquidity criteria: a) more than three years of existence and b) a minimum total Net Asset Value (NAV) of US$1 billion on December 31, 2005.

These selected ETFs were defined as follows:

1) Asset classes: market capitalization (large, medium, small, micro-cap, Dow Jones Industrial Average, S&P 500 index, total stock market, selected dividends); investment style (value, core, growth); industries (financials, health care, technology, industrial, materials, REITs, precious metals, commodities, etc.); bonds (corporate and government short-, medium-, and long-term, fixed-income, high-yield); and regions (U.S., international, global).
2) The returns, variances, standard deviations, correlations, covariances, and betas were determined for a period of three years, from December 30, 2002 to December 30, 2005.

3) The optimal portfolio was determined for each asset class based upon ETF statistical data, an expected risk-free rate of 5% per annum (p.a.), and market return of 13% p.a.. A maximum participation of 25% was allowed for each ETF for diversification purposes. This participation was relaxed to 50% if the portfolio had only four ETFs to avoid an automatic equal participation of 25% for each ETF and to allow optimization of the portfolio's diversification.
4) The performance of the optimal portfolios, measured in terms of return per unit of risk from December 30, 2005 to December 30, 2006, was compared with that of the S&P 500 index.
5) The returns per unit of risk of the ETF and market portfolios were statistically tested at a 95% confidence level, using correlation analysis and a one-tailed test.

As of December 30, 2005, there were 203 ETFs in different asset classes (stocks, bonds, industries, market capitalization, precious metals, and commodities.), in different regions (U.S., developed ex-U.S., and emerging markets), and with different investment styles (growth, core, and value). The total NAV market was US$292 billion (see Table 1). In accordance with the maturity and liquidity criteria described above, the analysis was limited to 41 ETFs, selected from among the original list of 203 (see Table 2A and 2B).

Table 1: Descriptive Statistics of the ETFs Market

Asset Class	Number	% Number	NAV (US$ billion)	% NAV
Bond	6	3%	15	5.1%
Industries	84	41%	35	11.9%
International	41	20%	58	19.9%
Market Cap	72	36%	184	63.1%
Total	203	100%	292	100%

4. Hypotheses

From among the selected 41 ETFs, the optimal portfolios were constructed and their performances were compared with that of the S&P 500 Index for the period between December 30, 2005 and December 29, 2006. The following hypotheses were formulated:

H1: A portfolio composed of U.S. ETFs by market capitalization provides a higher return per unit of risk than the S&P 500 index.

H2: A portfolio composed of U.S. value-index ETFs provides a higher return per unit of risk than the S&P 500 index.

H3: A portfolio composed of U.S. ETFs by industries provides a higher return per unit of risk than the S&P 500 index.

H4: A portfolio composed of international ETFs provides a higher return per unit of risk than the S&P 500 index.

H5: A portfolio composed of global ETFs provides a higher return per unit of risk than the S&P 500 index.

H6: A portfolio composed of global ETFs, when rebalanced quarterly, provides a higher return per unit of risk than the S&P 500 index

Table 2A: Descriptive Statistics of Selected ETFs

Asset Class	Number	% Number	NAV (US$ billion)	% NAV
Bond	6	15%	15	7%
Industries	11	27%	40	18%
International	5	12%	35	16%
Market Cap	19	46%	128	59%
Total	41	100%	218	100%

The ETF portfolio for each type of asset class was determined based on the ETFs' statistical data, the expected market return and risk-free rate, and the mean-variance optimization model of MPT. Software determining the optimal portfolio was used. This software applied MPT and determined the weights of participating ETFs in the optimal portfolio. The total returns and risks were calculated as of December 29, 2006 for the ETF portfolios and the S&P 500 Index. A correlation analysis was conducted at a 95% confidence level using a one-tailed test to determine the significance and magnitude of the differences in the portfolios' returns per unit of risk.

5. ETF Portfolios

Six ETF portfolios were constructed according to MPT, and their performance measured against that of the S&P 500 Index. The selected ETF data was based upon ETFs in existence as of December 30, 2005 that satisfied the liquidity and maturity criteria. The optimal portfolios were constructed taking into account the variances, standard deviations, covariances, and correlations of each ETF and of the market Index over a period of three years, December 30, 2002 to December 30, 2005. The return per unit of risk of each portfolio was calculated by dividing the portfolio's 2006 return, net of the risk-free rate, to its total risk, the standard deviation. This ratio, the return per unit of risk, was then compared with the same ratio for the S&P 500 Index. The final outcome was statistically tested to determine support or rejection of the hypotheses.

Hypothesis 1 was tested using 19 U.S. ETFs, sorted by market capitalization. These ETFs focus on large, medium, and small companies that pursue a growth, core or value investment strategy; the S&P 500 index; the Dow Jones Industrial Average; the total market; and high dividends. The optimal portfolio of U.S. ETFs by market capitalization was composed of eight ETFs: DIA (10%), RSP (10%), SPY (13%), IVV (2%), IVW (25%), IVE (23%), IWR (7%), and VTI (10%).

Hypothesis 2 was tested using four ETFs that focus on large, medium, and small companies with a value investment style (value-index). The four ETFs were selected from among the 19 ETFs in the market capitalization asset class. Considering the existence of only four ETFs in this asset class, and in order to optimize the portfolio's diversification, the maximum participation of each ETF was relaxed from 25% to 50%. The optimal portfolio of U.S. value-index consisted of four ETFs: IVE (50%), IWS (26%), IJJ (15%), and IJS (9%).

Hypothesis 3 was tested with eleven selected ETFs that focus on the following industries: financials, energy, health care, technology, utilities, real estate, natural resources, biotechnology, gold, and utilities. The optimal portfolio by industries was composed of eight ETFs: XLE (4%), XLF (25%), XLV (23%), IGE (7%), ICF (2%), QQQQ (11%), XLK (25%), and XLU (3%).

Table 2B: Selected ETFs

	ETF	Symbol	NAV*	Asset Class
1	iShares Trust: iShares GS $ InvesTop Corporate Bond Fund	LQD	2367	Bond
2	iShares Trust: iShares Lehman 1-3 Year Treasury Bond Fund	SHY	4291	Bond
3	iShares Trust: iShares Lehman 20+ Year Treasury Bond Fund	TLT	1053	Bond
4	iShares Trust: Lehman 7-10 Year Treasury Bond Fund	IEF	1216	Bond
5	iShares Trust: Lehman TIPS Fund	TIP	3248	Bond
6	iShares Trust: Lehman US Aggregate Bond Fund	AGG	2830	Bond
	Sub-total		15005	
7	iShares Trust: iShares Nasdaq Biotechnology Index Fund	IBB	1609	Biotechnology
8	Select Sector SPDR Trust: Energy Select Sector SPDR Fund	XLE	3526	Energy
9	Select Sector SPDR Trust: Financial Select Sector SPDR Fund	XLF	1853	Financials
10	iShares Trust: Dow Jones US Healthcare Sector Index Fund	IYH	1185	Health Care
11	Select Sector SPDR Trust: Health Care Select Sector Fund	XLV	1737	Health Care
12	iShares Trust: Goldman Sachs Natural Resources Index Fund	IGE	1020	Natural Resources
13	streetTRACKS Gold Trust: streetTRACKS Gold Shares	GLD	3653	Precious Metals
14	iShares Trust:Cohen & Steers Realty Majors Index Fund	ICF	1712	Real Estate
15	Nasdaq-100 Trust, Series 1	QQQQ	20458	Technology
16	Select Sector SPDR Trust: Technology Select Sector Fund	XLK	1644	Technology
17	Select Sector SPDR Trust: Utilities Select Sector SPDR Fund	XLU	1919	Utilities
	Sub-total		40314	
18	iShares Trust: iShares MSCI EAFE Index Fund	EFA	21732	International
19	iShares Trust: iShares S&P Europe 350 Index Fund	IEV	1210	International
20	iShares Trust: iShares S&P Latin America 40 Index Fund	ILF	1095	International
21	iShares, Inc: iShares MSCI Emerging Markets Index Fund	EEM	9320	International
22	iShares, Inc: iShares MSCI Pacific ex-Japan Index Fund	EPP	1643	International
	Sub-total		35000	
23	DIAMONDS Trust, Series 1	DIA	7484	Large Core
24	Rydex ETF Trust: S&P 500 Equal Weighted Index Fund	RSP	1250	S&P 500 index
25	SPDR Trust, Series 1	SPY	57064	SPDR 500 index
26	iShares Trust: iShares S&P 500 Index Fund	IVV	13814	S&P 500 index
27	iShares Trust: iShares S&P 500 Growth Index Fund	IVW	3119	S&P 500 growth
28	iShares Trust: iShares S&P 500 Value Index Fund	IVE	3036	S&P 500 value
29	iShares Trust: iShares Russell Midcap Index Fund	IWR	1607	Midcap core
30	iShares Trust: iShares S&P MidCap 400 Index Fund	IJH	3331	Midcap core
31	MidCap SPDR Trust; Series 1	MDY	8900	Midcap core
32	Vanguard Index Funds: Mid-Cap Index Fund	VO	1015	Midcap core
33	iShares Trust: iShares Russell Midcap Growth Index Fund	IWP	1259	Midcap growth
34	iShares Trust: iShares S&P MidCap 400 Growth Index Fund	IJK	1725	Midcap growth
35	iShares Trust: iShares Russell Midcap Value Index Fund	IWS	1895	Midcap value
36	iShares Trust: iShares S&P MidCap 400 Value Index Fund	IJJ	2463	Midcap value
37	iShares Trust: iShares S&P SmallCap 600 Index Fund	IJR	4279	Smallcap core
38	iShares Trust: iShares S&P SmallCap 600 Growth Index Fund	IJT	1315	Smallcap growth
39	iShares Trust: iShares S&P SmallCap 600 Value Index Fund	IJS	1656	Small cap value
40	Vanguard Index Funds: Total Stock Market Index Fund	VTI	5433	Total Market

41	iShares Trust: iShares Dow Jones Select Dividend Index Fund	DVY	7330	Dividends
	Total NAV		**127,973**	

*in millions

Hypothesis 4 was tested using five international ETFs that focus on non-U.S. shares. Considering the existence of only four ETFs in this group, the maximum participation of each ETF was relaxed from 25% to 50% in order to optimize the portfolio's diversification. The optimal international portfolio was composed of four ETFs: EFA (36%), IEV (26%), ILF (22%), and EPP (16%).

Hypothesis 5 was tested with an optimal portfolio chosen from among 41 ETFs that focus on both U.S. and non-U.S. markets. This portfolio is, therefore, a global one. The optimal portfolio in this category was composed of 16 ETFs with different weightings (see Table 3).

Hypothesis 6 was tested using the previous optimal portfolio of global ETFs and rebalancing it on a quarterly basis. The number of ETFs in the optimal portfolios varied from 10 to 16 with different weightings (see Table 4).

Table 3: Optimal Portfolio of Global ETFs

ETFs	Name	Weight
XLE	Energy Select Sector SPDR Fund	1%
XLF	Financial Select Sector SPDR Fund	9%
XLV	Health Care Select Sector SPDR Fund	7%
IGE	GS Natural Resources Index Fund	3%
ICF	CS Realty Majors Index Fund	2%
QQQQ	Nasdaq-100 Trust, Series 1	6%
XLK	Technology Select Sector SPDR Fund	3%
XLU	Utilities Select Sector SPDR Fund	2%
EPP	Pacific ex-Japan Index Fund	2%
DIA	Diamonds Trust, Series 1	14%
RSP	Rydex S&P 500 Equal Weighted Index Fund	7%
IVW	S&P 500 Growth Index Fund	22%
IVE	S&P 500 Value Index Fund	14%
IWR	Russell Midcap Index Fund	3%
IJS	S&P Smallcap 600 Value Index Fund	2%
VTI	Vanguard Total Stock Market Index Fund	3%
	Total	100%

Table 5 shows the six tested portfolios and the S&P 500 Index portfolio. It shows the number of securities in the portfolios, the 2006 total return and risk, and the portfolios' return per unit of risk. The risk-free rate was determined based on the average of the 90-day Treasury Bill rate, and risk was measured as the volatility of the portfolios' returns (standard deviation). The returns per unit of risk were statistically tested and their p-values (.000) were found to be lower than their levels of significance.

Table 4 Optimal Portfolio of Global ETFs Rebalanced Quarterly

ETF	Asset Class	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
LQD	Top Corporate Bond		11%		
SHY	Treasury 1-3 yrs			16%	
XLE	Energy	1%	3%	8%	4%
XLF	Financials	9%		25%	16%
XLV	Health Care	7%	15%	10%	4%
IGE	Natural Resources	3%			
ICF	Real Estate	2%			
QQQQ	Nasdaq 100	6%	3%	8%	
XLK	Technology	3%	8%	13%	14%
XLU	Utilities	2%			3%
EFA	EAFE		2%		
ILF	Latin America 40				2%
EPP	Pacific ex-Japan	2%		1%	
DIA	Dow Jones 30	14%	9%	12%	9%
RSP	S&P500 Equal Weight	7%	8%		9%
SPY	S&P 500				11%
IVV	S&P 500		14%		
IVW	S&P 500 growth	22%	7%	2%	7%
IVE	S&P 500 value	14%	2%		
IWR	Midcap	3%			
IWS	Midcap value		8%		7%
IJS	Small cap value	2%			
VTI	Total Market	3%	10%	5%	14%
TOTAL		100%	100%	100%	100%

Table 5: Portfolios' Return per Unit of Risk

ETF Portfolios	# of Securities	Return	Risk-free Rate	Risk	Return/Risk (***)
Market Capitalization	8	14.02%	4.66%	10.01%	0.94
Value-Index	4	16.52%	4.66%	11.13%	1.07
Industries	8	12.00%	4.66%	10.79%	0.68
International	4	27.14%	4.66%	16.82%	1.34
Global	16	13.97%	4.66%	10.25%	0.91
Global Rebalanced	10 to 16	13.90%	4.66%	9.38%	0.99
S&P 500 index	500	12.77%	4.66%	9.98%	0.81

(***) $p<0.005$

6. Summary and Conclusions

The analyses conclude that ETF portfolios, in the categories of market capitalization, value-index, international (ex-U.S.), global (U.S. and ex-U.S.), and global rebalanced quarterly, are likely to provide higher returns per unit of risk than the S&P 500 Index. So, hypotheses 1, 2, 4, 5 and 6 are supported. The international ETF portfolio (1.34) and the value-index portfolio (1.07)

had the best performance in 2006 among the portfolios tested. The only exception was the ETF portfolio by industry, which showed a lower return per unit of risk (0.68) than the market (0.81). Thus, hypothesis 3 is not supported. It is likely that the 11 ETFs which focus on industries and represent 18% of the total ETF market capitalization do not yet provide enough industry coverage and/or diversification to allow the construction of an optimal portfolio that matches or exceeds the S&P 500 Index in return per unit of risk.

It is noteworthy that the optimal portfolios required the inclusion of only a small number of ETFs. The number varied from four ETFs in the international and value-index portfolios to sixteen in the global and global rebalanced portfolios. This was expected because an ETF is already a diversified security. Thus, the use of ETFs could constitute an efficient and cost effective way of building and rebalancing optimal portfolios.

The study also found that a market portfolio can be optimized in terms of beta and total risk using only existing ETFs by market capitalization. The ETF portfolio by market capitalization had a beta of 1.0 (similar to S&P 500 Index) and a total risk of 10.0% (close to the 9.98% of the S&P 500 index). The study also indicated that the portfolio of international ETFs had the highest return per unit of risk and also the highest alpha. It is likely that the S&P 500 Index may not be an optimal market proxy for a portfolio of international ETFs.

The global ETF portfolio, rebalanced quarterly, provided a higher return per unit of risk (0.99) than the non-rebalanced global ETF portfolio (0.91). The performance improvement occurred because quarterly rebalancing reduced the portfolio's risk from 10.25% to 9.38%. As suggested by the theory, portfolio rebalancing is likely to be an efficient method of improving a portfolio's performance. However, the optimal rebalancing frequency has yet to be evaluated in light of the inherent transaction and administrative costs.

These findings shed light on the question of whether investors should diversify their portfolios with ETF securities, according to MPT, to increase returns over those of the S&P 500 Index. The outcome of this study may be of benefit to practitioners interested in investing in ETFs to achieve higher returns per unit of risk than the market index. The study found that this is possible for ETF portfolios defined by market capitalization, value-index, international, global, and global rebalanced quarterly, but not for portfolios composed of industry ETFs. Additionally, since ETFs carry the diversification benefits of funds and the trading benefits of stocks, practitioners may substantially simplify their work by constructing ETF portfolios, thereby reducing the time, research efforts, and administrative costs required to achieve performance targets.

In an academic sense, the study tests MPT with a new category of indexed securities. It concludes that MPT is a valid theory and an acceptable tool for constructing efficient portfolios, and that, in many cases, the performance of these portfolios, when measured in terms of return per unit of risk, may be superior to that of the S&P 500 Index. The application of this theory supports the arguments that MPT may increase the portfolio's return and decrease the level of risk, increase the portfolio return for the same level of risk, and reduce the portfolio's risk for the same level of return. MPT has proven to be an efficient way of diversifying a portfolio and reducing its total risk through the testing of different types of portfolios and the use of different asset classes of ETFs.

The ETF market is growing significantly in terms of both number and NAV. As more ETFs comply with the maturity and liquidity criteria applied in this study, it may be possible to construct even more efficient ETF portfolios in the future and demonstrate even greater benefits from diversification.

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