Spiders:

Where are the Bugs?

by

Edwin J. Elton,* Martin J. Gruber,*

George Comer and Kai Li****

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* Nomura Professors of Finance, Stern School of Business, New York University

** Doctoral Students, Stern School of Business, New York University

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One of the clearest trends in asset management is the rapid increase in the amount of individual and institutional money invested in indexed products. By far the most popular index which investors want to replicate is the S&P 500 index. While many academic studies have examined the characteristics of two instruments frequently used to replicate the S&P, index funds and futures, very little has been written about the newest way to replicate the S&P 500 index: Standard and Poors Depository Receipts (SDPR) commonly referred to as Spiders. The importance of Spiders can be seen by the fact that at the end of 1999 there were 19.8 billion dollars invested in Spiders and that in 1998 daily shares traded in Spiders exceeded any other stock except Compaq and daily dollar volume was the highest of any share traded. This is all the more surprising given the fact that Spiders have not been around very long.

There are three major reasons why this analysis is useful. First, the principal advantage of Spiders versus index funds is that they can be purchased and sold at prices which exist at any time during the trading day. As we will show, low-cost index funds produce higher returns than Spiders. Given that investors can use either vehicle, the difference in return gives a measure of the value of immediacy. The value of immediacy is an important issue in the literature on market microstructure. Second, since Spiders have become an important investment vehicle in terms of both trading volume and dollar value outstanding, their performance and characteristics are of interest by themselves. Third, the organizational form of Spiders is seen as the prototype for index funds of the future, and thus it is

important to understand both their performance and the affect of the organizational structure on that performance.

Before analyzing Spiders, we will briefly review their history and important characteristics. Each Spider represents an ownership interest in the SPDR Trust. The Trust as stated in the prospectus holds all of the common stocks in the S&P 500 composite stock price index and is intended to provide investment results that, before expenses, generally correspond to the price and yield performance of the S&P 500 Index. Spiders are traded on the American Stock Exchange and can be bought and sold like any stock at any time during the day. One Spider has a price equal to approximately 1/10 of the price of the S&P Index. The initial deposit creating Spiders was made on January 22, 1993. The Spider was organized as an investment trust and has a mandatory termination date of January 22, 2218[1]. Any trust is governed by a trust agreement and there are certain aspects of the trust agreement governing Spiders which are important to understand. First, Spiders charge an expense ratio to holders of the Spider. This has historically been 18.45 basis points per annum. Second, a specific mechanism exists for changing the number of Spiders outstanding. Investors can create or delete Spiders in minimum units of 50,000 shares by engaging in transactions in kind plus getting or receiving certain sums of cash. For example, investors can turn in a bundle of stock matching the S&P Index plus cash equal to the accumulated dividends less management expenses and receive Spiders in return. Investors can do so for a payment of $3,000 (regardless of the size of the transaction).

[1] There are several circumstances, none of which in our judgement is ever remotely likely, that cause the trust to dissolve earlier.

There is another peculiar aspect of Spiders that arises from their organizational form. Spiders pay out the dividends the trust receives on the stocks that it holds quarterly; on the last business days of April, July, October and January (though the ex-dividend day of the trust occurs in the previous month). What is unusual is that the dividends the trust receives from the underlying stock is held in a non-earning account between the time it is received and the time it is paid out.

Having provided background on Spiders, we turn to the purpose of this article: to study the performance of Spiders and to compare Spiders with other methods of indexing. This paper proceeds as follows: In the first section we examine the performance of Spiders as an investment vehicle. We start by examining the return from holding Spiders compared with the return from holding the S&P Index. In this section we first examine Spider returns as if Spiders could be bought and sold at their net asset value. We then examine the magnitude and time path of the differences between Spider price and NAV. Since Spiders are not the only way of holding an index, we next compare the return on Spiders with the return on other methods of indexing, index funds and futures. One of the unique aspects of Spiders is the ability of investors to create and delete them by turning in or receiving bundles of securities. We briefly examine this phenomenon in Section II of this paper. The third and last section examines the determinants of volume in Spider trading. The determinants of volume provide us with insight into who is trading Spiders, and why.

I. Performance of Spiders

The purpose of this section is to examine the return on Spiders to see if they appear to be a reasonable investment instrument. Since a Spider has its basic value determined by the S&P Index, we will compare the return on Spiders to the return on the S&P Index and then try to decompose any differences in return to see what accounts for them. In what follows, we break Spider return into two components: the return due to changes in NAV and the return due to deviations of NAV from price. This decomposition allows us to estimate return without having it depend on deviations that occurred at a particular point in time. Over long periods the difference between price and NAV is unimportant because, through the ability to create and delete Spiders, arbitrage limits deviations. For example, over our sample period the average annual return from holding Spiders was 21.91% while the return on NAV was 21.89%.[2] After examining overall return we will examine the reasons Spider returns differ from the S&P index. Later we will compare Spiders to other instruments whose performance is also directly related to the S&P Index.

A. Overall Return on Spiders

We begin our analysis by examining the overall return an investor could have earned from holding Spiders if Spiders were purchased and sold at their net asset value (NAV). It is important to

[2]We show later that differences between price and NAV are small and extremely short-lived.

note that the NAV of a Spider is equal to the market value of the securities which back the Spider plus an accumulation unit which is equal to accumulated dividends minus accumulated management fees. Later we will examine the impact on return of deviations of Spider price from NAV.

In Table 1 we report the NAV return from holding a Spider for each year from 1993-1998.[3] Since we are interested in total return, we computed return as change in NAV plus dividends paid to the Spider holder, all divided by NAV. The yearly return was computed by first computing daily returns and then compounding up to the yearly return. Cash payments to holders of the Spiders are assumed reinvested in the Spider on the payment date.

The first step is to compare these returns to the returns on the S&P Index with dividends reinvested daily. This left us with a problem: to estimate return on the S&P Index we had to estimate both the daily dividends and the price level of the S&P Index. Dividends were estimated by taking the daily dividends for the S&P Index computed by CRSP. To compute prices we considered two alternatives. One was simply to use the value (price) of the S&P Index computed by Standard & Poors. This is the official measure of the S&P Index and is the value that any investor will see reported in a public source. The second possible value is that reported by CRSP. The two values can be different because of differences in pricing or weighting of the component stocks. Prices can differ because of different treatment of the stocks where prices are not available (non-trading) or where multiple prices are available. Weighting can differ where when- issued-stocks exist, or where mergers

[3] 1993 is a partial year. Throughout, when we refer to 1993 return it is from February 1, 1993 to the end of the year.

or acquisitions are taking place, or because of different recognition of capital changes (such as new issues or stock dividends). While the Index value computed by S&P seems appropriate because this is the price most investors will look at when considering investment or arbitrage, the index value reported by CRSP might or might not be closer to the price at which investors can complete transactions in attempting to duplicate the S&P Index.

We will perform our analysis in terms of both index values for the time being. Later we will examine differences in more detail. We shall refer to returns based on the commonly reported S&P Index as standard S&P returns while those based on the CRSP data as CRSP S&P returns.

When we examine the standard definition of S&P return with dividends (Section A of Table 1), we see that on average the NAV return underperforms the S&P return by 28 basis points per year (column 6). The NAV is outperformed in every year and the yearly range of outperformance is 17 to 36 basis points. Comparison with the CRSP S&P Index (Section B) shows a larger discrepancy. The average underperformance of the NAV return is 40 basis points a year, and the range is from 5 to 71 basis points. The return earned on the assets by holders of Spiders are clearly smaller than the returns on the indexes. What can account for these differences?

(INSERT TABLE 1)

1. Cost Disadvantages of Spiders

It is obvious that Spiders have certain cost disadvantages relative to the indexes. First there is an amount for management expenses, including management fee which is charged every day. The

expense ratio on Spiders is 18.45 basis points per year.[4] Second, the dividends received from the underlying stock are not reinvested, but rather are held in a non-interest-bearing account. Next, Spiders also have their return reduced by the transaction costs they incur in replicating the index. While the Spiders do not have transaction costs due to cash inflows or outflows associated with the purchase or sale of Spiders, they do have transaction costs associated with changing their portfolio when the index changes and transaction costs associated with investors directly reinvesting their dividends.[5]

In addition to the cost disadvantages just mentioned, Spiders might underperform the index because of poor replication strategies. It is possible that at every point of time the stocks held by the Spider do not exactly match (in proportion) the stocks in the S&P Index. While at most times composition is very close, if not exact, around the time of a change in the Index purchase and sales might not exactly match the pattern assumed in constructing the Index. The transaction costs of purchase and sale, replication strategy and any inaccuracies in the reported index are considered tracking error, and we will begin our examination of the reasons for underperformance by examining it.

2. Tracking Error

The difference in performance due to tracking error is easy to estimate. By taking the NAV return, subtracting dividends paid on the underlying stocks and adding back management expenses, we

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[4] The expense ratio is frequently reported as 18 basis points because for many purposes it is legally acceptable to round to the nearest whole basis point. The expense ratio has recently been lowered to 12 basis points.

[5] Spiders offer investors a direct reinvestment plan. This plan allows the holders to have the firm that underwrites Spiders hold and reinvest dividends. However, all of these transaction costs should be low, as turnover in the portfolio amounts to only about 4% per year.

have the return-based entirely on price changes on the Spiders underlying portfolio. This can be directly compared with the price return on the S&P index and is free of management expenses and lost revenue due to holding the dividends in a non-interest-bearing account.

When we examine the return on the NAV of a Spider based solely on price changes of its underlying portfolio and compare it with the price return on the standard S&P Index (columns 4 and 5), we find almost no difference (column 7, Section A, Table 1). On average, the NAV price return and the return on the standard S&P index are the same. The range is from -6 basis points to +8 basis points per year, with four years positive and two years negative. It appears that against the S&P Price Index the shortfall is very close to zero. Failure to exactly hold the Index is as likely to lead to superior performance as to inferior performance, and over any period could be plus or minus. The net of transaction costs, any missed capital changes by S&P, and mismatching are quite small, and the total effect of all of these influences leads to virtually no difference.

When we compare the NAV price return with the CRSP S&P price index, we get very different results. The tracking error appears to lead to large underperformance. The average underperformance is 11 basis points per year. Which of these indexes better reflects the Spider performance? It would be surprising that with an average turnover of 4%, that transaction costs and mismatching could result in an 11 bp underperformance. Thus the standard S&P Index seems the more appropriate benchmark. However, as a further check we investigated the day-to-day tracking performance of the two indexes. We investigated which index better tracked the Spider by regressing the Spider NAV return against each index and the other index orthogonalized to the first. To do so, we

first ran a regression using daily data of the NAV return on Spiders, excluding dividends and with management expenses added back against the price return on the standard S&P Index, and the CRSP S&P Index with the effect of the standard S&P Index removed (Panel B of Table 2). We then ran a regression of Spider NAV return against the CRSP S&P price Index and the standard S&P price Index with the effect of the CRSP removed (Panel C of Table 2). Note that when the standard S&P Index is used along with the CRSP S&P Index orthogonalized to the S&P Index, the orthogonalized CRSP S&P Index is not statistically significant at the 10% level. However, when the CRSP S&P Index is used along with the S&P Index orthogonalized to the CRSP S&P Index, the orthogonalized S&P Index is significant at the 1% level. These results support the fact that Spiders track the standard S&P Index much closer than they track the CRSP Index. As a further test of this we selected the three largest S&P Index funds as of 1999. These were Vanguard, Fidelity Spartan and T. Rowe Price. We collected daily return data and ran the same two regressions using the daily return on each index fund as the dependent variable. The results for the three funds are also shown in Table 2. Note that like Spiders, the standard S&P Index appears to explain index fund returns better than the CRSP version of the S&P Index. Since the investor can purchase or sell the standard S&P Index by putting money into or taking money out of the S&P Index funds, the standard S&P Index seems to be a better benchmark for Spiders. The difference in return due to tracking error is close to zero when the more appropriate definition of the S&P Index is used.

TABLE 2 HERE

3. Other Sources of Underperformance

If tracking error doesn't account for the underperformance of Spiders relative to the standard S&P Index, what does?[6] Of the 28.4 basis points underperformance, clearly 18.45 basis points is due to the expense ratio charged against the return each year. The remaining difference, 9.95 basis points, is due to the return shortfall caused by putting dividends in a non-interest-bearing account. The reasonableness of this number can be seen by examining dividends and returns. The prospectus shows that the dividend yield was about 2.2% per year. Realizing that dividends are paid once a quarter and that dividends can occur any time over the quarter, the investor loses the market rate of return for an average of 1**2** months. However, the loss is even greater than this for dividends are not paid to the holders of Spiders for approximately one month after the ex-dividend date. This makes the appropriate loss two and one-half 12ths of the annual return. During the time period of this study the rate of return on the S&P Index was about 22.2%. Thus the loss due to not reinvesting the dividends on the underlying stock in the index at the time they were received was approximately 10.2 basis points. This is very close to our direct estimate of 9.95 basis points obtained by examining the underperformance of Spiders directly.

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[6] When we subtract out the difference due to tracking error from the total difference in NAV total return, we find the results are virtually identical whether we use the standard S&P Index or the CRSP S&P Index (see column 8 of Table 1).

As a further check on our statement that the underperformance is due to non-reinvestment of dividends we computed the underperformance each quarter. The amount of underperformance due to not reinvesting the dividends should depend on the performance of the S&P Index in each quarter. In the four quarters where the S&P had negative performance the Spider outperformed the index (since holding dividends in cash rather than reinvesting them is optimal when the market declines). In Table 3, we divide all quarters into 6 groups on the basis of return on the S&P Index (from low to high) and report the return from the Spider minus return on the S&P Index. The higher the return on the S&P Index in any quarter, the worse the relative performance of Spiders in that quarter. As a final check we regressed the difference in performance of the S&P and Spiders on the performance of the S&P Index and the R^2 was .99. The underperformance of Spiders is clearly related to the opportunity cost of not reinvesting dividends.

INSERT TABLE 3

B. Deviations of Price from NAV

In the prior section we assumed that all purchases and sales occurred at NAV. However, the Spider price can deviate from NAV and this represents both a cost and opportunity to the investor.

Table 4 shows the distribution using closing prices of both the dollar difference between price and NAV and the percentage difference expressed as the dollar difference divided by the NAV.[7] On

[7] This difference overstates the true difference because Spiders continue to trade 15 minutes after the New York Stock Exchange closes, and therefore NAV and price differ in time by 15 minutes.

average, price lies below NAV by 1.4¢ or .018%.[8] In most cases the difference is small. Only about 5% of the cases have absolute dollar differences greater than 25¢, and less than 4% have percentage differences above .35%. Less than 1% are above 50¢ or above .5%. About 70% of the time the difference is within 1/8 of a dollar.

While the fact that deviations of price from NAV are small at any moment in time is important, at least of equal significance is the persistence or lack of persistence of these deviations. To investigate this we first defined a variable D_t as the difference between price and NAV expressed in cents at the close of day t. We then regressed the value of D at t+1 against the value of D of t. The results are shown below.

$$D_{t+1} = \underset{(3.68)}{-1.34} + \underset{(2.39)}{.0620}D_t \qquad R^2 = .004$$

The results strongly support the fact that deviations of price and NAV disappear in a day. The R^2 and the slope of the regression coefficient are both close to zero. What makes the premium or discount disappear? Differences between NAV and price should signal an arbitrage opportunity and the price pressure associated with the arbitrage should cause the deviation to disappear.

In Section III we show that there is a statistically significant relationship between volume and the size of the discount or premium at the close of the previous day. This supports the hypothesis that arbitrage between the Spider and the stocks which back the Spider accounts for the disappearance of

[8] This means on average, price returns are slightly higher than NAV returns. Over the full period this resulted in a 2 bp difference.

the premium on a daily basis. The ability to create and destroy Spiders acts as a very effective mechanism in keeping price close to NAV at any moment in time and assuring that any differences between the two disappear quickly.

INSERT TABLE 4

C. Comparison to Alternative Vehicles

In addition to the possibility of holding the shares that comprise the S&P Index directly or holding Spiders, investors can approximate the return on an index by holding an index fund or by holding short-term debt instruments and an index future. These alternatives will be examined in turn.

1. Index Funds

An individual investor had a wide selection of S&P Index funds from which to choose. Morningstar lists over 100 index funds and over 50% of these are intended to track the S&P Index. In selecting among these S&P Index funds, there are two considerations: how well the index funds track the S&P, and the amount of the shortfall in return. There is very little difference in tracking error across most open-end S&P index funds with the typical R^2 on the S&P Index above .99. Differences in average performance are primarily related to differences in expenses. Because it has low expenses, we will use the Vanguard Index Fund as a comparison vehicle for Spiders. However, our analysis can be applied to any fund.

Relative performance of an index fund compared to the index itself and Spiders is affected by a number of factors. The first is costs. Mutual funds have a number of costs that reduce performance. An index fund pays management fees and other expenses that lower performance. In the case of Vanguard,

the total fees are approximately 18 basis points per year for individuals, and either 6 basis point or 2.5 basis points for institutions depending on the size of the investment. The fees paid by individuals are very close to the annual fees paid by investors in Spiders. In addition, an index fund pays transaction costs every time it buys and sells a stock. Security transactions may be generated when investors place more money with the fund or withdraw money, when the composition of the index is changed or when investors reinvest dividends. This is an area where Spiders have a potential advantage, since new investment or disinvestment is done in kind. In addition, an indirect cost may be borne by the index funds as they need to keep cash on hand to meet withdrawals. This can in part be mitigated by the use of futures, an instrument not available to Spiders. The second factor affecting relative performance is the way index funds adjust their holdings for changes in the composition of the index. They can differ in the way they react to tender offers and other capital changes. Also, they can differ in the timing of adjustments of their portfolio to deal with changes in the S&P 500 Index. The third factor affecting relative performance is security lending. Index funds can, and do, earn extra return by lending their securities for the purpose of short selling, while Spiders do not. The fourth factor affecting relative performance is the treatment of dividends. We know that Spiders underperform the index by about 10 basis points per year because of their requirement to hold dividends received from the underlying stocks in a non-interest-bearing account. In contrast, index funds can reinvest dividends as soon as they are received by the fund.

How do all these influences net out? Over the period 1994 to 1998 the Vanguard Index Fund available to individual investors underperformed the standard S&P Index by 10 basis points per year,

but outperformed Spiders by 18.1 basis points.[9] The Vanguard institutional fund performed 12 to 15.5 basis points better than the Vanguard fund available to individuals, depending on the size of the institution=s investment and thus the fees it payed. These differences are calculated pre-tax. If we include taxes, there is one further possible difference. Capital gains taxes are generated when capital gains are realized. Capital gains are realized when the index is changed and for index funds potentially if there are net withdrawals. Capital gains generated by net withdrawals should be small, since often they are covered by cash balances and the fund can sell off shares purchased at the highest price. The effect of index changes depends on the average purchase price of the security being sold. Age of fund is probably a reasonable proxy for this. Thus, initially Spiders have an advantage since the shares they hold were purchased more recently.

A major difference between index funds and Spiders is that Spiders can be sold intra-day. What does the prior say about the value of immediacy? For individual investors the index fund has a performance of pre-tax 18.1 basis points better than Spiders. Thus sophisticated investors in Spiders are valuing immediacy as if it is worth at least 18 basis points per year. We state this as Aat least@ because the investors in Spiders incur additional transaction cost associated with buying and selling the Spider, while transactions in the Vanguard index fund are at net asset value without commissions.

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[9] Over time the underperformance of Vanguard relative to the index has been going down. The reader should note that after our sample period the expense ratio on Spiders was lowered to twelve bases points.

2. Futures

The other alternative to a Spider is holding short-term money market instruments plus S&P futures contracts. If the futures contracts sold for their arbitrage value, then this strategy should generate returns equal to the true S&P return less the transaction costs of purchasing the future. In general, results are better since usually the implicit price of the S&P Index embedded in the future is low relative to the spot price of the Index. We estimate the implicit price of the S&P Index embedded in the futures price using closing prices and daily calculation of dividends. The implicit price requires an estimate of the dividend on the index. We assumed perfect forecasting. We took the daily dividends as reported by CRSP as our estimate of the forecasted dividends. We discounted dividends at the commercial paper rate. These resulted in the percentage difference between the S&P 500 Index and price of the S&P implied by the futures price (expressed as a percentage of the S&P Index) of .027%[10]. If an investor bought futures and the associated short-term instrument at the average difference between the futures price and arbitrage price, the result should be an outperformance of the S&P index by this 2.7 basis points. If higher yield short-term instruments were used, this performance could be further increased. If we compare the return from futures with Spiders, futures have an added return of 30.7 basis points per year. However, futures generally involve too large of an investment for individual investors to use these to construct index positions. Furthermore, many institutions cannot own futures or choose not to own futures. The use of futures also involves a certain amount of expertise in forecasting dividends, in

[10] We used the standard techniques for estimating the implied S&P price from the futures price. For example, see Elton and Gruber (1995), equation 21.3, page 626 . We used the commercial paper rate because this is the rate arbitragers use in valuing futures.

estimating correct positions, and in satisfying margin requirements. These reasons explain why the demand for Spiders can continue to grow despite the return advantages of futures.

Before leaving this section, it is worthwhile to examine the relationship of price changes in Spiders to price changes in the S&P Index implicit in futures. To examine this we regressed the change in the Spider price minus accumulations against the change in the implicit value of the S&P index embedded in the futures price. The adjusted R^2 was .98 with a slope coefficient of .99; thus Spiders and futures prices move closely together.

II Creation/Deletion

As discussed earlier, one of the unique features of Spiders is that they can be created and deleted. It is time to examine this attribute of Spiders more closely. Investors can create Spiders by turning in the shares that comprise the index plus an amount of cash equal to the accumulation unit (accumulated dividends and capital gains, less expenses). The amount of shares and the cash required are based on closing prices and are electronically posted. Orders to create are in minimums of 50,000 Spiders and need to be placed before close. Likewise, Spiders can be deleted by turning in Spiders (with a minimum amount of 50,000 shares) and receiving the stock shares that comprise the index plus an accumulation unit. The process of creation and deletion has meant that as discussed earlier, price and NAV are close.

Table 5 shows data on creation and deletion. Net creations or deletions occur on approximately 15% of the trading days. The first thing to note is the size of the net trades. On days

where there is a net creation, the average size of the net creation is 1,395,430 shares. With prices in the range of $50 to $120 per share, average creations are over $100 million. On days there are net deletions, the average is 1,816,119 shares or a dollar deletion of over $150 million. There are daily creations or deletions of over one $1 billion and many over $500 million. Clearly, creations and deletions are being done by large institutions. There is a fixed cost of $3,000 per creation or deletion. On a typical trade of 1,500,000 shares, this is a cost of .2 cents a share. Creations are more common than deletions. There were 158 days with net creations and only 67 with net deletions out of 1,497 trading days in our sample. This has meant that the number of Spiders has grown over time from 150,000 at inception to 131,670,000 on December 31, 1999.[11]

Who is doing the creations and deletions, and why? Discussion with market participants indicates there are two groups: managed accounts (particularly index funds), and market makers. Pension funds or institutional funds on occasion have large transfers. If an institutional fund gains a large customer, it would like to be fully invested very quickly. It might well find it desirable to hold the index and then adjust to a more active posture over time. It can construct an index fund by using futures and money market instruments, it can buy Spiders, or buy company shares directly. Depending on the relative prices, the best strategy may be to buy Spiders, turn them in for shares, and then over time adjust the portfolio. Likewise, an institutional index fund which has lost a large customer might find it cheaper to liquidate by turning in shares and selling the Spiders rather then selling the shares directly. Although the use of futures is generally considered the cheapest way to adjust portfolios, many

[11] See Prospectus 1999.

institutions or funds are prohibited from using futures and there are times where futures prices are very different from their arbitrage value and Spiders are the cheapest instrument.

Market makers and specialists seem to be the major creators and deletors. From trading activities they may find themselves heavily long or short Spiders. The price and NAV may be divergent and they may view that adjusting inventory may require trades so large in magnitude as to adversely move prices, so that creation and deletion is cheaper.[12]

INSERT TABLE 5

III Determinants of Volume

Before examining the determinants of volume, it is worthwhile examining volume directly. There is heavy volume in Spiders relative to the outstanding supply. Table 6 shows the average daily volume as a percentage of outstanding shares by year. In 1998 over 10% of the outstanding shares were traded each day. Over the full period on 6% of the days over 25% of the outstanding shares were traded. This heavy daily volume is an indication that short-term traders are active participants in the market.

Traditionally, trading volume of a security is thought to be generated by disagreements associated with new information about the security and by liquidity traders. From the earlier discussion it is clear that in the case of Spiders, volume is also heavily influenced by arbitrage and risk control strategies. Short-term traders are likely to use Spiders to hedge their positions to control risk or for

[12] It is an industry belief that at times there is such a dearth of shares available for borrowing and shorting that there is a lot of money in Spider lending and the market maker will create shares to profit from this.

short-term speculation.[13] In addition, Spider volume is likely to be affected by arbitrage strategies involving differences in Spider price from NAV. What does this suggest about what factors affect volume? First, market volatility is likely to be a reasonable proxy for times when Spider positions are needed for risk control, and also a proxy for occasions when arbitrage opportunities are likely to exist. We measure our first variable market volatility as the high price minus low price divided by the closing price of the S&P Index.

Arbitrage opportunities in the Spider market are also likely to exist when there is a big difference between price and NAV. To control for a time trend in volume and price, we express our second variable as the absolute difference between price and NAV divided by price. Since price differences from NAV are measured at the end of the day, difference should signal arbitrage opportunities the next day so that this variable is lagged.[14] In addition, since differences in either direction indicate arbitrage opportunities, we use the absolute value.

In summary, the regression we ran was

$$Volume_t = a + b_1\left[\frac{High_t - low_t}{close_t}\right] + b_3\left[\left|\frac{\Pr ice_{t-1} - NAV_{t-1}}{NAV_{t-1}}\right|\right] + e_t$$

[13] Part of the appeal of Spiders for short-term trading strategies is that they can be short-sold on a downtick while individual stocks cannot.

[14] An alternative explanation for differences is stale prices. Stale prices should occur when trading is low in the securities that comprise the S&P. We examined this by regressing differences in price and NAV on NYSE volume and found no relationship.

The results are reported in Table 7. Note, as speculated, the degree of price changes in the market has a large and very highly significant effect on the amount of trading in Spiders. Spiders do seem to be used for risk control and short-term trading strategies. In addition, when the absolute value of the difference between price and NAV is high, arbitragers induce a lot of trading on the following day. Note that the R^2 is .52, indicating that we have found influences which explain better than 50% of the changes in volume over time. As shown in Table 7, Spider volume increases substantially in times of high market volatility. Futures serve the same hedging role as Spiders do. The issue is in times of turbulence which is the instrument of choice. To examine this we regressed Spider volume divided by future volume against the difference between the S&P high and the S&P low over the S&P close. To examine time trends we performed this regression each year. The results are shown in Table 8. Table 8 shows the growing choice of Spiders as a risk control instrument. In 1993, if either instrument was chosen, it was futures. In the middle years, there was no relationship between market turbulence and relative volume in Spiders compared to futures. However, clearly in the last two years Spiders have become the instrument of choice for managing short term risk. Increased turbulence leads to substantial increases in Spider volume relative to futures volume.

Although we do not report the results, we also tested whether volume was affected by a tax postponement strategy and price discrepancies in the futures market. Spiders pay dividends about a month after they go ex-dividend. For example, at the end of the year the Spider goes ex-dividend in December but the dividend is not paid until January. This means that institutions that are on a cash basis (such as most broker dealers) and have a fiscal year that ends in a month when the Spider goes ex-

dividend can buy before the ex-dividend date and sell before the end of the fiscal year, and take the dividend in the next year. This allows the institution to take the loss associated with the change in price on the ex-dividend date in one year and a gain from receipt of the dividend in the next year, earning the present value of the tax postponement. To check on the possible impact of tax trades around ex-dividend days on volume we put in a dummy for the ex-dividend day and the following day. These were not significant. We also examined several variables to see if volume in Spiders increased when futures were priced very differently than their arbitrage value. None were significant.

INSERT TABLE 6, 7 & 8

Conclusion

In this paper we examine the characteristics and performance of Spiders. The S&P 500 Spider contract has become an important security in its own right, often being the most highly traded stock with an average daily volume in December 1999 of 5.52 million shares. But the instrument is even more important for its organizational form is widely discussed as a prototype for mutual funds of the future. Spiders would seem to offer the benefits of both open- and closed-end mutual funds. The desirable characteristics of Spiders is they trade at close to net asset value and like closed-end funds they offer the ability to transact at market price at any point during the trading day. They avoid the disadvantages of closed-end funds for which prices deviate widely from NAV and the disadvantage of open-end funds of pricing only once a day, and in addition, often having restrictions or minimum limits on sales and purchases.

The principal tool that restricts the deviation of price from NAV is the ability of investors to create or delete Spiders at the end of every trading day by turning in or receiving the physical bundle of securities that stand behind the Spider. When we examine differences in return based on the price of the Spider and return based on its NAV, we find that the difference is less than 1.8 basis points per year on average, and that almost all of the differences disappear within one day. In addition, we find that the NAV of the Spider, measured before management fees and dividends on the underlying securities, tracks the S&P Index almost exactly.

On the other hand, we show that the holder of a Spider earns a return 18 basis points below the holder of the low cost index funds and below that of futures. Spiders underperform the S&P Index

by 28.4 basis points. The two principal causes of the underperformance are the management fee of 18.45 basis points and the loss of return from dividend reinvestment of 9.95 basis points. The loss on dividend reinvestment comes about because the trust form used for Spiders requires all dividends and capital gains received by the Spider to be held in a non-interest-bearing account until paid out. It should be pointed out that this disadvantage has been eliminated in most exchange traded funds (e.g. webs) which were created subsequent to Spiders.

How can the different in return between Spiders and index funds exist? Why do people hold Spiders rather an index funds? We believe the difference is the value investors place on immediacy. Spiders are primarily used as a risk control mechanism and for short-term trading. Evidence of this is easily seen by noting that trading in Spiders increases significantly in times of turbulent stock markets (when prices move a lot).

Spiders also seem to offer a return lower than that which can be earned by holding short term debt and futures. Here immediacy cannot account for the appeal of Spiders. But Spiders have the advantage in that they can be bought and sold in much smaller units than futures, they do not require the active management that futures require (e.g., margin maintenance), and physical delivery can be taken (or supplied).

The success of Spiders would suggest that exchange-traded mutual funds are a viable investment vehicle. Two of their principal disadvantages (inability to earn investment income on dividends and capital gains, and the inability to earn income on security lending) have already been eliminated in most of the second generation of exchange-traded funds. The management fees that

Spiders charge have recently been decreased by a third. Despite their bugs, Spiders and other exchange-traded funds which offer immediacy are likely to prosper and reproduce.

BIBLIOGRAPHY

Elton, Edwin J. and Gruber, Martin J., 1995. Modern portfolio theory and investment analysis. John Wiley & Sons, New York, 5th edition.

Prospectus, Standard & Poors Depository Receipts, 1999.

Table 1
The Annual Performance of Spiders Relative to the S&P 500

This table shows the annual return from investing in Spiders relative to the return of the standard S&P 500 index and the CRSP value weighted S&P 500 index. The returns are compared with and without dividends included. NAV represents the return on the net asset value of the Spiders. The standard index represents the return on the S&P Composite Price Index. The CRSP S&P index is the value weighted return on the S&P index as constructed by CRSP. The total shortfall represents the difference between the return from the S&P and the return on the NAV of the Spider with dividends taken into account. This shortfall can be separated into two factors: 1) the difference between the NAV return without dividends and the S&P return without dividends and 2) the effect of management expenses and the lack of dividend reinvestment.

Standard Index

	With Dividends		**Without Dividends and Management Fee**		**Shortfall in Performance**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6) (2) – (3)**	**(7) (4) –(5)**	**(8) (6) – (7)**
Year	**NAV**	**S&P**	**NAV**	**S&P**	**Total**	**Tracking[1]**	**Expenses and Dividends**
1993*	8.92	9.19	6.25	6.30	-0.27	-0.06	-0.21
1994	1.15	1.32	-1.46	-1.53	-0.17	0.08	-0.25
1995	37.20	37.56	34.12	34.11	-0.36	0.01	-0.37
1996	22.72	22.97	20.26	20.26	-0.25	0.00	-0.25
1997	33.06	33.4	31.03	31.01	-0.34	0.03	-0.37
1998	28.28	28.57	26.64	26.67	-0.29	-0.03	-0.26
Average	21.89	22.17	19.47	19.47	-0.28	0.00	-0.28

CRSP S&P Index

	With Dividends		**Without Dividends and Management Fee**		**Shortfall in Performance**		
Year	**NAV**	**S&P**	**NAV**	**S&P**	**Total**	**Tracking[1]**	**Expenses and Dividends**
1993*	8.92	8.97	6.25	6.08	-0.05	0.16	-0.21
1994	1.15	1.37	-1.46	-1.49	-0.22	0.03	-0.25
1995	37.20	37.62	34.12	34.16	-0.42	-0.05	-0.37
1996	22.72	23.28	20.26	20.57	-0.56	-0.31	-0.25
1997	33.06	33.49	31.03	31.10	-0.43	-0.06	-0.37
1998	28.28	28.99	26.64	27.08	-0.71	-0.44	-0.27
Average	21.89	22.29	19.47	19.59	-0.40	-0.11	-0.29

* partial year

[1] doesn't equal difference in columns since calculations were carried to more decimals than reported in the table

Table 2
Regression of Spider and Index Fund Returns against the S&P 500

This table shows the coefficient of the variable listed at the top of the column when the return of the independent variable is regressed against either the S&P index or the CRSP index and the second of these indexes is orthogonalized to the first. Only one R^2 value is reported since the order of orthogonalization does not impact the overall goodness of fit.

Panel A

Index Fund Returns	Intercepts		Standard S&P		R^2
	Coef.	T Value	Coef.	T Value	
Spider	-0.000	-2.341	0.998	2680.82	0.998
Vanguard	0.000	0.1126	1.000	1035.68	0.999
Fidelity	-0.000	-0.592	1.002	558.11	0.995
T Rowe Price	-0.000	-0.401	1.001	326.83	0.986

Panel B

Index Fund Returns	Intercepts		Standard S&P		Orthogonalized CRSP S&P		R^2
	Coef.	T Value	Coef.	T Value	Coef.	T Value	
Spider	-0.000	-2.34	0.998	2680.64	0.008	0.893	1.000
Vanguard	0.000	0.113	1.000	1038.98	0.079	3.244	0.999
Fidelity	-0.000	-0.5932	1.002	559.38	0.126	2.790	0.995
T Rowe Price	-0.000	-0.4009	1.000	326.87	0.090	1.163	0.986

Panel C

Index Fund Returns	Intercepts		CRSP S&P		Orthogonalized Standard S&P	
	Coef.	T Value	Coef.	T Value	Coef.	T Value
Spider	-0.000	-4.375	1.002	2678.53	0.990	106.02
Vanguard	-0.000	-0.687	1.004	1038.78	0.922	38.20
Fidelity	-0.000	-1.028	1.006	559.04	0.876	19.52
T Rowe Price	-0.000	-0.653	1.005	326.65	0.911	11.87

Table 3

Excess Return on Spider over S&P as a Function of Reinvestment Return on Dividend

The table below presents the difference between the Spider return and the return on the S&P index for six groups formed by ranking the 24 quarterly S&P returns form lowest to highest.

	Group	Spider Returns minus S&P index return (Quarterly Reinvestment in %)
Lowest	1	0.020
	2	-0.011
	3	-0.028
	4	-0.041
	5	-0.062
Highest	6	-0.109

Table 4
Frequency Distribution of Spider Net Asset Value Versus Price

This table reports the frequency distribution of 1) the difference between the net asset value of the Spider and the Spider price, and 2) the difference between the net asset value of the Spider and the Spider price as a proportion of the net asset value

	NAV – Spider Price			**NAV – Spider Price / NAV**	
Difference in Dollars	**Frequency**	**Percentage**	**Difference in Percentage**	**Frequency**	**Percentage**
-2.05 to –1.05	1	.001	-2.05 to –1.05	0	0
-1.05 to –0.55	1	.001	-1.05 to –0.55	3	.002
-0.55 to –0.45	4	.003	-0.55 to –0.45	6	.004
-0.45 to –0.35	8	.005	-0.45 to –0.35	12	.008
-0.35 to –0.25	23	.015	-0.35 to –0.25	47	.031
-0.25 to –0.15	73	.049	-0.25 to –0.15	151	.101
-0.15 to –0.05	255	.170	-0.15 to –0.05	260	.174
-0.05 to 0.05	676	.452	-0.05 to 0.05	439	.293
0.05 to 0.15	304	.203	0.05 to 0.15	312	.208
0.15 to 0.25	79	.053	0.15 to 0.25	154	.103
0.25 to 0.35	33	.022	0.25 to 0.35	56	.037
0.35 to 0.45	19	.013	0.35 to 0.45	25	.017
0.45 to 0.55	11	.007	0.45 to 0.55	15	.010
0.55 to 1.05	10	.007	0.55 to 1.05	17	.011
	Average = .014			Average = .018%	

Table 5
The Creation and Deletion of Spider Units

The table reports the frequency distribution of the number of days on which net creations and deletions of different sizes occurred over the sample period. A negative sign indicates deletion. A positive sign indicates creation. Zero indicates neither creation nor deletion.

Creations and Deletions (in thousands)	Frequency	Percentage Occurrence
-4500 or larger deletion	4	0.27
-4499 to -3000	7	0.47
-2999 to -2000	18	1.20
-1999 to -1500	8	0.53
-1499 to -1000	12	0.80
-999 to -500	13	0.87
-499 to -50	5	0.33
0	1271*	85.96
50 to 499	11	0.73
500 to 999	65	4.34
1000 to 1499	27	1.80
1500 to 1999	18	1.20
2000 to 2999	25	1.67
3000 to 3999	3	0.20
4000 to 4999	6	0.40
5000 or more	3	0.20

Net Average Deletion = -1836.119
Net Average Creation = 1395.43

* Creations and deletions can not occur in the range –49.9 to +49.9.

Table 6
Daily Volume As Percentage of Outstanding Shares

This table shows the average annual daily volume as a percentage of outstanding shares of the Spider.

Year	Average Volume
1993	4.53%
1994	3.90%
1995	2.67%
1996	4.49%
1997	8.53%
1998	10.65%

Table 7
Explanations of Daily Spider Volume

This table reports the results of the regression used to explain the daily trading volume of the Spiders. The dependent variable is daily Spider volume. The independent variables are 1) the intercept term, 2) (SP500 intraday high – SP500 intraday low) / SP500 close, and 3) the absolute value of (Spider price – Spider NAV) / Spider price at time t-1.

	Intercept	$\frac{\text{SP500 high – SP500 low}}{\text{SP500 close}}$	**absolute value of** $\frac{\text{(SPDR price – SPDR nav)}}{\text{SPDR price at time t-1}}$	R^2
Coefficient	-0.016	3.228	2.376	0.52
Standard Deviation	0.001	0.085	0.506	
t-statistic	-14.152	37.790	4.693	

Table 8

Regression of Relative Volume of Spider against Market Volatility

This table reports the results of the regression used to explain the relative volume of Spider to volume of S&P500 index futures in times of pressure in the market. The regression is done annually. The independent variable is the ration of Spider volume over volume of S&P500 index futures (scaled by 1000). The independent variables are 1) the intercept term, 2)(S&P500 index intraday high-S&P500 index intraday low)/ S&P500 index close.

	Intercept		$\frac{\text{SP500 high – SP500 low}}{\text{SP500 close}}$		R^2
Year	**Coef.**	**T Value**	**Coef.**	**T Value**	
1993	0.00746	0.99	-0.34	-2.74	0.03
1994	0.00478	4.59	0.13	1.15	0.00
1995	0.00467	8.95	-0.03	-0.43	0.00
1996	0.00846	8.74	0.34	3.98	0.06
1997	0.01699	5.74	1.62	8.83	0.23
1998	0.0416	14.49	1.25	8.06	0.20