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How Are Derivatives Used? Evidence from the Mutual Fund Industry

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How Are Derivatives Used?
Evidence from the Mutual Fund Industry [1]

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Abstract : Approximately 20% of the 675 equity mutual funds analyzed in this paper invest in derivatives. We compare the return distributions of equity mutual funds that invest in derivatives to those that do not. We also analyze the use of derivatives to affect intertemporal changes in fund risk. Equity mutual funds that invest in derivatives have similar risk and similar net return performance in those that do not. Change in fund risk is negatively related to past performance, but derivatives allow funds to dampen these changes. We interpret these results as consistent with the hypothesis that managers are slow to respond to unexpected cash flows, and inconsistent with gaming of incentive compensation systems.

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1. Introduction

Derivative securities generate profits that are functions of changes in the price of underlying assets. Why do investment managers use derivatives? Theoretical work has advocated derivatives as a useful tool that allows investment managers to utilize information better, manage risk, and reduce transaction costs [Scholes (1981) and Stoll and Whaley (1985)]. In contrast, recent popular press commonly portrays derivatives as speculative, high-risk investments [see, for example, McGough (1995a, 1995b)]. Public concern has been strong enough to prompt the Securities and Exchange Commission to reevaluate risk disclosure requirements for mutual funds [Taylor and Calian (1995)] and to provoke possible regulatory initiatives [Anderson (1994)].

Although derivative use has generated substantial attention from many communities, no empirical evidence exists that documents how derivative securities are actually used by investment managers. This paper analyzes the use of derivatives by equity mutual funds, by comparing the return characteristics of funds that use derivatives to those that do not. We study portfolio returns, instead of individual trading in derivatives, because the ability to trade derivatives is likely to affect managers' decisions to trade non-derivatives. Our focus is on three alternative ways derivatives may affect the distribution of a mutual fund's returns. First, funds that invest in derivatives may have higher or lower risk than funds that do not invest in derivatives. Second, managers investing in derivatives may improve net portfolio performance, either due to lower transaction costs or because managers better utilize information.[1] Finally, managers may use derivatives to affect intertemporal changes in the fund's risk exposure, for example, to respond to cash flows from investor purchases and redemptions, or to allow fund managers to game incentive systems.

[1] In the absence of transaction costs, derivative securities are typically redundant, since strategies that trade the underlying securities can duplicate the derivative's payoff. Holding transaction costs constant, derivatives may allow a wider range of possible risk profiles. Holding risk constant, derivatives may allow trading at lower cost. Therefore, we analyze both risk distribution and portfolio performance after transaction costs.

The primary contributions of this research are as follows. First, we provide direct empirical evidence about the use of derivatives by one specific type of investor, equity mutual funds. Our findings show that most equity mutual funds do not use derivatives. From our sample of 675 general, domestic equity mutual funds, only 21% invest in derivative securities. Derivative use is not concentrated in a particular investment category.

Overall, we find no systematic differences between funds that use derivatives and those that do not. In contrast to the perception that derivatives increase risk exposure, we find that equity mutual funds that invest in derivatives have similar risk as funds that do not use derivatives. Specifically, funds that use derivatives have return distributions that have similar standard deviations, similar exposure to market risk, and similar skewness and kurtosis as funds that do not use derivatives. Derivative use is unrelated to net return performance. We cannot reject the hypothesis that the risk-adjusted returns that accrue to funds that use derivatives are the same as those that do not invest in derivatives.

Although funds that use and do not use derivatives may, on average, have similar return distributions, it is possible that derivative users are more heterogeneous. Specifically, it is possible that some funds that use derivatives have higher standard deviations due to speculative activity, and others have lower standard deviations as a result of hedging. Recent publicity may result from a small number of extremely risky funds. We examine the dispersion of risk measures, and find that this dispersion is similar for funds that use and do not use derivatives for most of the risk variables analyzed.

Mutual fund risk exposure is likely to vary with fund performance. Consistent with prior research, we posit that fund risk should decrease following good performance and increase after poor performance. Brown, Harlow and Starks (1995) and Chevalier and Ellison (1995) show that past performance and changes in risk are negatively related, which they attribute to managerial incentive gaming. We find a similar negative relation, and hypothesize that this performance-risk relation may be attributable either to managers who game incentive systems, or to managers who respond slowly to new cash flows. Although both hypotheses predict a negative relation between past performance and change in risk, the role of derivatives differs between the two theories. If managers use derivatives to manage unexpected cash flows, funds using derivatives will be able to maintain desired risk exposure more easily. In this case, the relation between past performance and changes in risk should be weaker for funds using derivatives. On the other hand, if managers want to game performance systems, derivatives provide a low cost way to change risk, and thus we expect that funds that use derivatives will have a stronger relation between performance and risk. We find that changes in risk in response to prior performance are less severe for derivative users, which is consistent with delayed managerial response to cash flows, but not with managerial incentive gaming. We also find that derivative use is related to changes in systematic risk, but not to changes in idiosyncratic risk, results that suggest the use of market-based derivatives.

Although there is no evidence regarding use of derivatives by investment managers, two recent papers examine use of derivatives in the commercial banking industry. Sinkey and Carter (1995) identify firm characteristics associated with derivative use by commercial banks, and Gorton and Rosen (1995) analyze the risk of interest rate swap positions for the U.S. commercial banking system as a whole. Geczy, Minton and Schrand (1995) analyze characteristics of corporations that are associated with the decision to use derivatives. These papers do not focus primarily on the actual impact of derivatives, and none of these papers specifically analyzes use of derivatives by professional investment managers.

The remainder of this paper is organized as follows. Section 2 summarizes current perceptions and theoretical uses of derivatives as an investment for mutual funds. Section 3 describes the sample. Results concerning risk, performance, and risk management are contained in Sections 4, 5, and 6, respectively. Section 7 concludes.

2. Perception and Theory of Derivative Use

Derivative securities have attracted much attention from the press recently. Highly publicized bankruptcies by Orange County, CA, in December 1994, and the British investment house of Barings PLC in February 1995, purportedly relating to losses from speculative positions in various derivative securities led to a flurry of discussion questioning investment in derivatives by mutual funds, pension funds, and other investment agencies. There have been numerous investor lawsuits over losses from derivatives. Large financial losses by money market funds resulted in much public concern over investment in derivatives by all mutual funds. There is growing discussion in Congress and at the Securities and Exchange Commission about whether to regulate investment in derivatives.

Much of the negative publicity about derivatives in the popular press is in at least partial contrast to more theoretical arguments in favor of derivatives. Merton (1995) summarizes the academic position regarding derivative securities, questioning recent concerns over risks associated with derivatives, because derivatives are just as likely to reduce risks for financial institutions as increase them. The advantages of derivatives are well documented. Stoll and Whaley (1985) and Merton (1995) describe the benefits of options, specifically better risk allocation, reduced information asymmetry and lower transaction costs. Silber (1985) notes that standardization and centralization of futures trading improve liquidity so that risk transfer is less expensive and price discovery more reliable than in cash markets. According to Scholes (1981), improved risk sharing lowers costs to firms by reducing the probability of bankruptcy; furthermore, derivatives are a particularly efficient means of taking short positions in assets.[2] Malkiel (1990) and Silber (1985) discuss the use of derivatives by portfolio managers to manage changing asset positions temporarily in response to the inflow or outflow of funds.

As an additional consideration, the Investment Company Act of 1940 stipulates that mutual funds must have asset-to-debt coverage of at least 300%. This requirement may be a binding constraint for a fund manager who wants to increase risk. Derivatives provide managers a way to effectively increase leverage without violating the Act.

3. Description of Sample

[2] The discussion about bankruptcy is relevant for corporations. We do not expect this argument to be as important for mutual funds, although it may be a consideration if funds have financial distress costs.

To construct the sample, we consider all general, domestic equity mutual funds as classified by *Morningstar Mutual Funds OnDisc* as of December 31, 1993. Given that this research involves extensive manual data collection, it is not feasible to include the entire population of funds covered by Morningstar. We exclude funds that are primarily bond funds; because of the wide variety and complexity of fixed income derivative securities, it is difficult to define what constitutes a derivative security for purposes of this research. Equity funds invest primarily in relatively simpler derivative securities, particularly options and futures contracts [Schultz (1994)]. We exclude specialty equity funds and global funds for tractability. The initial sample includes 798 funds classified by Morningstar as Aggressive Growth, Equity-Income, Growth and Income, Growth or Small Company Funds.[3]

Data for returns on the funds included in the sample come from *Morningstar Mutual Funds OnDisc,* January 1995, providing monthly returns data through December 1994. We include returns for the period January 1992 through December 1994.[4] Information on whether the fund invested in derivatives is obtained primarily by telephone. Appendix A describes the collection of data about derivative use in detail. The final sample includes 675 funds that meet the following criteria: 1.) included on *Morningstar Mutual Funds OnDisc* as of December 31, 1993 and December 31, 1994, in one of the five equity fund classifications listed above, and 2.) data concerning derivative use available from telephone interviews, or if interviews were inconclusive, from fund prospectus or annual report.

We expect the results of the telephone inquiries to be very reliable because there are potential legal implications for a respondent who denies using derivatives when the mutual fund actually does invest in derivatives. Given the current public perception regarding derivatives, we also consider it unlikely that a fund would claim to use

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[3] Much of the recent negative publicity about mutual funds and derivatives centers on losses due to interest rate movements for money-market funds. We do not analyze this type of fund.

[4] Using returns from a longer time period would improve precision of our variable estimates, but would also increase the length of time between the date of the returns and the date of our information about investment in derivatives. This time period was chosen as a compromise between these two considerations.

derivatives when it does not. However, in order to verify the accuracy of the telephone interviews, we pursued additional information for all Growth and Income funds that claimed not to use derivatives. For this subsample of funds, we checked the accuracy of the telephone interview with the information regarding asset holdings in the fund's reports where available. Of 140 such funds, we had prospectus information for 118. Ten of these funds (8.5%) had options or futures listed as assets in their portfolio holdings, even though fund representatives denied using derivatives on the phone. Another 84 funds stated in their prospectus that they were allowed to use derivatives; it is probable that most of these funds did not invest in derivatives even though the fund charter allowed it.

Table 1 summarizes the number of funds by fund type and use of derivatives. Of the 675 funds in the total sample, 140, or 20.7%, invest in derivatives. This number compares to 130 of 726 (17.9%) equity funds responding to a survey by Investment Company Institute that report using derivatives. The proportion of funds using derivatives for each fund type ranges from 16.7% of the Small Company funds to 27.3% of the Aggressive Growth funds, but these differences in the proportions are not significant (χ^2 test, p-value = 0.29).

Tables 2 and 3 contain additional descriptive information about the nature of investments for the 140 funds that report using derivatives. Table 2 summarizes the self-reported reasons that funds use derivatives. Approximately 46% of funds report using derivatives primarily for hedging, and only a small number (12 funds, or 8.6%) report using derivatives only for speculative purposes. Table 3 outlines the types of derivatives used by these funds. Almost 68% of funds use options and/or futures contracts.

4. Results: Risk

As noted by Merton, Scholes and Gladstein (1978, p. 178) and others, derivatives "provide a significant expansion of the patterns of portfolio returns available to investors." The current public perception described in Section 2 seems to be that derivatives are highly speculative assets that increase the risk of mutual funds. On the other hand, hedging with derivatives may actually reduce fund risk. Bookstaber and Clarke (1981) discuss another specific change, that options can skew a return distribution away from the normal distribution. This section analyzes the impact of investment in derivatives on the higher moments of return distributions, and the next section examines expected returns.

Our first test examines whether cross-sectional variation in fund risk is related to use of derivatives. To analyze this issue, we define three different variables to measure risk:

Standard deviation (STD): the standard deviation of the monthly return for a fund over the period January 1992-December 1994. Standard deviation is computed as, $\sqrt{\left(\frac{1}{(N-1)}\sum_{i=1}^{N}(r_i - \bar{r})^2\right)}$.

Idiosyncratic risk (IDIO): the standard deviation of the residual terms from a market model regression of fund return in excess of the risk-free rate on a constant and the CRSP value-weighted return in excess of the risk-free rate.[5] This term is computed as $\sqrt{\left(\frac{1}{(N-1)}\sum_{i=1}^{N}e_i^2\right)}$, where e_i equals the market model residual.

Beta (BETA): the estimated beta coefficient in a market model regression of fund return in excess of the risk-free rate on a constant and the CRSP value-weighted return in excess of the risk-free rate.

We choose these variables to measure total risk (STD), and its decomposition into idiosyncratic risk (IDIO) and systematic risk (BETA). The SEC is considering requiring disclosure of either beta or standard deviation as a measure of fund risk.

[5] For the regressions to estimate IDIO and BETA, we use the one-month Treasury bill rate from Datastream as the risk-free rate.

Given that derivatives may be used to truncate return distributions, for example to hedge against losses, or to generate income from writing covered call options and limiting upside gains, we also examine skewness. This statistic will measure symmetry, or lack thereof, of the return distribution:

Skewness (SKEW): the skewness of the monthly return of a fund, January 1992-December 1994. Skewness is computed as $\sum_{i=1}^{N} z_i^3 n / (n-1)(n-2)$, where $z_i = (r_i - \bar{r}) / STD$.

We include kurtosis (KURT) to measure peakedness. If fund return standard deviation varies from month to month, the distribution of returns will have a higher peak and fatter tails [for example, Press (1967), and Roll (1988)]. This feature will be reflected in a higher kurtosis statistic. Stock price returns have been shown to typically have positive kurtosis, which is described as leptokurtic [Fama (1976)]. Mutual fund managers may lower kurtosis by using derivatives to hedge against extreme returns, or to smooth month to month variation in risk.

Kurtosis (KURT): the kurtosis of the monthly return of a fund, January 1992-December 1994. Kurtosis is computed as $\left(\sum_{i=1}^{n} \frac{z_i^4 n(n+1)}{(n-1)(n-2)(n-3)}\right) - \left(\frac{3(n-1)^2}{(n-2)(n-3)}\right)$.

The sample correlations between each variable for the overall sample are reported in Table 4. Beta and skewness are not significantly correlated, but all other variables are highly correlated.

The five fund investment categories capture variation in fund risk measures. Table 5 reports results of tests of differences in mean estimates of the five return parameters described above across investment objective. We can strongly reject the hypothesis that funds in different investment objective categories have the same standard deviation, idiosyncratic risk, beta, skewness or kurtosis. This conclusion is robust to either an F-test or the nonparametric Kruskal-Wallis test.[6]

For each type of fund, Table 6 reports the cross-sectional mean values of each variable for the overall sample, and for subgroups of funds that do and do not invest in derivatives. Standard deviation and beta are monotonically increasing across the fund investment objective types, from least to most risky as follows: Equity-Income, Growth and Income, Growth, Small Company and Aggressive Growth. Unlike the risk measures, the higher moments (skewness and kurtosis) do not exhibit the same strong pattern. Figure 1 contains a graphical representation of the results in Table 6.

Comparing funds that invest in derivatives to those that do not, the most notable result is that there is no significant difference between the two groups for most of the investment objectives and variables considered. Beta is significantly lower for the Aggressive Growth funds that use derivatives than for those that do not, indicating that derivative use is associated with lower systematic risk for funds in this category. Kurtosis differs significantly between funds that use and do not use derivatives in the Small Company and Aggressive Growth categories, but there is no systematic tendency for higher kurtosis to be associated with derivative use.

Results in Table 6 support the hypothesis that there is no difference in return distributions between funds that do and do not use derivatives. However, similarities in mean values may obscure greater variation in distributions. Specifically, it is possible that some funds that use derivatives have higher standard deviations due to speculative activity, and others have lower standard deviations as a result of hedging. Table 6 reports only the mean values of the risk variables, which will not reflect variation in the extreme values. The concerns detailed in the popular press may more accurately reflect concerns about a few firms with a high degree of risk as a result of derivative investments.

To examine these issues, Table 7 reports data concerning the dispersion of the distributional parameters summarized in Table 6. This table reports the standard deviation of each variable (i.e. the standard deviation of the beta or idiosyncratic risk

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[6] The Kruskal-Wallis test is a nonparametric test that is based on each category’s deviation from the population’s median.

estimates for the funds in each category), and the 10th and 90th percentiles. Results in Table 7 show that there is no systematic tendency for funds that use derivatives to have greater (or less) variation in the risk measures than funds that do not use derivatives. The 90th percentile values of the risk variables (corresponding to the most risky funds) for funds that use derivatives are neither systematically higher nor lower than for non-users. An F-test comparing the standard deviation of the variables for funds using derivatives to those that do not show that there are a few fund types for which specific risk variables are more widely dispersed for funds using derivatives. However, most of these results are only marginally significant and are not consistent across fund type or risk measure.

We also investigate the dispersion of non-risk measures, in particular, skewness and kurtosis. Funds that use derivatives typically have more similar skewness and kurtosis than funds that do not use derivatives. The exception is Aggressive Growth funds, for which derivative users have more diverse skewness and kurtosis than non-users.

Overall, it appears that results concerning mean variable estimates do not obscure a great deal of variation in the extreme fund values. We conclude that derivative use is cross-sectionally unrelated to risk exposure and the higher moments of return distributions.

5. Results: Performance

Results in Section 4 suggest that use of derivatives is not cross-sectionally related to fund risk, either increased risk due to speculation or decreased risk from hedging. Given that derivatives do not seem to be associated with the higher moments of the distribution of fund returns, our second test examines whether derivatives affect mean returns by allowing trading at lower cost. As noted by *The Wall Street Journal* [McGee (1995)], "...[S]tock futures not only boast greater liquidity but also lower transaction costs than traditional trading methods. Portfolio managers stress that in today's fast-moving markets, it's critical to implement decisions quickly. For giant mutual and pension funds eager to keep assets fully invested, shifting billions around through stock-index futures is much easier than trying to identify individual stocks to buy and sell." The opportunity to invest in derivatives may allow a fund manager to implement trades at lower cost, and to manage inflows and outflows of money to and from the fund more efficiently [Silber (1985)]. If so, then funds that use derivatives should achieve higher returns (after trading costs) than those that do not.[7]

To analyze this question, we compute a multivariate analog to Jensen's alpha for each fund type. Alpha is computed as the estimate of α in the regression

$$r_t - r_{ft} = \alpha_t + \beta_t^{MKT} MKT_t + \beta_t^{CAP} CAP_t + \beta_t^{BOND} BOND_t + \varepsilon_t$$

where

$$\beta_t^{MKT} = \delta_0^{MKT} + \delta_1^{MKT} DIVYIELD_{t-1} + \delta_2^{MKT} PERF_{t-1} + \delta_3^{MKT} r_{ft}$$
$$\beta_t^{CAP} = \delta_0^{CAP} + \delta_1^{CAP} DIVYIELD_{t-1} + \delta_2^{CAP} PERF_{t-1} + \delta_3^{CAP} r_{ft}$$
$$\beta_t^{BOND} = \delta_0^{BOND} + \delta_1^{BOND} DIVYIELD_{t-1} + \delta_2^{BOND} PERF_{t-1} + \delta_3^{BOND} r_{ft}$$

and r_t = the mutual fund's return for month *t*,

r_{ft} = the risk-free rate at month *t*,

MKT_t = the return on the CRSP value-weighted index for month *t*,

CAP_t = the difference between the return on the tenth decile (small firm) CRSP capitalization portfolio and the first decile (large firm) capitalization portfolio,

$BOND_t$ = the return on the CRSP long-term corporate bond index (GBTRET) minus the one-month T-bill yield at month *t*,

$DIVYIELD_{t-1}$ the return difference between the CRSP value-weighted index with and without dividends in month *t-1*, and

$PERF_{t-1}$ = the difference between the fund's return and the CRSP value-weighted index return in month *t-1*.

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[7] Morningstar's Operations Manual states that "Momingstar's calculation of total return is computed each month by taking the change in monthly net asset value, reinvesting all income and capital-gains distributions during that month, and dividing by the starting NAV...Morningstar does not adjust the total returns in this section for sales charges (such as front-end and deferred charges and redemption fees)...The total returns do account for management, administrative, and 12b-1 fees and other costs automatically taken out of funds assets." (p. 116-117).

This specification controls for three types of risk exposure, market risk, small stock risk, and interest rate risk. Following Shanken (1990), the beta coefficient on all three types of risk are modeled as functions of previous performance, dividend yields, and interest rates. Mutual funds are a natural extension for models that capture risk exposure variation. For example, a similar specification was utilized by Pontiff (1995) to estimate variation in closed-end fund risk, and by Ferson and Schadt (1995) to estimate variation in open-end fund risk. Our decision to incorporate information from dividend yields and interest rates follows Ferson and Schadt. We incorporate information about performance, since we expect risk to change based on performance. Section 6 presents a full discussion and examination of this topic.

We use ordinary least squares to estimate this model with the following equation:

$$
\begin{aligned}
r_t - r_{ft} = a_t &+ b_t^1 MKT_t + b_t^2 CAP_t + b_t^3 BOND_t + \\
&+ b_t^4 MKT_t DIVYIELD_{t-1} + b_t^5 MKT_t PERF_{t-1} + b_t^6 MKT_t r_{ft} \\
&+ b_t^7 CAP_t DIVYIELD_{t-1} + b_t^8 CAP_t PERF_{t-1} + b_t^9 CAP_t r_{ft} \\
&+ b_t^{10} BOND_t DIVYIELD_{t-1} + b_t^{11} BOND_t PERF_{t-1} + b_t^{12} BOND_t r_{ft} + \varepsilon_t
\end{aligned}
$$

Table 8 contains these results.[8] For three of the five fund types the alphas for funds using derivatives are greater than those for funds that do not use derivatives. These differences are generally neither statistically nor economically significant. Results show that there is no significant difference in performance as measured by alpha between the funds that use derivatives and those that do not.

6. Results: Risk Management

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[8] Bookstaber and Clarke (1984, 1985) argue that investment in options skews the distribution of portfolio returns so that traditional mean-variance analyses are not appropriate. Results in Table 6 suggest that the skewness of funds that use derivatives does not differ significantly from those that do not. Therefore, funds in this sample that use derivatives do not appear to use options extensively enough to alter skewness, and we proceed with this mean-variance analysis.

Mutual fund risk may vary with fund performance during the year for at least two reasons, both of which predict that risk should decrease after good performance, and increase after poor performance. First, fund managers may respond slowly to cash inflows and outflows. Ippolito (1992) shows that cash flows are related to fund performance; specifically, money flows into funds that perform well and out of funds that perform poorly. A similar finding is documented using aggregate data by Warther (1995). Managers may be reluctant to invest or divest securities immediately in response to unexpected cash flows, perhaps because unexpected cash flows do not necessarily correspond with managers' information about optimal trading. This view is supported by Edelen (1995), who shows that mutual fund trades that are related to unexpected cash flows are less profitable than trades that are not influenced by cash flows. Managerial reluctance to invest new cash immediately causes the fund's cash position to increase after periods of good performance, which leads to a decrease in fund risk. Likewise, after poor performance investors will redeem shares, and fund risk will increase if managers borrow to meet redemptions.

Second, mutual fund managers may alter fund risk to game incentive compensation plans. Investment manager compensation contracts have asymmetric pay-for-performance relations that resemble call options. These contracts provide incentives for a manager to increase risk, especially after periods of poor performance. One type of contract awards bonuses for outperforming a benchmark. Other, simpler contracts pay the manager a flat percentage of fund assets. This structure still leads to a call-option-like payoff since the amount of new cash that flows into a well-performing fund is greater than the amount of cash that is redeemed from a poor performer [for example, Ippolito (1992), Sirri and Tufano (1993), and Chevalier and Ellison (1995)].

Managers incur some costs from increasing fund risk. If managers are risk averse, then increasing fund risk also increases compensation risk. Also, some incentive contracts specify a maximum payment to the manager, which implies a cost for increasing risk. The manager's choice of risk exposure will depend on the relative costs and benefits. The net benefits of increasing risk will be greater after poor performance.

Thus, managers should increase risk after poor performance, and decrease risk after good performance [for a formal treatment, see Grinblatt and Titman (1989)].

Both the slow manager response conjecture and the incentive gaming conjecture predict that risk will increase after periods of poor performance and decrease after periods of good performance. The use of derivatives is likely to vary, depending on which conjecture is more accurate. For example, if managers have an information disadvantage when forced to trade individual securities for fund flow management, futures contracts will allow them to respond to cash flows and maintain desired risk exposure without trading individual securities. This conjecture predicts that funds that use derivatives will have a weaker performance/risk relation than funds that do not use derivatives. If managers game performance systems by increasing risk after poor performance and decreasing risk after good performance, derivatives will provide a lower cost way to change risk, and thus we expect that funds that use derivatives will have a stronger relation between performance and risk.

Two studies document a relation between past performance and changes in risk: Brown, Harlow and Starks (1995) and Chevalier and Ellison (1995). Both studies conclude that past performance and changes in risk are negatively related, which they attribute to managerial incentive gaming. Chevalier and Ellison (1995) mention that managers may use derivatives to manage risk, but the authors provide few direct empirical results regarding derivatives. Neither Brown et al. nor Chevalier and Ellison consider the impact of delayed managerial response to cash flows.

To test the relation between prior fund performance and use of derivatives to alter fund risk characteristics, we estimate the following pooled cross-sectional regression

$$\Delta RISK = \alpha + \beta_1 D + \beta_2 PERF + \beta_3 D * PERF + \beta_4 LagRISK + \beta_5 D_{93} + \beta_6 D_{94} + \sum_{j=1}^{4} \beta_{6+j} TYPE_j + \sum_{j=1}^{4} \beta_{10+j} D_{93} TYPE_j + \sum_{j=1}^{4} \beta_{14+j} D_{94} TYPE_j + \varepsilon$$

where $\Delta RISK$ is the change in variable (STD, IDIO, BETA, SKEW or KURT) between the first six months and the second six months of the year, D is a dummy variable equal to 1 if the fund invests in derivatives, and PERF is the difference between the mean excess return on the fund and the mean excess return for funds with the same investment objective over a comparable period.[9] LagRISK is the value of the risk variable during the first six months, D_{93} is a dummy variable equal to 1 if the change in risk variable is for 1993, D_{94} is a dummy variable equal to 1 if the change in risk variable is for 1994, and $TYPE_i$ represents dummy variables for 4 of the 5 fund types.

From this regression we can infer the performance-risk relation for funds that do not use derivatives from parameter β_2. From β_3, we can infer the incremental effect that derivative holdings have on this relation. Lagged risk is included in our specification, since we expect that this variable will capture variation in risk changes that is caused by mismeasurement. Our risk measures are summary statistics, and are measured with error. In periods in which measured risk is high, we expect lower risk next period, due to mean reversion in the noise component of our estimate.

Ferson and Schadt (1995) provide evidence that funds in similar objective categories exhibit risk that is related to economy-wide factors. In order to control for changes in risk that are related to an entire group of funds, we include dummy variables for year and fund type.

Table 9 reports the regression estimates using weighted least squares. The weights are computed by running a first-pass ordinary least squares regression. The residual terms from this regression are used to compute a fund-specific standard deviation. The inverse of this term is used as the weight in the second-pass weighted least squares regression.

For all three risk measures- STD, IDIO, and BETA- the slope coefficients on past performance are negative and statistically significant. This result is similar to the findings of Brown et al. (1995) and Chevalier and Ellison (1995). Overall, this finding lends support to both the incentive gaming conjecture and the slow managerial response conjecture.

[9] Our decision to use a peer group benchmark is influenced by Farnsworth et al., (1995), who show that peer group benchmarks are very informative about future returns. Performance was also estimated using the CRSP value-weighted index as a benchmark. This specification had no material impact on any of the results.

The coefficient on the interaction between derivatives and performance is positive for all three risk parameters, and significant for standard deviation and beta. Thus, the relation between previous performance and change in risk is less severe for funds that use derivatives. These findings support the slow managerial response conjecture and contradict the incentive gaming conjecture. For the idiosyncratic risk regression, the slope coefficient on the interaction variable is insignificant. We cannot reject the hypothesis that derivatives use is unrelated to changes in non-market risk. This evidence supports the notion that mutual fund managers manage risk with market-based derivatives such as options and futures on the S&P 500 Index.

7. Conclusions

This paper provides evidence about the ways in which mutual fund managers use derivatives. 21% of the equity mutual funds analyzed in this paper use derivatives, mainly options and futures and primarily for hedging. We find no systematic differences in various risk measures and the higher moments of return distributions between funds that do and do not use derivatives. This finding contradicts the popular association of derivative use with increased risk exposure. We also find that funds that use derivatives do not perform significantly better or worse than those that do not.

Finally, previous research suggests that mutual fund risk should decrease after good performance and increase after poor performance. We find evidence that change in fund risk is negatively related to past performance, but that derivatives allow funds to dampen these changes. Derivative use is significantly related to changes in systematic risk, but not to changes in idiosyncratic risk, suggesting use of stock index derivatives. We interpret these results as consistent with the hypothesis that managers are slow to respond to inflows and outflows of funds, and inconsistent with the hypothesis that managers game incentive compensation systems.

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Appendix A:

Collection of Information About Use of Derivatives

> "Fund-tracking services such as Morningstar Inc. and Lipper Analytical Services Inc. generally find it difficult to compile lists of funds that are active users of derivatives. That's because of the inconsistency of disclosure and the fact that certain bonds--such as kitchen-sink bonds or structured notes--don't lend themselves to easy identification... Michael Lipper, president of Lipper, laments that funds can buy and sell a derivative security between financial-statement dates, leaving no trace...So what's a shareholder to do? [One] suggestion is to call the fund companies and ask if they use derivatives, and if so, how and why they use them. A fund prospectus often can state that the fund manager has the authority to invest in complex derivatives. But, in fact, the manager may act only rarely on that authority." [Schultz (1994)]

During the period December 1994 through June 1995, we attempted to contact 798 funds classified as Aggressive Growth, Equity-Income, Growth and Income, Growth or Small Company Funds by *Morningstar Mutual Funds OnDisc.* We called each fund at the telephone number listed in the Operations Information section of the Morningstar database. Each successful telephone interview gathered responses to the following questions:

1.) Has Fund _____ invested in derivatives in the last couple of years?
1 a.) For example, has Fund ______ invested in options or futures in the last couple of years?
2.) If so, what types of derivatives (options, futures or other derivatives)?
3.) What does the fund use derivatives for?

Question (1) was designed to identify funds that use derivatives, and Question (1a) to verify the response. Questions (2) and (3) were designed to collect additional information about the use of derivatives. Also, each fund was asked to mail a copy of the fund prospectus and annual report to us.

The telephone respondents demonstrated a wide variety of knowledge about the funds themselves and finance in general. Some fund representatives had no idea what derivatives were, despite repeated explanations on our part. At least one fund manager delivered a hostile lecture about how derivatives were not evil securities. Each time we had doubts about the knowledge of the respondent or the accuracy of the response, we asked to speak to the fund manager or someone more knowledgeable. Also, all questionable responses were verified by another phone call and/or review of the prospectus.

From the telephone calls, we obtained information about derivative use for 663 of the 798 funds. We were missing information from the funds for the following general reasons: the telephone number was disconnected or there was no response after repeated attempts, the fund had merged, liquidated or was otherwise closed to new investors, or the person responding to the call did not know the answer and was unable to provide the name of someone who did. For the 135 funds missing information after the telephone calls, we reviewed the prospectus (if available) to attempt to classify derivative use. We reviewed both the investment objective description and the balance sheet data. The investment objective indicated whether the fund was allowed to invest in derivatives, and the balance sheet indicated derivative positions as of a particular date. Over half of the funds reviewed are allowed to invest in derivatives, but many do not actually do so. Therefore, we considered only those funds with positive positions listed on their balance sheets as investing in derivatives. We obtained information for 42 additional funds from the prospectus, for a sample of 705 funds. We lost an additional 30 funds when we extended the sample period through December 1994, for a final sample of 675 funds.

Table 1:

Summary of Sample Funds' Investment in Derivatives

Sample of 675 equity mutual funds from Morningstar. Derivative use is self-reported during telephone interviews. Numbers in parentheses represent the percentage of funds for a given Investment Objective.

Investment Objective	Number of Funds	Number (%) of Funds Using Derivatives	Number (%) of Funds Not Using Derivatives
Equity-Income	52	14 (26.9%)	38 (73.1%)
Growth and Income	182	42 (23.1%)	140 (76.9%)
Growth	295	55 (18.6%)	240 (81.4%)
Small Company	102	17 (16.7%)	85 (83.3%)
Aggressive Growth	44	12 (27.3%)	32 (72.7%)
Overall Sample	675	140 (20.7%)	535 (79.3%)

Table 2:
Self-Reported Uses of Derivatives

Mutual funds' self-reported reasons for using derivatives for 140 equity funds that are categorized as using derivatives. Numbers in parentheses represent the percentage of funds for a given Investment Objective self-reporting a particular reason.

Investment Objective	Total	Reason: Hedging	Speculation	Hedging & Speculation	Unknown
Equity-Income	14	4 (28.6%)	0 (0.0%)	1 (7.1%)	9 (64.3%)
Growth and Income	42	21 (50.0%)	3 (7.1%)	2 (4.8%)	16 (38.1%)
Growth	55	24 (43.6%)	7 (12.7%)	4 (7.3%)	20 (36.4%)
Small Company	17	9 (52.9%)	1 (5.9%)	1 (5.9%)	6 (35.3%)
Aggressive Growth	12	6 (50.0%)	1 (8.3%)	1 (8.3%)	4 (33.3%)
Overall Sample	140	64 (45.7%)	12 (8.6%)	9 (6.4%)	55 (39.3%)

Table 3:
Types of Derivatives Used by Mutual Funds

Types of derivatives used by 140 equity mutual funds who report using derivatives. Classifications are self-reported by the mutual funds. Numbers in parentheses represent the percentage of funds for a given Investment Objective reporting a particular derivative type.

		Types of Derivatives					
Investment Objective	**Total**	**Options**	**Futures**	**Options & Futures**	**Interest Rate Securities**	**Int. Rate Sec. & Futures**	**Misc./ Unknown**
Equity-Income	14	1 (7 .1%)	1 (7.1%)	3 (21.4%)	3 (21.4%)	2 (14.3%)	4 (28.6%)
Growth and Income	42	13 (31.0%)	6 (14.3%)	11 (26.2%)	3 (7.1%)	1 (2.4%)	8 (19.0%)
Growth	55	17 (30.9%)	8 (14.5%)	17 (30.9%)	3 (5.5%)	0 (0.0%)	10 (18.2%)
Small Company	17	2 (11.8%)	3 (17.6%)	5 (29.4%)	1 (5.9%)	0 (0.0%)	6 (35.3%)
Aggressive Growth	12	4 (33.3%)	2 (16.7%)	2 (16.7%)	1 (8.3%)	0 (0.0%)	3 (25.0%)
Overall Sample	140	37 (26.4%)	20 (14.3%)	38 (27.1%)	11 (7.9%)	3 (2.1%)	31 (22.1%)

Table 4:
Correlation Between Variables Used to Measure Risk

STD denotes the standard deviation of the return. IDIO is the standard deviation of the residuals from a market model regression with the CRSP value-weighted index. BETA is the slope coefficient from this regression. SKEW represents the skewness. KURT is the kurtosis of the return. Values in parentheses represent p-values for a two-sided test of the null hyothesis that the correlation coefficient equals zero.

	IDIO	BETA	SKEW	KURT
STD	0.916 (0.00)	0.744 (0.00)	0.310 (0.00)	-0.068 (0.08)
IDIO		0.434 (0.00)	0.421 (0.00)	0.110 (0.00)
BETA			0.016 (0.67)	-0.354 (0.00)
SKEW				0.146 (0.00)

Table 5:
Tests of Differences in Mean Across Investment Objective

Tests of the hypothesis that the mean risk or higher moments are equal across the five investment objective types. Kruskal-Wallis is a nonparametric location test. p-values are in parentheses.

	Tests of Differences Across Investment Objective:	
Variable	**F-Test (p-value)**	**Kruskal-Wallis (p-value)**
Standard Deviation	89.1 (0.00)	250.4 (0.00)
Idiosyncratic Risk	144.4 (0.00)	329.0 (0.00)
Beta	15.6 (0.00)	81.2 (0.00)
Skewness	30.8 (0.00)	150.9 (0.00)
Kurtosis	4.3 (0.00)	44.6 (0.00)

Table 6:
Mean Risk and Higher Moments by Investment Objective and Use of Derivatives

Mean estimates of the risk variables standard deviation, idiosyncratic risk and beta, and of higher moments, skewness and kurtosis, by Investment Objective. Results are reported for all funds, and for funds that do and do not invest in derivatives. *Tests of Differences* represent tests of the null hypothesis that mean variable estimates are equal for users and non-users of derivatives. Wilcoxon is a nonparametric location test. Monthly returns are in percents.

	Overall		Users		Non-Users		Tests of Differences	
Investment Objective	**N**	**Mean**	**N**	**Mean**	**N**	**Mean**	**t-test (p-value)**	**Wilcoxon Test (p-value)**
Standard Deviation								
Equity-Income	52	2.18	14	2.24	38	2.16	1.07 (0.29)	0.92 (0.36)
Growth & Income	182	2.38	42	2.32	140	2.40	-1.06 (0.29)	-1.43 (0.15)
Growth	295	2.92	55	2.95	240	2.91	0.34 (0.74)	0.48 (0.63)
Small Company	102	3.71	17	3.97	85	3.66	1.07 (0.29)	1.04 (0.30)
Aggressive Growth	44	3.83	12	3.50	32	3.95	-1.28 (0.21)	-1.01 (0.31)
Idiosyncratic Risk								
Equity-Income	52	1.08	14	1.09	38	1.08	0.13 (0.89)	0.36 (0.72)
Growth & Income	182	1.05	42	1.00	140	1.06	-0.60 (0.55)	-1.29 (0.20)
Growth	295	1.73	55	1.73	240	1.73	-0.03 (0.98)	0.20 (0.84)
Small Company	102	2.90	17	3.08	85	2.87	0.84 (0.41)	0.49 (0.62)
Aggressive Growth	44	2.88	12	2.76	32	2.93	-0.50 (0.62)	-0.38 (0.70)
Beta								
Equity-Income	52	0.83	14	0.87	38	0.82	1.30 (0.20)	0.96 (0.34)
Growth & Income	182	0.93	42	0.90	140	0.94	-1.53 (0.13)	-0.81 (0.42)
Growth	295	1.03	55	1.05	240	1.02	0.72 (0.47)	0.99 (0.32)
Small Company	102	1.03	17	1.12	85	1.02	1.31 (0.19)	1.40 (0.16)
Aggressive Growth	44	1.09	12	0.91	32	1.16	-2.16 (0.04)	-1.70 (0.09)
Skewness								
Equity-Income	52	-0.38	14	-0.35	38	-0.39	0.56 (0.58)	1.06 (0.29)
Growth & Income	182	-0.30	42	-0.30	140	-0.30	-0.05 (0.96)	-0.00 (0.99)
Growth	295	-0.14	55	-0.16	240	-0.13	-0.67 (0.50)	-0.16 (0.87)
Small Company	102	0.00	17	-0.08	85	0.02	-1.24 (0.22)	-1.06 (0.29)
Aggressive Growth	44	-0.01	12	-0.00	32	-0.02	0.19 (0.85)	0.51 (0.61)
Kurtosis								
Equity-Income	52	-0.09	14	-0.14	38	-0.07	-0.38 (0.70)	-0.55 (0.58)
Growth & Income	182	-0.46	42	-0.53	140	-0.43	-0.70 (0.49)	-0.75 (0.46)
Growth	295	-0.51	55	-0.64	240	-0.48	-1.58 (0.11)	-1.01 (0.31)
Small Company	102	-0.38	17	-0.64	85	-0.33	-1.96 (0.05)	-1.92 (0.05)
Aggressive Growth	44	-0.43	12	0.03	32	-0.60	2.56 (0.01)	1.41 (0.16)

Table 7:
Dispersion of Distributional Parameters

Standard deviation and 10th and 90th percentiles of the estimates of standard deviation, idiosyncratic risk, beta, skewness and kurtosis reported in Table 6. Results are reported for funds that use derivatives and for funds that do not. *N* denotes the number of observations. *SD* represents the standard deviation of the variable. *10%* and *90%* are the 10th and 90th percentiles. *F-Test p-value* is the p-value for an F-test of equality of variances between the sample of funds using derivatives and the sample of funds not using derivatives. Monthly returns are in percents.

	Users:				Non-Users:				F-Test
Investment Objective	N	SD	10%	90%	N	SD	10%	90%	p-value
Standard Deviation									
Equity-Income	14	0.31	1.92	2.43	38	0.22	1.91	2.50	0.09
Growth & Income	42	0.45	1.91	2.77	140	0.40	1.96	2.87	0.35
Growth	55	0.70	2.15	3.93	240	0.70	2.20	3.96	0.96
Small Company	17	1.13	2.82	6.17	85	1.08	2.46	5.01	0.74
Aggressive Growth	12	1.33	1.91	5.29	32	0.89	2.99	4.78	0.08
Idiosyncratic Risk									
Equity-Income	14	0.25	0.85	1.38	38	0.32	0.66	1.54	0.30
Growth & Income	42	0.61	0.35	1.66	140	0.48	0.56	1.66	0.03
Growth	55	0.70	0.99	2.61	240	0.75	0.96	2.90	0.59
Small Company	17	1.13	1.57	5.12	85	0.95	1.86	4.00	0.30
Aggressive Growth	12	1.20	1.20	4.64	32	0.97	2.03	3.82	0.35
Beta									
Equity-Income	14	0.87	0.73	0.96	38	0.11	0.67	0.94	0.48
Growth & Income	42	0.18	0.66	1.04	140	0.15	0.78	1.09	0.14
Growth	55	0.23	0.77	1.31	240	0.21	0.79	1.24	0.31
Small Company	17	0.22	0.82	1.35	85	0.30	0.62	1.44	0.14
Aggressive Growth	12	0.47	0.08	1.35	32	0.27	0.75	1.39	0.01
Skewness									
Equity-Income	14	0.21	-0.78	-0.10	38	0.23	-0.67	-0.10	0.80
Growth & Income	42	0.28	-0.61	0.02	140	0.30	-0.58	-0.01	0.74
Growth	55	0.22	-0.42	0.08	240	0.29	-0.42	0.24	0.01
Small Company	17	0.15	-0.25	0.18	85	0.30	-0.28	0.46	0.00
Aggressive Growth	12	0.42	-0.22	0.34	32	0.18	-0.24	0.22	0.00
Kurtosis									
Equity-Income	14	0.42	-0.51	0.62	38	0.67	-0.65	0.64	0.08
Growth & Income	42	0.54	-0.95	0.02	140	0.81	-0.91	0.09	0.00
Growth	55	0.34	-1.00	-0.17	240	0.73	-1.00	0.12	0.00
Small Company	17	0.32	-1.07	-0.15	85	0.64	-0.93	0.46	0.00
Aggressive Growth	12	1.32	-0.94	2.22	32	0.33	-0.99	-0.09	0.00

Table 8:
Mean Manager Alpha by Investment Objective and Use of Derivatives

Alpha is computed as the estimate of α in the regression

$$r_t - r_{ft} = \alpha_t + \beta_t^{MKT} MKT_t + \beta_t^{CAP} CAP_t + \beta_t^{BOND} BOND_t + \varepsilon_t$$

where

$$\beta_t^{MKT} = \delta_0^{MKT} + \delta_1^{MKT} DIVYIELD_{t-1} + \delta_2^{MKT} PERF_{t-1} + \delta_3^{MKT} r_{ft}$$
$$\beta_t^{CAP} = \delta_0^{CAP} + \delta_1^{CAP} DIVYIELD_{t-1} + \delta_2^{CAP} PERF_{t-1} + \delta_3^{CAP} r_{ft}$$
$$\beta_t^{BOND} = \delta_0^{BOND} + \delta_1^{BOND} DIVYIELD_{t-1} + \delta_2^{BOND} PERF_{t-1} + \delta_3^{BOND} r_{ft}$$

and r_t = the mutual fund's return for month t, r_{ft} = the risk-free rate at month t, MKT_t = the return on the CRSP value-weighted index for month t, CAP_t = the difference between the return on the tenth decile (small firm) CRSP capitalization portfolio and the first decile (large firm) capitalization portfolio, $BOND_t$ = the return on the CRSP long-term corporate bond index (GBTRET) minus the one-month T-bill yield at month t, $DIVYIELD_{t-1}$ = the return difference between the CRSP value-weighted index with and without dividends in month t-1, and $PERF_{t-1}$ = the difference between the fund's return and the CRSP value-weighted index return in month t-1. "Users" and "Non-Users" refer to funds that use and do not use derivatives, respectively. *Tests of Differences* represent tests of the null hypothesis that mean variable estimates are equal for users and non-users of derivatives. Wilcoxon is a nonparametric location test. Monthly returns are in percents.

	Overall		Users		Non-Users		Tests of Differences	
Investment Objective	**N**	**Mean Alpha**	**N**	**Mean Alpha**	**N**	**Mean Alpha**	**t-test (p-value)**	**Wilcoxon (p-value)**
Equity-Income	52	0.079	14	0.168	38	0.046	1.53 (0.13)	0.86 (0.39)
Growth and Income	182	0.024	42	0.050	140	0.016	0.72 (0.47)	0.29 (0.77)
Growth	295	0.015	55	-0.024	240	0.023	-0.85 (0.39)	-0.73 (0.46)
Small Company	102	0.145	17	0.089	85	0.157	-0.60 (0.55)	0.33 (0.74)
Aggressive Growth	44	0.016	12	0.123	32	-0.024	0.73 (0.47)	0.49 (0.63)
Overall Sample	675	0.042	140	0.044	535	0.041	0.07 (0.94)	0.13 (0.90)

Table 9:
Regressions of Change in Alternative Measures of Risk and
Higher Return Moments on Various Performance Measures

Results of regression analyses testing relation between mutual fund performance during the first six months of the year, and the change in risk variable between the first six months and the second six months of the year. For each variable, the reported regression is the weighted least squares estimate of the regression

$$\Delta RISK = \alpha + \beta_1 D + \beta_2 PERF + \beta_3 D * PERF + \beta_4 LagRISK + \beta_5 D_{93} + \beta_6 D_{94}$$
$$+ \sum_{j=1}^{4} \beta_{6+j} TYPE_j + \sum_{j=1}^{4} \beta_{10+j} D_{93} TYPE_j + \sum_{j=1}^{4} \beta_{14+j} D_{94} TYPE_j + \varepsilon$$

where $\Delta RISK$ is the change in variable (STD, IDIO, BETA, SKEW or KURT) between the first six months and the second six months of the year, D is a dummy variable equal to 1 if the fund invests in derivatives, and PERF is the difference between the mean excess return on the fund and the mean excess return for funds with the same investment objective, LagRISK is the value of the risk variable during the first six months, D_{93} is a dummy variable equal to 1 if the change in risk variable is for 1993, D_{94} is a dummy variable equal to 1 if the change in risk variable is for 1994, and $TYPE_j$ represents dummy variables for 4 of the 5 fund types. Only the coefficients for the intercept and first 4 independent variables have been reported. Returns are in percent. p-values for tests of the null hypothesis that the coefficient equals zero are in parentheses.

Variable	Intercept	D	PERF	D*PERF	LagRISK	F-TEST
Risk Variables:						
ΔSTD	1.465	-0.149	-0.016	0.017	-0.484	120.6
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ΔIDIO	0.588	-0.148	-0.006	0.001	-0.603	909.0
	(0.00)	(0.00)	(0.00)	(0.62)	(0.00)	(0.00)
ΔBETA	0.791	-0.029	-0.010	0.004	-0.698	1,242.2
	(0.00)	(0.00)	(0.00)	(0.04)	(0.00)	(0.00)
Higher Moments:						
ΔSKEW	-0.233	-0.269	-0.003	0.006	-0.892	555.9
	(0.00)	(0.00)	(0.19)	(0.25)	(0.00)	(0.00)
ΔKURT	0.560	0.065	-0.020	-0.066	-0.834	50.3
	(0.00)	(0.60)	(0.05)	(0.01)	(0.00)	(0.00)

Figure 1

Bar graph comparison of various risk measures for mutual funds which use and do not use derivatives. This figure is constructed from the data in table 6. Mean estimates of the risk variables, standard deviation, idiosyncratic risk and beta, and of higher moments, skewness, and kurtosis, by investment objective.