Derivatives Do Affect Mutual Fund Returns: Evidence from the Financial Crisis of 1998

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Using a unique data set of detailed balance sheet information on mutual funds, we find that most mutual funds using derivatives do so to a very limited extent that has little discernable impact on returns. However, there exist two types of funds that make more extensive use of derivatives, global funds and specialized domestic equity funds. The risk and return characteristics of these two groups of funds are significantly different from funds employing derivatives sparingly or not at all. Fund managers time their use of derivatives in response to past returns.

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INTRODUCTION

Although the press and recent academic studies indicate derivative use is widespread among mutual funds, the duration and extent of individual fund holdings remains relatively unknown. The use of derivative securities by mutual funds raises challenging questions for financial economists. First, do derivatives constitute an extensive portion of mutual fund portfolios both in terms of the fraction of funds holding derivatives and the significance of individual fund holdings? Second, do derivatives produce a discernible effect on returns for funds that hold derivatives, and does that effect differ between average returns and returns realized only during times of financial crisis? Third, do fund managers time their use of derivatives in response to past returns or in anticipation of market events? Finally, is derivative use consistent with funds' cash management theory which predicts a positive relationship between past return and derivative use or instead consistent with agency theory, which ties derivative use to managerial incentives and end of year window dressing?

This study is one of the first to examine the *magnitude* of derivative use by mutual funds. To address the above-mentioned questions, we collect by hand a unique data set of detailed financial statement information for over 300 mutual funds for a 5-year period from Securities and Exchange Commission (S.E.C.) filings. We collect data from 2,154 reports for 471 separate funds. Although the sample does not cover the entire population, it is a substantial proportion of the funds with derivative positions and is shown to be a representative sample. The advantage of financial statement data is that both balance sheet and off-balance sheet items are presented with exact holdings and dollar amounts as of the filing date. Using this data, we address the four key issues, namely (1) do mutual funds use derivatives extensively, (2) do derivatives alter a funds' return distribution, (3) do managers time the use of derivatives in anticipation of future events, and (4) is derivative use consistent with agency or cash management use. To each of these four issues, previous studies have given some answers. Our detailed data allow us to shed a much sharper and brighter light on each of these issues.

The S.E.C. filings used in this study reveal that although 77% of 4,518 equity-oriented investment companies reporting between June 1996 and January 1998 are authorized to use derivatives, only 14% of them do so during the 18-month period. From our detailed analysis of 322 funds, there is a substantial variation in derivative use by fund type. For foreign exchange derivatives, funds using these instruments tend to have substantial positions. Thirty-eight of the 322 sample funds have an average face value of their forward foreign exchange contracts in excess of 10% of net asset value.[1] However, most funds using equity derivatives employ them to a very limited extent. For the 214 domestic funds, 137 average less than 1% of assets in equity derivatives. Finally, there is a relative handful of mutual funds that have large positions in equity derivatives and average 10% or more of their assets in equity derivatives with a few having the underlying value of their futures position being in excess of 50% of net asset value.

Apart from these stylized facts about the extent of derivative use which answer issue (1) we examine several hypotheses pertaining to (2), namely whether derivative use affects return distributions. Existing work uses surveys to identify derivative users and then a dummy variable approach to compare users and non-users, finding little impact of derivative use on returns. Taking advantage of our more detailed data to test the hypothesis, we find that the typical fund using derivatives show no perceptible effect on returns. However, funds that are in the top decile of the sample in terms of derivative use show a significantly different return distribution from other funds. In particular, international funds that are heavy derivative users, typically of forward foreign exchange (FX) contracts, show significantly higher returns than other funds without a significant increase in risk during the sample period. Domestic equity funds that are heavy users of options contracts show lower returns but a return distribution that is skewed toward the upside, consistent with a hedging role for options.

An alternative return-based motivation for using derivatives is to provide insurance against extreme events, rather than to enhance average returns (i.e. issue (3)). An examination of funds' balance sheets before and after the 1998 Russian crisis shows that the overall level of derivative use did not increase during the crisis nor did it decline significantly following the crisis. However, a comparison of the cross-sectional returns for the derivative user and non-user samples shows that funds, which were heavy equity derivative users and equity option users experienced significantly different results during the crisis than funds that did not employ derivatives in their investment strategy. In particular, for funds with heavy option positions, their relative overperformance during the crisis and underperformance in most other time periods supports the hypothesis that options provide a form of costly insurance to a portfolio. In summary, there is evidence that fund managers time their use of derivatives in response to past performance of the fund, but not in anticipation of future events.

Our final inquiry concerns issue (4), namely the possible other motives of mutual funds managers for using derivatives. Given that derivatives only

[1]For the 332 funds in our sample of derivative users, 118 are international and 214 are domestic. Including international funds in the sample provides a more comprehensive analysis of derivative use than would be possible for domestic funds alone.

appear to affect returns for funds that make extensive use of them, one suggested motivation for money managers to use derivatives would be to meet transient portfolio considerations driven by cash flows or transactions costs. Alternatively, managers may use derivatives to reduce (increase) risk following a period of good (poor) performance in order to maximize payoffs from their compensation contracts. Our unique data set allows us to analyze directly the changes in risk and changes in derivative use. Results of panel data analyses of changes in fund risk and a number of potential factors indicate that changes in fund risk are related to changes in equity derivative use but changes in risk are unrelated to changes in FX derivative use. A fixed effects logit model with derivative use as the dependent variable shows that there is a positive and significant relationship between lagged returns and changes in the use of derivatives, consistent with the cash flow hypothesis of Lynch-Koski and Pontiff (1999). However, when changes in derivative positions at the end of the calendar year are considered, the relationship between lagged returns and derivative use becomes negative as predicted by the managerial incentive hypothesis.

The balance of this study is organized as follows. Section 2 describes the data and reports some stylized facts. Section 3 outlines the hypotheses to be tested. Section 4 explores the nature and extent of mutual fund derivative holdings from their financial statements. Section 5 analyzes the relationship between mutual fund holdings and return performance. Section 6 examines fund managers timing of derivative use and the behavior of fund derivative holdings and returns around the August 1998 financial crisis. Section 7 contains concluding remarks.

DESCRIPTION OF THE BALANCE SHEET DATA AND STYLIZED FACTS

This section describes the data and reports stylized facts about the use of derivatives by mutual funds. A first subsection describes the data, while a second discusses summary statistics.

The Data

We provide a summary description of the data, with details appearing in Appendix A. The data on mutual fund use of derivatives come from the S.E.C.'s Electronic Data Gathering and Retrieval (EDGAR) database. The sources are two filings by investment companies, form N-SAR and form N-30-D. From these two filings we can identify the funds authorized to use derivatives, using derivatives during the current reporting period, and detailed financial statements including specific on- and off-balance sheet assets and liabilities. Form

TABLE I

Summary of Derivative Use by Registered Investment Companies

Investment Objective	*No. of Funds (% of Total Funds)*	*No. of Funds Authorized to Use Derivatives (% of Funds in objective class)*	*No. of Funds Using Derivatives (% of Funds in objective class)*	*No. of Funds with Open Options Positions (% of Funds in objective class)*
Aggressive capital	271 (6.0)	213 (78.6)	31 (11.4)	9 (3.3)
Appreciation	1615 (35.7)	1281 (79.3)	183 (11.3)	54 (3.3)
Capital appreciation				
Growth	1021 (22.6)	760 (74.4)	149 (14.6)	20 (2.0)
Growth and Income	767 (17.0)	567 (73.9)	114 (14.8)	23 (3.0)
Income	163 (3.6)	105 (64.4)	15 (9.2)	6 (3.7)
Multiple	84 (1.9)	77 (91.6)	12 (14.3)	3 (3.6)
Total return	597 (13.2)	470 (78.7)	136 (22.8)	19 (3.2)
Total funds	4518 (100.0)	3473 (76.9)	640 (14.2)	134 (3.0)

This table presents the extent of derivative use by equity-oriented Registered Investment Companies as reported in semi-annual S.E.C. N-SAR filings for the period from June 1996 through January 1998. Included is the total number of funds in the sample, the number of funds authorized to use derivatives, the number of funds that use derivatives in the reporting period, and the number of funds with open option and/or futures option positions on their balance sheet at the reporting date. Summary statistics are reported for each self-described investment objective category used in the S.E.C.'s form N-SAR. S.E.C., Securities and Exchange Commission.

N-SAR also provides aggregate balance sheet information including the dollar amounts of open positions for options on equities and options on futures. As futures and forwards positions are off-balance sheet, these positions are not included in the N-SAR filing (see Appendix A for details).

Table I provides summary data on derivatives used by equity-oriented registered investment companies categorized by the funds' self-declared investment objective for the period June 1996 to January 1998.[2] A substantial majority of investment companies (77%) are authorized to use derivatives.[3] Although there is some variation in the level of authorized derivative use across categories, in no category does the percentage of funds with derivative authorization drop below 60%. However, when it comes to use of derivatives, only 14% of funds indicate that they used derivatives during the reporting period. Using survey results, Lynch-Koski and Pontiff (1999) report a higher usage rate of 21% for equity mutual funds, and their survey askedwhether derivatives had been used in the past few years. The N-SAR report discloses derivative use in the current reporting period, typically six months. Finally, only 3% of funds have open option and futures option positions on their balance sheets at the reporting date. There is a large difference between the fraction of funds

[2]We thank Daniel Deli for making the N-SAR data available to us.

[3]This number is comparable to the 81% reported by Deli and Varma (2002) for closed-end funds.

authorized to use derivatives and the number that actually use derivatives during a given six-month reporting period.

The N-SAR report does not contain sufficient information to determine the nature and extent of funds' use of derivatives. To obtain this information, we collect data from N-30-D filings. An N-30-D filing is a detailed financial statement issued to shareholders semi-annually, and they are described in more detail in Appendix A. Tractability forces us to reduce the universe of investment companies that file form N-SAR to a more limited set. We collect data from 2,154 reports for 471 separate funds. Considering that there were 640 funds that report engaging in derivative use on their N-SAR filings in Table I, these 471 funds represent just under 75% of that total. Therefore, the sample represents a substantial proportion of the funds with open derivative positions.

Since we require return data for our analyses, Morningstar's Principia ProPlus database provides return data on the funds in our sample. Morningstar also assigns funds to investment objective categories and provides return histories for those categories. Because Principia ProPlus only includes a subset of investment companies, we eliminate 149 funds that are closed-end funds, variable annuities, or otherwise not in Morningstar leaving a sample of 322 funds and 1,402 reports. For the 322 funds, we extract the monthly return history from Morningstar's Principia ProPlus product.[4] To address survivability concerns, we use five different disks from August 1997 through August 1999 in order to obtain monthly return data for funds that are no longer in Morningstar as of August 1999.[5] We also extract returns for the Morningstar objective categories that match the funds in our sample. One difficulty in comparing return distributions is that Morningstar currently divides its fund universe into 51 different investment objective categories of which 36 apply to the funds in our sample. Given that we have only 322 funds in our sample, meaningful statistical analysis using the Morningstar categories is not possible. Therefore, we combine Morningstar's categories into eight categories described in Appendix A. We subdivide the funds in each category into two groups. Funds in the 332 fund sample are identified as derivative users. All the remaining funds in that Morningstar category are designated as non-users. Although this is not a perfect mapping, the sample construction design is such that the funds in the user category are more likely to be derivative users than the funds in the non-user category.

Table II presents the average holdings by asset class of the funds in the original sample of 471 funds and the Morningstar sample of 322 funds. These

[4]Where multiple classes exist for the same fund, we follow Morningstar's guidance and collect returns for the longest lived of the classes, defaulting to the A shares in the event of equal longevity.

[5]The disks used contain data for September 1997, May 1998, September 1998, December 1998, and August 1999. The necessary return data is not available from Morningstar prior to 1996.

TABLE II
Summary of Use of Derivatives for Equity Mutual Funds

	Full Sample	*Morningstar Sample*
Total funds	471	322
Total reports	2,154	1,402
Median assets ($ millions)	$148.6	150.2
Avg. total assets	564.9	688.7
Avg. total exposure	601.0	730.4
Avg. total equity ($ millions)	435.5	553.6
(% of total assets)	(70.7%)	(73.4%)
Avg. total debt	71.2	69.6
	(15.9%)	(13.8%)
Avg. total derivative	37.4	43.1
	(3.5%)	(3.4%)
Avg. other assets	56.9	63.9
	(12.7%)	(12.1%)

This table presents asset class holdings for a sample of equity mutual funds as reported in semi-annual Securities and Exchange Commission N-30-D filings for the period June 1993 to June 1999. Holdings for individual funds are first averaged over the time series of filings where the fund reports non-zero derivative holdings. Reported below are the total number of funds in the sample, total number of N-30-D reports, and the cross-sectional averages of total assets, total exposure (balance sheet and off-balance sheet items), total equity, total debt and total derivatives expressed in dollars and percent of total assets (in parentheses). Total derivatives include balance sheet items, such as option positions, and off-balance sheet items, such as futures and forwards. Holdings are reported net (total long positions less total short positions). The netting calculation includes, but is not limited to, offsetting contracts. The results are reported for the full sample and for the sample, where Morningstar data is available. Asset class holdings are in million dollars.

funds are large, with mean assets of over $500 million. The median is smaller, around $150 million. All told, the funds in the original sample and Morningstar sample control $260 and $220 billion in assets, respectively. The total size of investments held by equity, bond and hybrid mutual funds during the period is $3 trillion.[6] The percentages of equity (70%), debt (15%), derivatives (4%), and other assets (13%) in the two groups are roughly similar.[7] The funds in the two samples are roughly the same size, with the funds also available in Morningstar being slightly larger, and have roughly similar levels of equity, debt, derivative, and other holdings. Therefore, any bias introduced by using only those funds that appear in Morningstar should be minor.

Stylized Facts

The purpose of this subsection is to document some stylized facts about derivative holdings. We start with the prevalence of the different types of derivative

[6]See Investment Company Institute *Mutual Fund Fact Book* (1999).
[7]Derivative holdings are measured as the dollar value of their notional exposure, not in terms of their balance sheet entries, which are typically zero. Therefore, the percentages do not sum to 100%.

TABLE III
Total Derivatives by Underlying Asset Type and by Derivative Type

	Gross (long + short)	*Net (long – short)*
FX derivatives ($ million)	$44.0	36.8
Non-FX derivatives	15.3	6.4
Forward contracts	43.5	37.0
Futures	10.8	5.7
Options	5.0	0.4
Total	59.3	43.2

Reported below are the derivative positions by underlying asset type for the sample of equity mutual funds as reported in semi-annual Securities and Exchange Commission N-30-D filings for the period June 1993 to June 1999. Holdings are measured in terms of either balance sheet entries for balance sheet items, or exposure for off-balance sheet items. Holdings for individual funds are first averaged over the time series of filings where the fund reports non-zero derivative holdings. Included in the top panel are Foreign Exchange (FX) and non-FX derivative holdings. FX and non-FX derivatives include balance sheet items, such as option positions, and off-balance sheet items such as futures and forwards. In the bottom panel are holdings in forwards, futures, options and total derivative holdings. Holdings are reported both gross (total long positions plus total short positions) and net (total long positions less total short positions). The netting calculation includes, but is not limited to, offsetting contracts. The sample contains 322 funds where both N-30-D and Morningstar data is available. Derivative positions are in million dollars.

holdings in our sample. Next, we examine the cross-sectional heterogeneity of derivative holdings. Finally, we describe the temporal dependence of holdings.

Types of holdings

The extent of derivative exposure by mutual funds appears small, around 3.5% of assets. A more detailed examination of these holdings in Table III shows that derivatives are concentrated in FXcontracts. The left-hand column of Table III presents gross exposure, the sum of long and short positions in FX forwards, futures, and options respectively. The majority of funds' derivative exposure is in FX (74%). Futures exposure is much smaller (18%) and options smaller still (8%). Consequently, most derivative activity is in foreign exchange and the impact of derivative use would be most likely to appear in global funds. Why derivatives are more heavily used in FX than other assets is a puzzle, but survey responses in Levich, Hayt, and Ripston (1999) indicate that institutional investors are almost evenly divided about the need to hedge or manage FX risk.

In the right-hand column of Table III, we consider net exposure where short FX positions, futures, calls, and puts are subtracted from long positions in similar assets to gain an idea of the net exposure.[8] FX contracts are 85% of

[8]This does not mean netting by individual contracts.

TABLE IV
The Distribution of Relative Derivative Positions

	Total Derivatives Relative to Assets (%)	*Total Derivatives Relative to Common (%)*	*Non-FX Derivatives Relative to Assets (%)*	*Non-FX Derivatives Relative to Common (%)*	*FX Derivatives Relative to Assets (%)*	*FX Derivatives Relative to Common (%)*
Mean	4	1,004	1	41	4	964
Std. Dev.	15	13,831	8	578	13	13,801
First percentile	−46	−45	−14	−4	−13	−25
Fifth percentile	−3	−17	0	0	0	0
Tenth percentile	0	0	0	0	0	0
25th percentile	0	0	0	0	0	0
Median	1	2	0	0	0	0
75th percentile	6	10	1	1	4	5
90th percentile	14	37	4	9	13	22
95th percentile	26	98	7	16	22	53
99th percentile	73	16,767	17	338	52	674
No. funds	322	309	322	309	322	309

Reported below are the distributions of the percentage derivative holdings relative to total assets and to total common stock for the sample of equity mutual funds as reported in semi-annual Securities and Exchange Commission N-30-D filings for the period June 1993 to June 1999. Holdings for individual funds are first averaged over the time series of filings where the fund reports non-zero derivative holdings. Included are the percentages of FX and non-FX derivative holdings relative to total assets and common stock. FX and non-FX derivatives include balance sheet items, such as option positions, and off-balance sheet items such as futures and forwards. Holdings are reported net (total long positions less total short positions). The netting calculation includes, but is not limited to, offsetting contracts. The sample contains 322 funds where both N-30-D and Morningstar data is available. Thirteen funds hold no common equity.

total net derivative exposure. Futures are 13% of net derivatives and options only 1%. Offsetting transactions in futures and options would result in the positions being removed from the balance sheet but the same does not apply to forwards. The finding that futures, and particularly options, have smaller net positions than gross positions implies that funds are simultaneously long calls on some securities while being short calls on others. Similar reasoning can be applied to futures and puts. Reasons for simultaneous long and short positions in similar securities include arbitrage strategies, liquidity management, and management of idiosyncratic and/or systematic risk.

Distribution of holdings

Although the average holdings of derivatives for the 322 fund sample are small, there is a large dispersion in the distribution of derivative holdings. Table IV presents the cross-sectional distribution across funds of derivative holdings relative to both total assets and to common stock. The median for all derivative holdings is 1% (2%) of assets (common stock). The 25th and 75th percentile levels for derivative holdings relative to total assets are 0 and 6%, respectively. Relative to common stock, these statistics are 0 and 10%. Most funds derivative holdings are nearly trivial. What is surprising about the information in Table IV is the behavior of the tails of the distribution. There are clearly some funds whose derivative exposure, particularly off-balance sheet exposure, is of approximately the same magnitude as their asset value. These funds tend to be funds that either (1) are engaged in replication strategies, or (2) hedging a large fraction of their foreign exchange exposure. The funds with high ratios of derivatives to common generally hold few common shares. There are 13 funds that do not hold common equity at all.

Results of Table IV indicate that the population of derivative users is heterogenous. Among the equity funds that are heavy users of derivatives, there are striking differences. Some funds use derivatives to hedge out systematic risk. Others construct replicating index portfolios holding derivative positions in conjunction with large positions in cash market assets. There are some that construct 'bear' funds by combining written index futures with cash. Global funds exhibit a similar range of uses for FX derivatives. Some global funds partially hedge their foreign exchange exposure, others attempt to immunize their holdings to FX risk, and others add additional foreign exchange risk to their existing international investments.

Temporal dependence

The results in Table IV represent the cross-sectional distribution of time series means for the funds in our sample. Previous research indicates that there may be considerable variation through time in derivative use as managers respond to cash flows and/or incentives. If this is the case, then time series means will smooth out this behavior. To examine time series properties of derivative use, we start by examining the number of periods when each fund might have held derivatives. The left-hand column of Table V presents the cross-sectional distribution of the number of 6-month periods from June 1993 to June 1999 that each fund in the sample exists. The sample period spans 12 six-month periods and the median fund was in existence for 11 of those periods. A substantial proportion of the funds exists for all 12 periods but there are also some that have a very short existence.[9] Given the different time spans when each fund is in existence, we proceed to examine derivative use only for those periods when each fund was in existence.

In the center and right-hand columns of Table V, we present evidence that most funds do not hold derivatives in every reporting period in the sample.

[9]Some of these are 'seed' funds. Seed funds are small funds, typically around $1 million, that disappear if unsuccessful.

TABLE V
The Distribution of Periods with Non-zero Derivative Holdings

	Periods When Fund was Extant	*Periods with Derivative Holdings*	*Percent of Periods with Derivative Holdings*
Mean	9.9	4.4	46.0%
S.D.	3.1	3.0	28.0%
First percentile	2	1	8.3%
Fifth percentile	4	1	8.3%
Tenth percentile	5	1	9.1%
25th percentile	8	2	22.2%
Median	11	3	42.8%
75th Percentile	12	6	66.7%
90th Percentile	12	8	85.7%
95th Percentile	12	9	100.0%
99th Percentile	12	11	100.0%
Number of Funds	322	322	322

Reported below are the distributions of the percentage of the number of reporting periods with non-zero derivative holdings for the Morningstar sub-sample of equity mutual funds as reported in semi-annual Securities and Exchange Commission N-30-D filings for the period June 1993 to June 1999. Included are the distributions for the total number of reporting periods where the fund was extent, the number of reporting periods with non-zero derivative holdings and the percentage of reporting periods with non-zero derivative holdings. The sample contains 322 funds where both N-30-D and Morningstar data is available.

The average number of periods with open derivative positions is just over 4 and the average fund holds derivatives in 46% of the periods when it is required to file form N-30-D. Again, there is a wide dispersion across the funds in our sample. Ten percent of the funds hold derivatives in only one report although they may be in existence throughout the sample period. Another 10% hold derivatives in over 85% of the periods. As with the results of Table IV, it is clear that the extent of derivative use varies widely even among funds that hold derivative securities.

To test the intertemporal variation in the levels of derivative holdings, we estimate correlation coefficients for the level of derivative holdings in consecutive N-30-D reports. We do this by dividing the sample into 11 pairs of consecutive semi-annual periods and estimating the cross-sectional mean correlation coefficient for each period. The median correlation coefficient is 0.74, indicating that the level of derivative holdings is relatively stable through time. However, Table V has shown that a number of funds only hold derivatives in one or two reporting periods. Hence, the presence of a large number of periods with zero holdings might considerably bias the median estimate. Moreover, it may be more of interest to examine correlations conditional on non-zero holdings to measure persistence. We therefore re-estimate the correlation coefficients for consecutive periods when a fund has a non-zero derivative position. The median correlation coefficient increases from 0.74 to 0.91, suggesting that the correlation coefficient for the level of derivative holdings is substantially higher for funds that hold derivatives in consecutive periods. Taken together, these results indicate that there are some funds whose level of derivative use varies through time and another group of heavier users of derivatives that maintain a more consistent level of derivative holdings in their portfolio.

DERIVATIVES AND MUTUAL FUNDS: THE HYPOTHESES OF INTEREST

Having reported some stylized facts, we turn now to the key questions of interest. There are two types of hypotheses that are central to our analysis. The first type relates to the decisions to use derivatives, the second pertains to the outcome of such decisions measured by returns. The focus on these follows from the many discussions in the academic and practitioner's literature on derivatives. Since the advent of exchange traded financial derivatives in the 1970's, a substantial literature has developed on different economic purposes for these securities (see Stoll & Whaley, 1988). Some strategies are a variation of portfolio separation theorems where instead of an investor altering her mix of the market portfolio and the riskless asset, an investor holds index derivatives in conjunction with other assets to achieve the desired level of systematic risk. The rationale being that index futures are more liquid and easier to trade than a portfolio of equity securities. Mutual funds following such a strategy should not show appreciably different return distributions than funds which use a mix of cash and direct equity investments in a similar manner to a fund employing derivatives.

Another set of strategies considers the use of derivatives to substantially alter the expected return distribution of a portfolio so that mean/standard deviation analysis is no longer valid (see, for example, Merton, Scholes, & Gladstein, 1978). The use of dynamic hedging, written calls, and purchased puts in conjunction with an equity portfolio may produce highly truncated return distributions. Although such funds' return distributions are easily distinguishable from those of funds that do not employ derivatives, an ex-ante analysis is more difficult. The critical feature of these funds is that the portfolio is 'insured' against certain market outcomes. If these realizations are infrequent, the returns of funds that insure themselves through derivatives will differ from non-hedging funds only by the cost of the insurance, which is typically small. However, funds using options for insurance should exhibit markedly different returns from non-insured funds during times of crisis.

Finally, liquidity costs, short sale constraints, leverage constraints, or other market frictions may prevent mutual funds from using direct equity investment to pursue certain investment objectives. Therefore, there would be some region of the return/standard deviation space that is populated only by funds employing derivatives. If this is true, there will be some funds whose returns differ from the remaining population of mutual funds for nearly all market outcomes.

It will be useful to start formulating the hypotheses of interest in a generic context, starting with hypotheses pertaining to return distributions. Namely, let r_i be a return, or some measure of return in excess of a benchmark, for fund i, then consider the following null hypothesis:

$$H_0^r(X, Y; Z): F(r_i|X, Z) = F(r_i|Y, Z) \tag{1}$$

where $F(r_i|\text{u.}, Z)$ is the distribution of r_i conditional on either X or Y with Z being a set of control variables, i.e. $Z_t = (Z_{1t}, Z_{2t}, \ldots, Z_{kt})$. An example of (1) would be to test whether there is a significant difference in the realized return distributions of funds that use derivatives and funds that do not. Here, $X = U$ would represent all "U = users" of derivatives, $Y = N$ all "N = Non-users" and $Z = All$ would represent the all funds. A finding of a significant difference in the return distribution would result in rejecting $H_0^r(U, N; Z = All)$, and would indicate that the typical fund electing to employ derivatives intends to offer risk-return tradeoffs not available from conventional funds. If we fail to reject the null hypothesis that derivatives do not alter returns, we could narrow the hypothesis by looking for instance at a particular style of funds, choosing for instance Z equal to all the aggressive growth funds ($Z = AG$), then we would test the null $H_0^r(U, N; AG)$. Alternatively, we may want to examine whether funds that are heavy users of derivatives ($X = HU$) offer returns that are not significantly different from funds that are light users of derivatives ($Y = LU$), again with either across all styles ($Z = All$) or for a specific class of funds. A failure to reject the null $H_0^r(HU, LU; Z)$ would again lead to the conclusion that derivative use is not related to returns. However, if the null is rejected, then there may be two classes of funds that use derivatives. One class that employs derivatives for reasons not expected to substantially alter the return distribution and another that seeks to offer investors a return distribution that is not available from conventional equity funds.

Another set of hypotheses central to our analysis relates to the decisions to use derivatives. In this study, we consider variables D_i that measure attributes of derivatives use for fund i The hypotheses regarding the impact of derivatives on returns involved comparisons of distributions because derivatives usually affect the tail and shape of return distributions. Hypotheses regarding D_i are simpler and usually involve a generic equation such as:

$$D_i = f(Y, Z, \varepsilon_i) \tag{2}$$

since our analysis may involve linear regressions as well logit models the functional form of f is left unspecified. The generic null hypothesis here will be:

$$H_0^D(Y; Z): D_i = f(Z, \varepsilon_i) \tag{3}$$

For instance, consider the hypothesis whether fund managers time their use of derivatives. Because of their relatively low transaction costs, derivatives may be a desirable vehicle for funds intending to change their risk/return profile. There is a growing literature on incentives for mutual fund managers to change their risk/return profile either to try and improve performance or to preserve good results already attained (see, for example, Brown, Harlow, & Starks, 1996; Chevalier & Ellision, 1997; Sirri & Tufano, 1998; Berkowitz & Kotowitz, 2000). If managers use derivatives to manage their risk/return profile as suggested in the incentive literature, funds should increase their use of 'long' derivatives to increase returns and risk following the periods of low returns and increase their use of 'short' derivatives to hedge following the periods of high returns.[10] This implies a negative relationship between derivative use and prior returns. Such a hypothesis can be stated by using changes in derivatives positions as D_i and using Y as prior low returns. Under the null (3), the variable Y i.e. prior low returns, should not enter the equation. An alternative is that derivatives use is tied to cash management needs. If managers use derivatives to maintain a constant level of risk in the face of cash inflows following a period of strong performance, then there should be a positive relationship between derivative use and prior returns. Such a hypothesis can be again be stated by using changes in derivatives positions as D_i and selecting Y on the basis of prior fund performance.

A second possible reason for timing derivative use would be in anticipation of a future event. This is similar in spirit to testing for market timing ability by mutual fund managers for which there is an established literature beginning with Henriksson and Merton (1981). The most commonly cited reason for derivative use of all types by institutional investors is hedging (Levich et al., 1999). Hedging generally produces its most noticeable impact during times of financial crisis. Therefore, during the August 1998 financial crisis, we test for market timing ability by fund managers by determining whether funds significantly increased their hedging activities prior to August 1998. Evidence of increased derivative use, along with evidence that hedging was effective during the crisis, would be consistent with market timing ability by investment managers.

Since distributions of returns come in all shapes and forms and the impact of derivatives usually appears in the tail or skew features, testing hypotheses (1) will typically not be accomplished via testing differences in means or medians. In Section 4, we will be more explicit about the test statistics that will be used

[10]Specifically, equity funds should go 'long' by increasing their holdings of long futures or purchases of call options. Conversely, going 'short' implies selling futures, writing calls, or buying puts to hedge existing, less liquid, equity positions.

to test (1). In contrast, testing the null (3) is typically simpler as regular variable exclusion tests will suffice.

DO DERIVATIVES ALTER THE RETURN DISTRIBUTION?

We now turn to the null hypothesis (1), namely the question whether derivative use is reflected in return distributions of otherwise similar funds. We first start with the weakest form of (1), $H_0^r(U, N; Z)$, namely examine whether the distribution of return of derivative users (given a class of funds Z) $F(r_i|uU, Z)$ differs from the distribution of non-users $F(r_i|uN, Z)$ and therefore there aren't any discernable effects of derivatives with Z representing various types of mutual funds. This hypothesis is also considered by Lunch-Koski and Pontiff (1999), with Z representing the eight fund categories pooled from Morningstar and across all fund. Then, we refine the null hypothsesis to $H_0^r(HU, LU; Z)$, namely examine whether the distribution of return of Heavy derivative users (given a class of funds Z) $F(r_i|uHU, Z_t)$ differs from the distribution of light users and therefore there aren't any discernable effects among heavy and light users of derivatives with Z representing various types of derivatives.

At first, we focus on the mean, median, standard deviation, skewness and kurtosis of the return distributions $F(r_i|u., Z)$ Hence, we first only compare particular moments of the distributions. For each fund category, Table VI reports the cross-sectional means of the first four moments and median of the distribution of the funds' returns for both raw and mean-adjusted returns.[11] At the bottom of Table VI, we also report $H_0^r(U, N; Z = All)$ for the entire populations of funds. There is little evidence of statistically significant differences in the mean raw returns between the user and non-users groups within each category. While the mean raw return for the user funds is significantly higher in the Domestic Value category, this relationship does not appear to apply to other fund categories. Further, the median and the higher moments of the return distribution do not show a consistent pattern of statistically significant differences between the two groups although individual pairs of cross-sectional means do differ statistically. When we turn to mean-adjusted returns, we find that the levels of significance changes for individual tests. We note from Table VI that in almost all cases there is a significant difference in the tail behavior as measured by the kurtosis. Overall we may conclude that there is no appreciable difference between user and non-user populations, except for the different tail behavior when mean-adjusted returns are used.

[11]We calculate mean-adjusted returns by subtracting the monthly Morningstar category return from the fund's monthly return. We take this approach because much of the analysis to follow will be non-parametric. Calculating benchmark returns via a market model would be inconsistent with a non-parametric approach.

TABLE VI
Tests for Difference in Return Distribution Moments Between Derivative Users and Non-Users

Investment Category	Number of Funds (Users/Non-users)	Raw Returns p-value	Mean-Adjusted Return p-value
Domestic blend	User/non-user: 49/703		
	Mean	0.23	0.98
	Median	0.70	0.89
	Std Dev	0.01	0.58
	Skewness	0.24	0.08
	Kurtosis	0.58	0.01
Domestic bond	User/non-user: 21/926		
	Mean	0.67	0.17
	Median	0.25	0.29
	Std Dev	0.03	0.12
	Skewness	0.01	0.01
	Kurtosis	0.07	0.01
Domestic growth	User/non-user: 48/658		
	Mean	0.20	0.21
	Median	0.18	0.30
	Std Dev	0.65	0.44
	Skewness	0.01	0.01
	Kurtosis	0.01	0.01
Domestic value	User/Non-user: 29/515		
	Mean	0.01	0.44
	Median	0.05	0.65
	Std Dev	0.01	0.03
	Skewness	0.98	0.12
	Kurtosis	0.31	0.01
Global	User/non-user: 108/669		
	Mean	0.69	0.27
	Median	0.62	0.17
	Std Dev	0.01	0.08
	Skewness	0.76	0.35
	Kurtosis	0.77	0.46
Global Bond	User/non-user: 10/112		
	Mean	0.64	0.93
	Median	0.31	0.83
	Std Dev	0.76	0.42
	Skewness	0.17	0.75
	Kurtosis	0.38	0.09
Hybrid	User/non-user: 39/359		
	Mean	0.56	0.18
	Median	0.23	0.19
	Std Dev	0.25	0.08
	Skewness	0.26	0.13
	Kurtosis	0.33	0.01

(Continued)

TABLE VI *(Continued)*

Investment Category	*Number of Funds (Users/Non-users)*	*Raw Returns* *p-value*	*Mean-Adjusted Return* *p-value*
Sector	User/non-user: 18/218		
	Mean	0.13	0.78
	Median	0.59	0.98
	Std Dev	0.20	0.14
	Skewness	0.83	0.35
	Kurtosis	0.93	0.02
All	User/non-user: 322/4,518		
	Mean	0.10	0.76
	Median	0.05	0.67
	Std Dev	0.01	0.03
	Skewness	0.50	0.61
	Kurtosis	0.14	0.01

Reported in this table are *p*-values for *t*-tests of the difference in monthly return distribution moments for funds that use derivatives and funds that do not use derivatives. Tests are based on cross-sectional means for the mean, median, standard deviation, skewness, and kurtosis of monthly returns. We consolidate 36 Morningstar fund categories into eight categories. The results are reported for raw returns and mean-adjusted returns, and for each category, respectively. The mapping between consolidated and original Morningstar categories is the following:

1. Domestic Blend includes Large Blend, Mid-Cap Blend, and Small Blend funds.

2. Domestic Bond includes High Yield Bond, Intermediate Government, Intermediate-term Bond, Long Government, Long-term Bond, Multisector Bond, Municipal National Long, and Short Government funds.

3. Domestic Growth includes Large Growth, Mid-Cap Growth, and Small Growth funds.

4. Domestic Value includes Large Value, Mid-Cap Value, and Small Value funds.

5. Global includes Diversified Emerging Markets, Diversified Pacific/Asia, Europe Stock, Foreign Stock, International Hybrid, Japan Stock, Latin America Stock, Pacific/Asia ex-Japan, and World Stock funds.

6. Global Bond includes Emerging Markets Bond and International Bond funds.

7. Hybrid includes Convertibles, and Domestic Hybrid funds.

8. Sector includes Specialty-Financial, Specialty-Health, Specialty-Natural Resources, Specialty-Precious Metal, Specialty-Real Estate, and Specialty-Technology funds.

One difficulty in comparing cross-sectional mean returns is that the mean of the individual fund return is not very precisely estimated, because month-to-month return variation is high. Further, the time series of returns is relatively short. Finally, there is a relatively small number of funds in the user group, between 10 and 108 depending on category. Therefore, tests based on cross-sectional estimates of higher moments of returns may have low power. Hence, we would like to consider tests that are 'distribution-free' and better tailored toward testing $H_0^r(U, N; Z)$ in small samples with potentially complex shaped distributions. More specifically, we turn to tests for differences in the empirical

TABLE VII
Non-Parametric Tests for Difference in Return Distributions Between Derivative Users and Non-Users

Investment Category	*Number of Funds (Users/Non-users)*	*Wilcoxon p-value*	*K-S p-value*	*S-S p-value*	*Rank p-value*
Domestic blend	49/703	0.43	0.13	0.25	0.77
Domestic bond	21/926	0.04	0.05	0.54	0.00
Domestic growth	48/658	0.04	0.04	0.18	0.44
Domestic value	29/515	0.45	0.31	0.43	0.13
Global	108/669	0.54	0.85	0.25	0.49
Global bond	10/112	0.26	0.19	0.98	0.12
Hybrid	39/359	0.98	0.23	0.67	0.21
Sector	18/218	0.76	0.98	0.89	0.34
All	322/4,518	0.25	0.00	0.01	0.00

Reported in this table are *p*-values for non-parametric tests for the differences in the cross-sectional distribution of mean monthly mean-adjusted returns distribution for funds that use derivatives and funds that do not use derivatives. For each fund in each month, we adjust the reported return for a fund by subtracting the return for the appropriate Morningstar category. We then calculate the time-series mean for each fund's mean-adjusted return. The distributional tests are then applied to the time series means for the derivative user and non-user groups. The tests are Wilcoxon, Kolomogorov–Smirnov (K-S), Savage–Scores (S-S), and Conover Square Ranks (Rank) test. We consolidate 36 Morningstar investment categories into 8 categories, and report results for each category, respectively.

distribution function (EDF), known as the Kolmogorov–Smirnoff test.[12] These tests are more directly related to the null hypothesis of interest as well. We also supplement these tests with non-parametric rank-based tests such as the Wilcoxon test, the Savage–Scores test, and the Conover Square Ranks test.[13]

We calculate the mean and mean absolute deviation of the mean-adjusted return for each fund and then apply the Wilcoxon, Kolmogorov–Smirnoff and Savage and Conover test to determine whether the distribution of the derivative user and non-user populations differ. Table VII presents the results of these tests. There is some increase in the number of significant statistics from Table VI. For the sample of all funds, the Kolmogorov-Smirnoff, Savage, and Conover tests reject the null of equality in the return distributions for the user and non-suer funds. The fact that the medians are not significantly different is not surprising since the returns are all mean adjusted. The tests remain ambiguous for individual categories.

[12]The Kolmogorov–Smirnoff test determines whether two-sample distribution functions are drawn from the same population. The test is based on the maximum vertical distance between the two EDFs. For further discussion, see e.g. Conover (1980, p. 368).
[13]The Wilcoxon test compares the medians of two samples. The Savage test is also a non-parametric rank-based test described in Hájek and Sidák (1967, p. 97) and is asymptotically optimal for exponential distributions and designed to have power for location shifts in extreme value distributions. Particularly, the latter is appropriate, as we examine return distributions. Finally, the Conover, or squared-ranks, test is a Wilcoxon-type test applied to the absolute value of deviations from the sample mean. Hence the test is designed to detect changes in the dispersion of returns. The test is described in Conover (1980, p. 239).

TABLE VIII
Tests for Difference in Excess Return Distribution Between Light and Heavy Derivative Users

Sample	*Mean*	*Median*	*Std. Dev*	*Skewness*	*Kurtosis*
FX derivative users					
Light users (Deciles 1–9)	0.069	0.030	1.902	0.024	1.449
Heavy Users (Decile 10)	0.272	0.254	1.981	−0.167	1.586
t-test (*p*-value)	(0.06)	(0.05)	(0.95)	(0.15)	(0.74)
Wilcoxon (*p*-value)	(0.04)	(0.04)			
Rank (*p*-value)			(0.59)		
Equity derivative users					
Light users (Deciles 1–9)	0.114	0.090	1.837	0.003	1.470
Heavy users (Decile 10)	−0.128	−0.271	2.468	0.020	1.404
t-test (*p*-value)	(0.37)	(0.27)	(0.11)	(0.87)	(0.89)
Wilcoxon (*p*-value)	(0.74)	(0.48)			
Rank (*p*-value)			(0.45)		
Equity option users					
Light users (Deciles 1–9)	0.142	0.119	1.777	−0.024	1.411
Heavy users (decile 10)	−0.369	−0.522	3.040	0.255	1.920
t-test (*p*-value)	(0.00)	(0.01)	(0.00)	(0.01)	(0.38)
Wilcoxon (*p*-value)	(0.01)	(0.00)			
Rank (*p*-value)			(0.00)		
All users (322 funds)	0.089	0.053	1.901	0.005	1.463
All non-users (4,196 funds)	0.053	0.026	1.622	0.086	1.708

Reported below are tests of mean monthly mean-adjusted return distribution moments for eight fund samples: (1–2) the light and heavy users of FX derivatives from the N-30-D sample, (2–4) the light and heavy users of equity derivatives from the N-30-D sample, (5–6) the light and heavy users of equity options from the N-30-D sample, (7)all derivative users identified from SEC N-30-D filings, and (8) Morningstar non-derivative users. Funds are grouped into Heavy and Light categories depending on their use of FX, equity, or equity option derivatives. A mutual fund is classified as a heavy derivative user if its total derivative position relative to total assets falls into the top tenth percentile (decile 10) among all derivative users. A mutual fund falls into deciles 1–9 is classified as a light derivative user. Tests for difference in the mean-adjusted excess return distribution between light and heavy derivative users are performed by using the *t*-test, Wilcoxon, and Conover Square-Ranks (Rank) test. All statistics are in percent.

So far we did not take into account that the population of derivative users is heterogeneous, as pointed out in Section 2. To better measure how derivatives affect return distributions, we now group funds by the relative extent of derivative use. Using the N-30-D data, we calculate the time series average of the derivatives-to-asset ratio for each of the three derivative types, and classify funds in the top 10% (33 funds) of derivative use with respect to foreign exchange derivatives, equity derivatives or equity options as (*HU*) Heavy users of that type of derivative. The remaining 289 funds are classified as *LU* Table VIII reports tests pertaining to $H_0^r(UH, UL; Z)$, for $Z = \text{FX}$, equity or options derivatives. The tests involve the same cross-sectional averages of the median and first four moments of the mean-adjusted return distribution as in Table VI and the Wilcoxon and squared-rank tests of Table VII.[14] Although the sample sizes are

[14]The results of this section are qualitatively the same when we use the 4,196 funds from our non-user sample as a benchmark instead of the 289 funds classified as light users of derivatives.

smaller than for some of the investment categories in Table VI, the separation of funds into Heavy and Light user groups has dramatically increased our ability to identify the effects of derivative use.

Heavy FX derivative users have significantly higher mean residual returns during the sample period than non-users, 0.272 vs. 0.069%. Similar conclusions can be drawn from median returns. The other moments of the return distribution are not significantly different for Heavy and Light FX users. In general, the presence of higher mean returns for Heavy FX users should be consistent with a higher level of risk taking by these funds. Although the mean standard deviation of Heavy FX users is higher, and the mean skewness negative, the insignificant differences in mean standard deviation, skewness and kurtosis provide no evidence of greater risk. The non-parametric tests yield similar results. This finding would indicate that the gains to international diversification during the sample period are primarily due to the availability of a broader universe of stocks and not from foreign currency exposure.[15]

Although the magnitudes of the differences in cross-sectional mean returns for Light and Heavy equity derivative users is large, none of the differences are statistically significant. The reason is that the standard errors of the cross-sectional mean estimates are relatively high. A closer examination provides more economic insight. Among the funds classified as Heavy equity derivative users are (1) bear funds, which hold a combination of short common, short index futures and put options, (2) hedge funds with long common positions and employing various derivative strategies, and (3) replicating funds, which hold long index futures. The bear funds tend to dominate and have negative residual returns in most periods. However, the cross-sectional average reflects a combination of the negative mean-adjusted returns of the bear funds and the positive mean-adjusted returns of the hedging and replicating funds and has a very high standard error. The impact of averaging bear funds with hedging/replicating funds can be seen in the large difference between the mean and median returns, −0.128 and −0.271%, respectively. The non-parametric tests also do not reject the null that returns of the user and non-user groups differ.

The group of funds classified as Heavy options users represents a similar combination of investment purposes as Heavy equity derivative users. However, the replicating funds that use long index futures and T-bills to replicate an index position are not present in this group. Therefore, the cross-sectional mean estimates between Heavy and Light user groups differ more for options users than for equity derivative users and the standard errors are lower. The median and all the moments of the residual return distribution except kurtosis differ both economically and statistically for the Light and Heavy option user

[15]For a thorough discussion of the issues in international diversification, see Stulz (1996).

groups. The lower return is consistent with options being a costly form of insurance. The higher average standard deviation is not consistent with risk reduction. However, the standard deviation is often an inappropriate measure of risk for an option enhanced portfolio as the return distribution may not be symmetric. The significantly more positive mean skewness is also consistent with a lack of symmetry in residual returns for Heavy option users. As with the FX and Equity derivative groups, the non-parametric tests support the parametric results.

To summarize the findings from this section, the data supports the null $H_0^r(U, N; Z)$ for the entire population of funds as well as the eight categories we defined. Hence, the typical mutual fund using equity derivatives does not appreciably differ from returns of other funds with similar investment objectives. However, funds, which are in the top decile of derivative users, do show different realized returns from funds that are light users. That is, the data reject the null $H_0^r(HU, LU; Z)$ with Z representing various types of derivatives contracts.

WHAT ARE THE MOTIVES FOR DERIVATIVE USE?

In this section, we test the second class of hypotheses $H_0^D(X, Y; Z)$ appearing in (3). As noted in Section 3, this includes hypotheses whether mutual fund managers time their use of derivatives either in response to past performance or in anticipation of future events. The timing of derivative use based on past performance has been suggested by Brown, Harlow, and Starks (1996), Chevalier and Ellison (1997), and Lynch-Koski and Pontiff (1999), who identify both managerial incentives and cash flow induced changes in risk as possible motives. The null hypothesis $H_0^D(X, Y; Z)$ appearing in (3) also covers the conjecture that managers time their use of derivatives in anticipation of future events is related to the broad literature on the market timing ability of investment managers.

Past Performance and Change in Derivative Use

Sirri and Tufano (1998) indicate that the top performing funds experience a disproportionate share of cash inflows in the following period. Other authors (e.g. Brown, Harlow, & Starks, 1996; Chevalier & Ellision, 1997) have indicated that the incentives faced by mutual fund managers may lead to managers altering the risk/return characteristics of their fund in response to past performance. Berkowitz and Kotowitz (2000) find that this conclusion does not apply to risk-neutral managers whose performance is neither exceptionally good or bad. Lynch-Koski and Pontiff (1999) identify that there is a weaker relationship between changes in risk measured by the standard deviation of fund returns and past returns for funds that use derivatives and funds that do not. They conclude that funds using derivatives do so more for cash flow induced changes in risk than for managerial incentive reasons. Because the data set in this study contains detailed information on derivative holdings, we can more directly address the relationship between derivative holdings and changes in risk. We can also determine whether lagged performance measures have any explanatory power for changes in derivatives holdings.

We will use an indicator variable $D_{t,i,j}$ as dummy variable indicating whether the fund i increased its use of derivatives in period t (note that because of the time series dimension we add t as index, the index j will be discussed shortly). A value of 0(1) indicates a decrease (increase) in the ratio of derivatives to assets based on the current and preceding N-30-D filings. We test the hypothesis $H_0^D(Y, Z)$ in (3) by selecting Z as the funds using any type of derivative (Z = 1), funds using equity derivatives (Z = 2), and funds using FX derivatives (Z = 3). To facilitate the notation we will present Z through the index j which takes values 1, 2 and 3 Funds having no derivative holdings of the relevant type during two consecutive reporting periods are dropped from the sample. The null pertains to Y representing returns ($R_{t,i,j}$) and the standard deviation ($\sigma_{t,i,j}$) of returns are calculated using monthly return data from Morningstar's *PrincipiaProPlus*. We consider two statistical models to tests the null hypothesis, one is a fixed effect estimators panel data model and the other is a fixed effect probit model. The latter is probably more appropriate and yields a more direct test of the hypothesis whereas the former amounts to formulating an indirect test. We start with the former, i.e. the indirect test, namely:

$$\Delta\sigma_{t,i,j} = \alpha_{0,j} + \beta_{1,j} * I_{t,i,j} + \beta_{2,j} * R_{t-1,i,j} + \beta_{3,j} * \sigma_{t-1,i,j} + \varepsilon_{t,i,j} \tag{4}$$

where, as already noted, the subscripts $j = 1, 2, 3$ refer to the three samples employed, funds using any type of derivative, funds using equity derivatives, and funds using FX derivatives. $I_{t,j}$ is an indicator dummy variable indicating whether the fund increased its use of derivatives of type j during period t. We are interested in finding a significant β vector, as this would be an indication that the null hypothesis (3) is rejected. Admittedly these tests are only indirect evidence, yet equation (4) is relatively easy to implement and also easy to interpret, hence the appeal of starting with the setup.

The first analyses, Table IX, Panel A, show that there is a strong significant negative relationship between changes in risk and lagged risk for funds using derivatives, funds using equity derivatives, and for funds using FX derivatives. For all three types of fund derivative holdings, there is a positive relationship between changes in risk and the lagged 6-month return. The analyses differs from the existing literature because the data allows a comparison between

TABLE IX

Analysis of Changes in Derivative Use and Changes in Risk

	y = *Change in Std. Dev.*		
Panel A. The fixed effects model			
$I_{t,j}$ Total derivatives to assets	0.169 (0.04)		
$I_{t,j}$ Equity derivatives to assets		0.253 (0.02)	
$I_{t,j}$ FX derivatives to assets			0.073 (0.41)
Lagged 6-month return	0.083 (0.03)	0.077 (0.09)	0.275 (0.00)
Lagged 6-month Std. Dev.	−0.490 (0.00)	−0.529 (0.00)	−0.365 (0.01)
	$y = I_{t,j}$ $I_{t,j}$ = *Total Derivatives to Assets*	$I_{t,j}$ = *Equity Derivatives to Assets*	$I_{t,j}$ = *FX Derivatives to Assets*
Panel B. The fixed effects logit model			
Lagged 6-month return	0.159 (0.02)	0.186 (0.02)	0.273 (0.01)
Lagged 6-month Std. Dev.	−0.012 (0.73)	−0.033 (0.38)	0.053 (0.45)
Year end*Lagged 6-month return	−0.258 (0.03)	−0.284 (0.04)	−0.211 (0.39)
Year end*Lagged six month Std. Dev.	0.100 (0.16)	0.032 (0.68)	0.024 (0.84)

Panel A presents results of regression analyses testing the relationship between changes in risk and the lagged six-month return, lagged risk and changes in a mutual fund's use of derivatives. The fixed effects model estimated is the following:

$$\Delta\sigma_{t,i,j} = \alpha_{0,j} + \beta_{1,j} * I_{t,i,j} + \beta_{2,j} * R_{t-1,i,j} + \beta_{3,j} * \sigma_{t-1,i,j} + \varepsilon_{t,i,j}$$

where the subscript i identifies the ith mutual fund, the subscripts j = 1, 2, 3 refer to the three samples employed, funds using any type of derivative, funds using equity derivatives, and funds using FX derivatives. $I_{t,i,j}$ is an indicator dummy variable indicating whether the fund increased its use of derivatives of type j during a period t. A parameter value of 0 (1) indicates a decrease (increase) in the ratio of derivatives to assets based on the current and preceding N-30-D filings. Funds having no derivative holdings of the relevant type during two consecutive reporting periods are dropped from the sample. Returns ($R_{t,i,j}$) and the standard deviation ($\sigma_{t,i,j}$) of returns are calculated using monthly return data. Lagged 6-month returns and lagged 6-month standard deviation are each measured for the 6-month period beginning 12 months before the current date.

Panel B reports results of logit analyses testing the relationship between changes in a mutual funds use of derivatives and changes in risk, lagged risk, and lagged 6-month return. A fixed effects logit model is estimated:

$$\begin{aligned} I_{t,i,j} &= \alpha_{0,j} + \beta_{1,j} * \sigma_{t-1,i,j} + \beta_{2,j} * R_{t-1,i,j} \\ &\quad + \beta_{3,j} * \text{YearEnd}_{t,i,j} * \sigma_{t-1,i,j} + \beta_{4,j} * \text{YearEnd}_{t,i,j} * R_{t-1,i,j} + \varepsilon_{t,i,j} \\ \varepsilon_{t,i,j} &= \eta_{t,i,j} + \mu_{i,j} \end{aligned}$$

The variables are as defined as before except for the (0, 1) indicator variable *YearEnd*, which identifies fund filings for November and December. Each model is estimated via fixed effects techniques for a time series and cross-sectional panel. The sample consists of a panel of 332 funds for the 5-year period from January 1, 1995 to June 30, 1999. p-values are in parentheses.

changes in risk and changes in derivative use. For all funds using derivatives and for funds using equity derivatives, there is a positive and significant relationship between changes in risk and changes in derivative holdings indicating that increases in the 6-month standard deviation of returns are associated with increases in derivative use. The finding of a positive relationship between derivative use and risk is consistent with funds increasing their use of 'long' derivatives to increase risk and increasing their use of 'short' derivatives to reduce risk.

The results in Table IX, Panel B, are a more direct test of whether derivative use is related to past return performance. As the derivative use variable is discrete, a fixed effects logit model is used for the analyses.[16]

$$I_{t,i,j} = \alpha_{0,j} + \beta_{1,j} * \sigma_{t-1,i,j} + \beta_{2,j} * R_{t-1,i,j} + \beta_{3,j} * \text{YearEnd}_{t,i,j} * \sigma_{t-1,i,j} + \beta_{4,j} * \text{YearEnd}_{t,i,j} * R_{t-1,i,j} + \varepsilon_{t,i,j} \quad (5)$$

$$\varepsilon_{t,i,j} = \eta_{t,i,j} + \mu_{i,j} \quad (6)$$

where the subscript i identifies the ith mutual fund. The variables are as defined in equation (4) except for the (0, 1) indicator variable *YearEnd* which identifies fund filings for November and December.

For all three categories, the relationship between lagged returns and changes in derivative use is positive, which supports the cash flow hypothesis of Lynch-Koski and Pontiff (1999). However, when an end of year dummy for fund reports filed in November and December is interacted with lagged returns, the relationship between interacted lagged returns and changes in equity derivative use is negative. This is the correct sign for the managerial gaming hypothesis of Brown, Harlow, and Starks (1996) and Chevalier and Ellision (1997). Collectively, we find evidence supporting both the cash flow hypothesis and managerial gaming hypothesis.

Anticipatory Timing: The Financial Crisis of August 1998

In August 1998 a major financial crisis affected simultaneously foreign exchange, debt and equity markets. Russian stocks and bonds tumbled in early August 1998 and sparked a global sell-off which brought down Long-Term Capital and caused a major crisis in the US financial sector. The most commonly cited reason for derivative use of all types by institutional investors is hedging (Levich et al., 1999). As derivatives are often employed as part of a risk management program designed to protect a portfolio from extreme events, this period provides an opportunity to examine how money managers adjusted their derivative positions during a period of market stress. We can also determine how this period affected the returns of funds that use derivative securities. We test two hypotheses of interest, one pertaining to derivative use, hence of the type H_0^D, the other pertaining to returns distributions, of the type H_0^r. For the former, during the August 1998 financial crisis, we test for market timing ability by fund managers by determining whether funds significantly increased

[16]In both the logit model and the linear model results from Panel A, a fixed effects model for panel data is applied using STATA.

TABLE X
Derivative Holdings Around the Financial Crisis of 1998

	Mean	*75th percentile*	*90th percentile*
Before the crisis			
Funds holding derivatives (%)	52.2		
Total derivatives/total assets (%)	4.0	2.5	11.6
FX derivatives/total assets (%)	3.6	0.0	7.6
During the crisis			
Funds holding derivatives (%)	53.6		
Total derivatives/total assets (%)	2.7	2.4	11.4
FX derivatives/total assets (%)	2.1	0.1	6.7
After the crisis			
Funds holding derivatives (%)	52.8		
Total derivatives/total assets (%)	3.2	1.6	9.0
FX derivatives/total assets (%)	2.3	0.0	4.3

Reported below are cross-sectional distributions of derivative holdings relative to total assets before, during and after the financial crisis of August 1998. The sample funds are equity mutual funds as reported in semi-annual Securities and Exchange Commission N-30-D filings for the period January 1998 to June 1999. FX and total derivatives include balance sheet items, such as option positions, and off-balance sheet items such as futures and forwards. Holdings are reported net (total long positions less total short positions). The netting calculation includes, but is not limited to, offsetting contracts. The sample contains 322 funds where both N-30-D and Morningstar data is available. All statistics are in percent.

their hedging activities prior to August 1998. Second, we test whether the return distributions were significantly affected by derivative use during the time of the crisis.

Because the N-30-D statements are filed semi-annually, we are unable to identify short-term changes in derivative positions during the days and weeks of the crisis. Instead, we create three sample periods, one for the 6 months from January 1, 1998 to June 30, 1998, the second covering the period of the crisis from July 1, 1998 to December 31, 1998, and the third from January 1, 1999 to June 30, 1999 and refer to these as the periods before, during and after the crisis. For each period, we identify the appropriate N-30-D filing for the funds in our sample. We also extract monthly returns from Morningstar and assign the returns to the appropriate period.

We test first for market timing ability by fund managers. Table X presents statistics on the use of derivatives and the extent of derivative holdings during the three periods. Derivative use remains relatively stable throughout the period with a slight but insignificant increase during the period of the crisis. This finding indicates that funds did not change their policy regarding derivatives in response to the crisis. The extent of derivative use as measured by the percent of assets declines from the pre-crisis period through the crisis period and the period after the crisis. Funds may have reduced their derivative use in response to the widely publicized derivative losses during the period. However, none of the changes in mean holdings are statistically significant.

The results in Table X suggest that derivative holding strategies remained constant during the Russian financial crisis period of August 1998. This implies that there was no market timing ability of fund managers. We examine the next hypothesis of interest, namely whether the use of derivatives had any impact on returns during the crisis. We proceed with our analysis of the returns distributions maintaining the categories of Heavy and Light FX Derivative Users, Equity Derivative Users, and Equity Option Users. Hence, we revisit $H_0^r(HU, LU; Z)$, with Z controling for events during the Russian financial crisis. More specifically, we take a microscopic view of the returns surrounding the Russian crisis. We consider two periods: (1) August 1998 and (2) July through September 1998. The latter brackets the Russian debacle by 1 month. For both periods, we consider the cross-sectional samples of returns for the Heavy users and for the Light users in each of the three categories. Examining the cross-section of individual fund mean-adjusted returns allows us to estimate sample moments and compute test statistics across Heavy and Light users.

Recall that the hypothesis of interest is whether the return distributions during the crisis period are substantially different. Various results are reported in Table XI. The sample mean, median, skewness, kurtosis of mean-adjusted returns for Heavy and Light FX derivative users, equity derivative users, and equity option users are reported for two samples, August 1998 and July through September. In addition to the sample moments of the cross-section of returns, we also report the Wilcoxon test comparing the medians of Heavy and Light users in each category, the Kolmogorov–Smirnoff test comparing the empirical distribution functions, and finally to appraise the differences in the distributional characteristics the Savage-Scores and Conover Square Ranks tests.

The results in Table XI are revealing. They show both statistically and economically significant differences between Heavy and Light equity derivative and equity option users. The results in Table XI also reveal that there are no discernable differences between Heavy and Light FX derivative users. The mean of the August 1998 mean-adjusted returns for Light FX derivative users is 0.34; for the Heavy FX category, it is 0.28. The median is −0.28 and 0.43, respectively. Despite the large differences in kurtosis (31.15 for Light FX users versus 0.44 for Heavy), none of the non-parametric tests tell us that we should conclude that both populations are any different.

For equity derivative users and equity option users, the returns during August 1998 tell a totally different story. Heavy equity derivatives users had a 3.34 mean return, while Heavy equity option users did even better with 5.24 mean return. The Light users had negative returns, −0.13 and −0.19, respectively.

TABLE XI
Non-Parametric Tests for Difference in Return Distributions Between Heavy and Light Derivative Users During the Financial Crisis of 1998

Sample	*Mean*	*Median*	*Skewness*	*Kurtosis*	*Wilcoxon p-value*	*K-S p-value*	*S-S p-value*	*Rank p-value*
August, 1998								
FX derivative users								
Light users	0.34	−0.28	4.67	31.15				
Heavy users	0.28	0.43	−0.43	0.44	0.20	0.26	0.36	0.39
Equity derivative users								
Light users	−0.13	−0.26	0.74	2.50				
Heavy users	3.34	0.26	2.03	3.63	0.06	0.10	0.00	0.00
Equity option users								
Light users	−0.19	−0.28	0.20	0.90				
Heavy users	5.24	1.44	1.54	1.97	0.05	0.00	0.00	0.00
July–September 1998								
FX derivative users								
Light users	−0.15	−0.05	1.55	26.60				
Heavy users	−0.42	−0.13	−0.35	0.94	0.56	0.37	0.58	0.16
Equity derivative users								
Light users	−0.26	−0.08	0.72	31.42				
Heavy users	0.61	0.50	1.95	8.60	0.19	0.11	0.01	0.04
Equity option users								
Light users	−0.34	−0.08	−2.15	14.60				
Heavy users	1.36	0.12	2.32	8.16	0.30	0.01	0.00	0.00

Reported in this table are *P*-values for non-parametric tests for the differences in monthly mean-adjusted return distribution between mutual funds classified as heavy and light derivative users. For each fund in each month, we adjust the reported return for a fund by subtracting the return for the appropriate Morningstar category. The tests are Wilcoxon, Kolomogorov–Smirnov (K-S), Savage–Scores (S-S), and Conover Square Ranks (Rank) test. The results are reported for August, 1998 and for the period of July–September 1998.

The differences in median returns are less dramatic, yet still opposite in sign and the Wilcoxon rank test shows that the medians are significantly different at 6 and 5%. All the other non-parametric tests show strong support for the substantial differences in the return distributions for Heavy and Light equity derivative users and equity option users during August 1998. These findings are confirmed, though somewhat weakened when we enlarge the event window to 3 months, July through September 1998. The lower panel of Table XI shows that there are still both statistically and economically important differences between Heavy and Light users of equity derivatives and equity options. The lower panel of Table XI also reinforces the finding that FX derivatives use had no impact on the return distributions of mutual funds.

Overall, the findings in Table XI show clearly that during a major financial crisis there are substantial benefits to the heavy use of derivatives. The Russian crisis affected mainly fixed income and equity markets. Apart from the tumbling of the Russian Ruble, FX markets remained relatively unharmed which explains why heavy FX derivative users do not show any superior return performance. The results in Table X, however, showed that there is no market timing ability on the part of fund managers.

CONCLUSIONS

This study uses detailed balance sheet information on over 300 mutual funds over a 5-year period to explore the nature and effects of including derivatives in an investment portfolio. We find that many funds employ derivatives very sparingly, so there is little reason to expect a significant effect on ex-post returns. However, using the return history from Morningstar, we also find that funds whose derivative positions relative to assets are in the top decile show significant differences in their return performance from funds that either use derivatives lightly or not at all.

Our results suggest that there is evidence to support the theory that managers use derivatives to respond to past fund performance, consistent with the theoretical work on mutual fund cash flows. There is also evidence that the relationship between derivative use and past returns at the end of the calendar year is different from the rest of the year, which is consistent with managerial incentives effecting derivative use. However, we do not find evidence that managers time their use of derivatives to anticipate future market events.

Finally, during the financial crisis of 1998, we find that funds with large derivative and option positions show higher average returns. This result is consistent with an insurance role for options. It also shows that during a major financial crisis, there are substantial benefits to the heavy use of derivatives.

APPENDIX

Data Description Details

In this appendix, we provide some of the details of the derivatives data used in the study. The S.E.C.'s form N-SAR is a semi-annual filing that requires registered investment companies covered by the 1940 Investment Companies Act to disclose information about their business practices and financial condition. A separate form is filed for each fund in a fund family. Of particular interest are the responses to a series of questions on each fund's practices. In two separate responses, each fund responds Yes or No to the following questions on permissible investment practices and whether they were engaged in during the current reporting period:

- Writing or investing in options on equities
- Writing or investing in options on debt securities
- Writing or investing in options on stock indices
- Writing or investing in interest rate futures
- Writing or investing in stock index futures
- Writing or investing in options on futures
- Writing or investing in options on stock index futures.

As noted in Section 1, the N-SAR report doesn't contain sufficient information to determine the nature and extent of funds' use of derivatives. To obtain this information, we collect data from N-30-D filings. An N-30-D filing is a detailed financial statement issued to shareholders semi-annually. There is a separate N-30-D for each fund in a fund family. The N-30-D contains a full balance sheet including a detailed list of every individual security held by the fund. It also contains full disclosure of off-balance sheet items, such as forwards and futures with details about each individual contract held or written by the fund. Individual security holdings are also typically aggregated by asset class in the form N-30-D reports into categories, e.g. domestic stocks, treasury bonds, forwards, etc. For each fund, we collect data on long, short, and net positions in 21 different asset class categories from all reports available in EDGAR. Since we are interested in the time series behavior of derivative holdings, we wish to obtain the full history that is available in EDGAR for each fund.[17] Unlike the N-SAR, the N-30-D is not in a standardized format. Therefore, the information is collected manually.

Finally, as described in Section 1, we pool some of the Morningstar categories to conduct our analysis. The mapping between our categories and Morningstar's original categories is the following:

1. Domestic Blend includes Large Blend, Mid-Cap Blend, and Small Blend.
2. Domestic Bond includes High Yield Bond, Intermediate Government, Intermediate-term Bond, Long Government, Long-term Bond, Multisector Bond, Muni National Long, and Short Government.
3. Domestic Growth includes Large Growth, Mid-Cap Growth, and Small Growth.
4. Domestic Value includes Large Value, Mid-Cap Value, and Small Value.

[17]EDGAR filings of the N30-D began on a pilot basis in the first half of 1993. EDGAR filings were mandatory begin in the first half of 1995.

5. Global includes Diversified Emerging Market, Diversified Pacific/Asia, Europe Stock, Foreign Stock, International Hybrid, Japan Stock, Latin America Stock, Pacific/Asia ex-Japan, and World Stock.
6. Global Bond includes Emerging Markets Bond and International Bond.
7. Hybrid includes Convertibles and Domestic Hybrid.
8. Sector includes Specialty-Financial, Specialty-Natural Resources, Specialty-Precious Metal, Specialty-Real Estate, Specialty-Health, and Specialty-Technology.

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