Incentives and Mutual Fund Performance: Higher Performance or Just Higher Risk Taking?

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We study the impact of contractual incentives on the performance of mutual funds. We find that high-incentive contracts induce managers to take more risk and reduce the funds' probability of survival. Yet, funds with high-incentive contracts deliver higher risk-adjusted return, and the superior performance remains persistent. The top incentive quintile of funds outperforms the bottom quintile by 2.70% per year. Moreover, high-incentive winner funds from one year have a positive alpha of 0.41% per month in the following year. Focusing on funds' holdings, we show that active portfolio rebalancing is the main channel through which incentives increase performance. (*JEL* G23, G30, G32)

"Perverse incentives for investment managers may help explain price of risky assets . . . Most investment managers are rewarded for generating 'alpha.' But found it very difficult to do so . . . In practice most asset managers generated 'poor man's alpha' by taking on liquidity risk–-holding illiquid assets to maturity."
(R. Rajan, *Financial Times*, June 9, 2006)

Agency theory claims that investors can alleviate some agency problems through high-incentive contracts for managers. Such contracts would mean that managers' payoffs were more closely related to their performance, which could increase managers' efforts and thus lead to better performance. At the same time, high-incentive contracts would also induce managers to take more risks. The net effect is less clear. Indeed, if extra performance compensates only for the additional risk taken, high incentives are not beneficial for the principal. In fact, it has been argued that higher incentives lead managers to take excessive risks per unit of performance delivered.

This paper aims to contribute to the understanding of the role of incentives in managerial performance. We focus on the mutual fund industry and test how incentives, as defined in the advisory contract, affect performance. The mutual fund industry provides an ideal test setting, because it allows regular

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observation of managers' *ex ante* incentive structures and actions, as well as many of the other factors that may affect managerial choice.

We focus on those mutual funds in the United States for which contract incentives are a function of fee rates. These rates are based on the total assets managed by the funds. Two-thirds of funds have a fixed fee structure, while the remaining funds have a concave fee structure, in which the percentage advisory fee decreases as the total assets increase. In this paper, we postulate that incentives for fund managers are related to the shape (i.e., concavity) of the fee structure. Mutual funds with a concave fee structure have a lower incentive to increase the assets under management than funds with a linear fee structure. Hence, compared to the literature on incentive fees of mutual funds (Elton, Gruber, and Blake, 2003), concavity actually quantifies the disincentive to generate superior performance.

Agency theory posits that incentives increase risk taking. We therefore expect a positive relation between the incentives contained in contracts and fund risk taking. Moreover, incentives, by increasing risk, also increase the possibility of large negative return shocks that may induce liquidation of the fund, which reduces the probability that the fund will survive.

In terms of the net effect, if higher incentives only increase risk taking and reduce the probability of survival, there should be no relation between performance and incentives after controlling for risk. Superior performance would be explained entirely by higher risk taking and would not persist. If, however, incentives improve managerial effort (e.g., by increasing collection of information, encouraging better techniques for constructing portfolios, or improving technological infrastructure), there should be a positive relation between performance and incentives, even after controlling for risk and survival. Moreover, according to conditioning on incentives, performance should persist.

We find that incentives increase risk taking, which supports the theoretical predictions. An increase of 1% in the incentives investors are willing to pay leads to an increase of nearly 1% in the annual volatility of monthly fund returns. Moreover, incentives also impact the probability that funds will survive. After controlling for prior-year risk and risk-adjusted return, higher incentive funds have higher hazard rates and lower probabilities of survival. In economic terms, an increase in incentives of 1% increases the hazard rate by 8.46%. Equivalently, a 1% increase in incentives leads to a reduction in survival probability of 2%.

What are the implications for investors in mutual funds? If incentives increase fund managers' efforts, this should translate into higher risk-adjusted performance. We show that high-incentive funds outperform low-incentive funds and that the superior performance cannot be explained only by higher risk taking. Instead, superior performance relates to increases in managers' efforts, and this makes superior performance persistent.

The economic significance of the result is quite striking. Over our sample period from 1996 to 2003, the portfolio of funds with the highest incentive quintile outperforms the portfolio of funds with the lowest incentive quintile by 23 basis points per month in terms of raw return and 22 basis points per month in terms of risk-adjusted return. In a standard persistence test setting similar to that described by Carhart (1997), we provide evidence that the performance of winner funds persists among the funds with the highest incentives. The best-performing funds of the prior year have a positive alpha of 41 basis points per month in the following year. No analogous result exists for funds with the lowest incentives. In fact, the difference in performance among the best performing funds of the prior year, separated into high and low incentives, is a significant 71 basis points per month in the following year. The difference in risk-adjusted performance remains robust even after controlling for survival probabilities of the funds.

To investigate the channel through which incentives affect performance, we study a measure of the "unobserved actions" of fund managers. On the basis of the funds' holdings, this measure captures the difference between the gross return of the fund and the return of a buy-and-hold strategy based on the observable portfolio of the fund—the "return gap" (Kacperczyk, Sialm, and Zheng, 2006). Higher incentives improve fund performance by increasing the return gap. In particular, the risk-adjusted return gap of the portfolio of high-incentive funds is 13 basis points per month higher than the portfolio of low-incentive funds. However, there is no significant difference in the returns from a buy-and-hold strategy based on the disclosed portfolio of the funds. This suggests that investors cannot earn superior returns by mimicking the disclosed portfolios of high-incentive funds, which is public information. Most superior performances are related to dynamic portfolio rebalancing by the managers of funds with high-incentive contracts.

These findings make several contributions to the existing literature. First, they provide direct evidence for the theory on executive compensation and particularly the relation between incentives and risk taking. Jensen and Meckling (1976) and the corporate finance literature that followed show that value-maximizing levered-equity holders prefer more asset volatility, even at the expense of firm value. Grinblatt and Titman (1989) show that fund managers who hedge their incentive fees try to maximize the value of the fees by increasing fund leverage as much as possible. In the case of risk-averse managers, Guay (1999) shows that the convexity of the pay-off structure may be offset by the concavity of the utility function. Ross (2004) shows that no type of incentive scheme can make all expected utility maximizers willing to take on more risk. We contribute to this literature by providing empirical evidence that high-incentive contracts do indeed increase performance and risk taking.

Second, our results quantify the role the type of compensation plays in the mutual fund industry. This contributes to the strand of literature that studies the characteristics of advisory contracts in the mutual fund industry. Deli (2002) used N-SAR filings to look at differences in advisory contracts offered to mutual funds, and found that two types of contracts were prevalent in the mutual fund industry: linear contracts and concave contracts. Kuhnen (2004) and Warner and Wu (2004) use N-SAR filings to analyze the determinants of changes in mutual fund contracts. Although the absolute number of contract changes is very small, such changes benefit the investors. Almazan et al. (2004) look at the constraints imposed on mutual fund managers in terms of trading restrictions. We focus on the tradeoff between performance and survival, and show that the direct effect of incentives on risk-adjusted performance has important policy implications. Indeed, the most recent debate on mutual funds has concentrated on the cost of high compensation and greater incentives for investors; however, few have been able to quantify directly the benefits of higher incentive compensation.

Third, our results are relevant to the literature that studies mutual fund performance and its persistence. Hendricks, Patel, and Zeckhauser (1993); Goetzmann and Ibbotson (1994); Brown and Goetzmann (1995); Carhart (1997); and Bollen and Busse (2005) show evidence of short-term persistence in the performance of mutual funds.[1] Traditionally, this performance was attributed to managerial skill. However, Carhart (1997) shows that the momentum effect can explain all the observed persistence in performance of the best funds, while Wermers (2000) explains the persistence through fund expenses but not through managerial ability. Only the set of worst-performing funds, even after controlling for the market, size, book-to-market, and momentum factors, still seems to have persistently bad performance for up to 3 years after a year of bad performance.

More recently, the literature has shown new evidence of forecastability of mutual fund performance. Mamaysky, Spiegel, and Zhang (2005) show that the combined use of an ordinary least squares (OLS) regression and a Kalman filter model increases the number of funds with predictable out-of-sample alphas by about 60%, which provides evidence of persistence among fund performance. Kacperczyk, Sialm, and Zheng (2006) use a new measure of performance based on unobserved actions of mutual funds—the return gap—and show that it can predict future fund performance. Kosowski et al. (2006) find that a sizable minority of fund managers have stock-picking ability that offsets their expenses, and the performance of these funds displays-persistence over time. Avramov and Wermers (2006) form an investment strategy in mutual funds that incorporates predictability in manager skills, fund risk loadings, and benchmark returns. Our paper contributes to this literature by presenting novel evidence for the persistence of mutual fund performance by conditioning on incentives.

[1] Other papers in this literature include Grinblatt, Titman, and Wermers (1995); Elton, Gruber, and Blake (1996); Gruber (1996); Daniel et al. (1997); Nofsinger and Sias (1999); Wermers (1999); and Grinblatt and Keloharju (2000), among others.

The paper is structured as follows. Section 1 describes the data and construction of the variables. Section 2 reports the main results. A brief conclusion follows in Section 3.

1. Data and Main Variables

We use data collected from three sources: the US Securities and Exchange Commission (SEC) electronic data gathering, analysis, and retrieval (EDGAR) database, the Center for Research in Security Prices (CRSP) mutual fund monthly database, and the CDA/Spectrum mutual fund holdings database. We focus on the information contained in the N-SAR-B filings[2] from 1996 to 2003. Apart from the compensation contracts, we also collect information about the number of shareholder accounts in the fund, the minimum investment required, and other relevant variables from the N-SAR filings. The N-SAR dataset is then matched by fund name with the CRSP mutual fund monthly database. As CRSP separately reports data for each class within a single fund, we first combine the information from different classes of the same fund weighted by the total net assets (TNA) of the class. We take observations only if the fund existed in the CRSP database in the same calendar year as the N-SAR-B filing. Mutual fund advisory contracts are rarely changed (Kuhnen, 2004; and Warner and Wu, 2004), so we interpolate the structure of the advisory contract for the years when we cannot match the N-SAR data to the CRSP database. For example, if matches for a fund are found in 1998 and 2000 but not 1999, we assume the contract to be the same in 1999 as in 1998.

Finally, this dataset is matched with the CDA/Spectrum mutual fund holdings database (Wermers, 2000). This database merges information about individual funds and the quarterly stock holdings of each fund. As we measure fund performance with respect to the four common equity risk factors and have information only about the funds' equity holdings, we restrict our analysis to mutual funds that belong to one of three classifications of the Investment Company Data Inc. (ICDI)—aggressive growth (AG), long-term growth (LG), and growth and income (GI)—as long as 80% of their assets are invested in equities. We also remove index funds from our sample. The variables are defined in the Appendix, and their summary statistics are presented in Table 1.

1.1 Incentive variables

We look at two aspects of the compensation contract between managers and investors: the shape and the slope. We use information on the fund advisory contract, and we build on the literature that has studied advisory compensation and used it as a proxy for actual incentives received by fund managers (Coles, Suay, and Woodbury, 2000; Deli, 2002; Deli and Varma, 2002; Kuhnen, 2004; and Warner and Wu, 2004).

[2] Deli (2002) describes N-SAR filings in more detail.

Table 1
Summary statistics and correlation matrix of the variables

Panel A: Summary statistics

Variable	N	Mean	Median	Standard deviation
Coles' incentive rate	3,010	−0.1062	0.0000	0.1843
Coles' incentive rate (estimated)	3,010	0.1178	0.1276	0.1495
Weighted incentive rate	3,064	0.9581	1.0000	0.0963
Weighted incentive rate (estimated)	3,064	1.1073	1.1123	0.0878
Dollar incentive rate	2,933	−5.1813	0.0000	7.0175
Dollar incentive rate (estimated)	2,933	4.1542	4.4742	6.7880
Incentive ratio	3,095	0.9711	1.0000	0.0607
Incentive ratio (estimated)	3,095	1.1127	1.1021	0.1193
Effective fee rate (in percentage)	3,095	0.7517	0.7516	0.1447
Family TNA (in billions of dollars)	3,095	36.5748	7.7287	80.1864
ln (family TNA)	3,095	22.4601	22.7682	2.4267
Fund TNA (in millions of dollars)	3,095	710.9436	213.0960	1,719.7520
ln (Fund TNA)	3,095	19.0628	19.1773	1.7041
New money inflow	3,095	0.2128	−0.0025	0.8714
Fund age	3,095	10.0533	6.0000	9.5634
Fund return volatility	3,095	0.0628	0.0582	0.0274
Fund alpha	3,095	−0.0009	−0.0011	0.0096
Turnover	3,095	0.9655	0.7145	1.2208
12b-1 expense (in percentage)	3,095	0.3250	0.0789	1.1348
Minimum required investment (in thousands of dollars)	3,095	33.5998	1.0000	304.6025
Performance based fee	3,095	0.0042	–	–
Fee on rival performance	3,095	0.0084	–	–

Panel B: Correlation matrix of the variables

	Coles' incentive rate	Weighted incentive rate	Dollar incentive rate	Incentive ratio	Effective fee rate	ln (family TNA)	ln (fund TNA)	New money inflow	Fund age	Fund return volatility	Fund alpha	Turnover	12b-1 expense (in percentage)	Minimum required investment	Performance based fee	Fee on rival performance
Coles' incentive rate	1.00															
Weighted incentive rate	0.96	1.00														
Dollar incentive rate	0.95	0.92	1.00													
Incentive ratio	0.70	0.67	0.64	1.00												
Effective fee rate	0.29	0.23	0.25	0.06	1.00											
ln (family TNA)	−0.44	−0.48	−0.49	−0.23	−0.65	1.00										
ln (fund TNA)	−0.52	−0.56	−0.54	−0.17	−0.43	0.56	1.00									
New money inflow	0.17	0.14	0.13	0.08	0.13	0.02	0.04	1.00								
Fund age	−0.70	−0.68	−0.59	−0.26	−0.32	0.09	0.34	−0.15	1.00							
Fund return volatility	0.08	−0.10	0.06	−0.08	0.24	0.02	−0.01	0.06	−0.07	1.00						
Fund alpha	0.19	0.13	0.14	0.09	0.06	−0.05	0.05	0.23	−0.03	0.15	1.00					
Turnover	0.03	0.03	−0.01	−0.05	0.26	−0.01	−0.09	0.03	−0.04	0.18	−0.08	1.00				
12b-1 expense (in percentage)	−0.13	−0.10	−0.15	−0.07	−0.03	0.03	−0.06	0.01	−0.02	0.00	−0.02	0.03	1.00			
Minimum required investment	0.07	0.08	0.10	0.06	−0.19	0.04	−0.01	0.01	−0.03	0.00	0.01	−0.02	0.01	1.00		
Performance based fee	0.19	0.15	0.16	0.51	0.03	0.00	0.02	−0.01	0.04	−0.01	−0.03	0.04	0.00	−0.01	1.00	
Fee on rival performance	0.31	0.27	0.26	0.72	0.01	−0.01	−0.04	0.00	−0.03	−0.04	−0.01	−0.02	0.05	0.00	−0.01	1.00

Panel A presents the summary statistics of the variables used in the subsequent analyses. The number of observations for each variable is given under the condition that the data on all the main variables should be nonmissing. The definitions for each variable are provided in the Appendix. Panel B presents the correlation matrix of the variables.

For the shape of the contract (the aspect of the contract that better defines the contractual incentives and forms the main focus of our subsequent analyses), we follow the above literature by calculating incentives on the basis of the concavity of the contract. This measure is defined as the difference between the last and first marginal compensation rates divided by the effective marginal compensation rate (henceforth, Coles' incentive rate, or CIR). Thus, the shape of the contract takes the value 0 for linear contracts and negative values for concave contracts, with the incentive increasing as this variable increases.

This measure of incentive, however, takes into account only the first and last fee rates rather than the entire shape of the contract. We therefore use alternative measures of incentives. The first alternative measure, the weighted incentive rate (WIR), is the ratio of the weighted average of the marginal compensation rates (i.e., the linearized compensation rate) to the first applicable marginal compensation rate. This measure of concavity is equal to 1 for a linear contract and less than 1 for a concave contract. The second measure of incentives is constructed to account for the fact that managers mostly are affected by fees defined in terms of dollar. This measure, the Dollar Incentive Rate (DIR), is defined as the difference between the last and the first fee rates multiplied by the TNA of the fund times the flow-performance sensitivity of the category that the fund belongs to in a given year. The DIR measure proxies for the dollar value that accrues to the manager from the expected inflows due to a unit increase in performance. The third measure captures the potential losses and gains due to changes in TNA around the current TNA of the fund. This measure, the Incentive Ratio (IR), is defined as the ratio of the fee rate that would apply because of a 10% increase in TNA compared with the fee rate that would apply because of a 10% decrease in TNA. We also use a dummy variable, which takes a value of 1 for funds with linear contracts and 0 for funds with concave contracts, to test for robustness of our results. All the results in the paper are robust to the chosen measure of contractual incentives. In order to be consistent with the existing literature (Deli, 2002), however, we focus mainly on the results based on the CIR. The results with other measures are available on request.

For the slope of the compensation contract, we use the effective fee rate (EFR), which is defined as the compensation rate paid to the manager on the basis of the current net assets of the fund reported in the N-SAR filing. An increase in any of the four measures (CIR, WIR, DIR, or IR) reflects an increase in the incentives.

The use of linear contracts in our sample is approximately stable over time. It increased in the late 1990s and reached a peak in 2000, when 67% of funds had linear contracts. In subsequent years, however, concave contracts became relatively more frequent, with 36.5% of funds having a concave contract in 2003. The CIR on average increases, while the EFR slightly decreases. Figure 1 describes the trend for the industry. We report the trends over our sample period

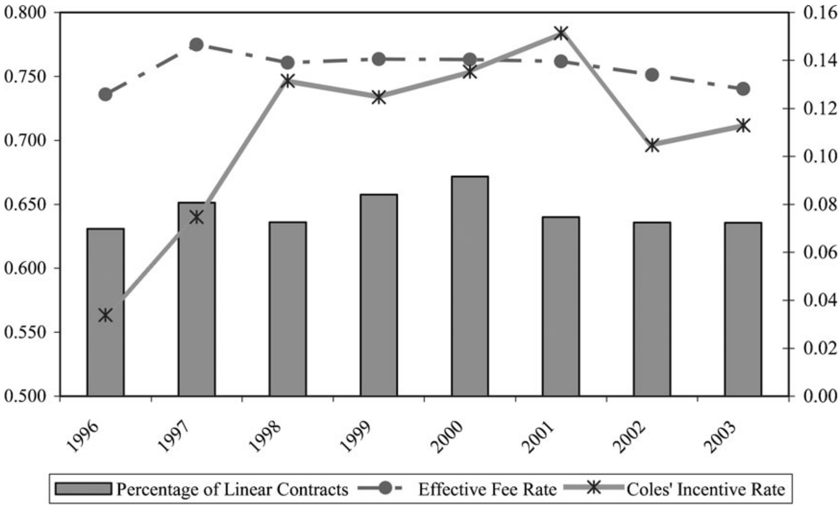

Figure 1
Variation of Incentives over the Sample Period
The figure illustrates the variation of percentage of funds that have linear fee structure over the sample period. It also plots the cross-sectional averages of Coles' incentive rate measure and the effective fee rate (in percentage) over the sample period.

for the percentageof funds with linear fee structure, the average CIR, and the average EFR.

1.2 Endogeneity issues

The potential endogeneity of the choice of contract and choice of investment strategy is an issue. The contract may be considered as the outcome of a bargaining process between the fund's advisors and its investors. Indeed, the contract type might be set to take into account the fund's performance and its other characteristics. To address this issue, we rely on methods used in labor economics to control for the "matching problem" (i.e., the fact that a particular incentive contract is enforced on funds with certain characteristics). We directly model the choice of contractual incentives and then use this specification as the first stage of a two-stage least squares estimation procedure.

We use one characteristic of the investors in the fund as our main identifying restriction—the amount invested with the fund (average account size).[3] Theory posits that principals who are better able to monitor agents give higher incentive compensation to elicit the desired behavior. This suggests a direct relation between the size of investors' accounts and the incentive contained in the contract. We expect that the larger the amount invested, the greater an investor's

[3] From N-SAR filings, we know the number of portfolio accounts of a mutual fund (i.e., the number of investors in the fund). The TNA divided by the number of investors gives the size of an average shareholder account.

incentive to monitor and the more able the investor will be to impose a contract more suited to their own interests. The resultant contract is likely to be structured in a way that produces the highest incentives per dollar of compensation. Also, we expect that the level of the overall expense for the investors (expense ratio[4]) should be related to the incentive part of the contract. Indeed, investors may find it optimal to structure the contract so that the incentive is negatively related to the overall expense ratio. In this case, we expect a negative correlation between incentives and expense ratio.

Table 2 provides the results of the determinants of contractual incentives. We consider five alternative proxies of contractual incentives: CIR, WIR, DIR, and IR, as well as a dummy that takes the value of 1 if the contract is linear and 0 if it is concave. The results show a strong and statistically significant positive relation between incentives and average account size, and a negative relation between incentives and expense ratio. We also check for the robustness of our results by using the average account size as the only instrument. The results are consistent with those reported.[5]

Based on the first-stage regression, we derive the implied (estimated) incentive as the expected value of CIR (or WIR, DIR, or IR) projected on the set of instruments and other explanatory variables that determine the choice of the contract. As the original CIR variable is right-censored at zero, we use a Tobit regression to derive the estimated value of CIR. We use this estimated incentive in our subsequent analysis.

1.3 Other variables

We include a number of additional control variables to control for fund-specific characteristics. We measure the size of the family as the logarithm of the TNA managed by all the funds belonging to the family [ln(*family TNA*)]. Similarly, fund size is defined as the logarithm of the TNA managed by the fund [ln(*fund TNA*)]. Our measure of net inflow (*new money inflow*) is the net dollar inflow as a fraction of TNA of the fund. The fund's age (*age*) is the number of years the fund has traded. If different classes of funds have different ages, we take the oldest age. We use the prior-year volatility of the fund (*lagged fund return volatility*) as one of our control variables. This is the standard deviation of monthly fund returns for the 12 months in a calendar year. The turnover (*turnover ratio*) is defined as the minimum of sales or purchases divided by the TNA of the fund. The 12b-1 expense (*12b-1 expense*) and the minimum initial investment required are used as additional control variables in the subsequent analysis.

[4] This variable accounts for other expenses of the fund (postage, transaction, etc.), as well as the remuneration for the manager. The overall level of expense is what matters. Similar results are obtained by using the expense net of the remuneration. These results are available on request.

[5] It is worth noting that if we include the instrument among the explanatory variables in our main set of tests, it is not significant. This (unreported) result is in line with the fact that a good instrument should correlate with the endogenous explanatory variable and should not be related to the dependent variable other than through its effect on the explanatory variable.

Table 2
Determinants of incentives in the advisory contracts

	Incentive in the advisory contract				
Dependent variable	Coles' incentive rate (1)	Weighted incentive rate (2)	Dollar incentive rate (3)	Incentive ratio (4)	Dummy (linear versus concave) (5)
Average account size	0.0104***	0.0057***	0.5192***	0.0038**	0.0319***
	(3.08)	(2.87)	(3.61)	(2.32)	(2.95)
Expense ratio	−10.4662***	−6.0010***	−587.6551***	−5.2877***	−40.9139***
	(5.41)	(5.23)	(7.35)	(5.70)	(6.74)
ln(family TNA)	−0.0189***	−0.0123***	−1.0462***	−0.0116***	−0.0815***
	(4.54)	(5.02)	(6.06)	(5.81)	(6.50)
ln(fund TNA)	−0.0232***	−0.0151***	−1.3200***	−0.0014	−0.0603***
	(3.73)	(4.19)	(5.10)	(0.46)	(3.13)
New money inflow	0.0140	0.0083	0.6025	0.0073	0.0396
	(1.36)	(1.39)	(1.42)	(1.48)	(1.38)
Fund age	−0.0096***	−0.0054***	−0.3444***	−0.0033***	−0.0254***
	(11.01)	(11.16)	(9.48)	(8.10)	(8.88)
Lagged volatility	0.1633	−0.4447**	8.8576	−0.1777	0.5171
	(0.46)	(2.21)	(0.59)	(1.10)	(0.48)
Lagged fund alpha	1.8675**	0.8237	74.2633*	0.8643**	5.5838**
	(2.04)	(1.56)	(1.95)	(2.03)	(1.98)
Turnover ratio	0.0045	0.0050	0.0036	−0.0009	0.0023
	(0.59)	(1.09)	(0.01)	(0.27)	(0.12)

(*continued overleaf*)

Table 2
(Continued)

	Incentive in the advisory contract				
Dependent variable	Coles' incentive rate (1)	Weighted incentive rate (2)	Dollar incentive rate (3)	Incentive ratio (4)	Dummy (linear versus concave) (5)
12b-1 expense	-0.0152^{**}	-0.0073^{*}	-0.7331^{***}	-0.0088^{***}	-0.0597^{**}
	(2.28)	(1.89)	(2.70)	(2.98)	(2.09)
Minimum required investment	0.0022	0.0057	0.6209	0.0122	0.0885
	(0.08)	(0.36)	(0.55)	(0.83)	(0.77)
Intercept	1.2045^{***}	1.8474^{***}	63.0214^{***}	1.5173^{***}	4.1071^{***}
	(10.33)	(26.62)	(12.87)	(26.97)	(11.44)
Number of observations	3010	3064	2933	3095	3010
Pseudo R^2	0.1038	0.1899	0.0350	0.1649	0.0829

This table presents the estimates of $C_i = \alpha + \beta Z_i + \gamma X_i + \varepsilon_i$, where C represents the incentives in the advisory contract, Z represents the instruments, and X is the set of other control variables. We use the following measures of incentives: Coles' incentive rate (column 1), weighted incentive rate (column 2), dollar incentive rate (column 3), and incentive ratio (column 4). Alternatively, we define incentives in terms of a binary variable that takes the value of 1 for funds with linear fee schedule and 0 for funds with a concave fee schedule (column 5). The set of instruments includes the average account size (the ratio of the TNA of a fund to its number of shareholder accounts) and the expense ratio. The measures of incentives used in columns 1–4 have a truncated distribution, with Coles' incentive rate and the dollar incentive rate being right-censored at 0 and the weighted incentive rate and incentive ratio being right-censored at 1. We therefore use Tobit regressions for columns 1–4, while column 5 is estimated with Probit regression. We use only the funds belonging to one of the following three categories according to the ICDI classification in the CRSP database—LG, AG, and GI—and with at least 80% of assets invested in equities. Index funds are excluded from the analysis. All specifications include year dummies to control for time fixed effects and category dummies to control for category fixed effects. We also include dummies (unreported) to control for funds that have their own performance-based fee or a rival performance-based fee in all regressions. The t-statistics are in parentheses. The symbols ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

We also employ a set of dummies for whether the fund charges performance-based fees (*performance-based fee*) and whether a component of the fees is determined as a function of the performance of the rival funds (*fee on rival performance*). In about 0.42% of funds, performance-based compensation is tied to the performance of their own fund, while in about 0.85% of funds, part of the compensation is linked to the rivals' performance. Table 1 (panel B) provides a correlation matrix for the main variables.

2. Main Findings

2.1 Incentives and survival

We start by estimating the impact of incentives on the survival probability of the mutual funds. If higher incentives indeed lead to increased risk taking, they may also increase the probability of large negative return shocks, which may force the fund to liquidate (i.e., incentives may reduce the probability that the fund survives). We perform a survival analysis by using data on fund delisting from CRSP. We use the Cox semiparametric hazard rate model and a parametric proportional hazards model, in which the baseline hazard has exponential functional form, on fund closure data.

The Cox regression model estimates the hazard rate for fund i as $h(t\,|Z_i) = h_0(t)\exp(Z_i\beta)$, where $h(t\,|Z_i)$ is the hazard rate for fund i at time t, and Z is the vector of explanatory variables that includes incentive (C) and size of the fund family (F), as well as the other explanatory variables (X), as defined in the previous section. The vector β stacks the maximum likelihood estimates of the coefficients. The Cox model does not impose any parameterization on the baseline hazard rate $h_0(t)$ and does not make any assumption about the shape of the hazard over time. The only assumption is that the shape of the hazard is the same for all funds. In the parametric proportional hazards model, the baseline hazard rate, $h_0(t)$, is specified to have the following functional form: $h_0(t) = \exp(\psi)$, where ψ is an additional parameter to be estimated in the model.

We report the results in Table 3. The first two columns report the results for the Cox proportional hazard model; the other two columns report the results for the exponential hazards model. We also include EFR, the level of advisory fee, in our regressions. Columns 1 and 3 present the results of estimating the regression equation in a panel framework in which the standard errors are adjusted for clustering at the fund level. In columns 2 and 4, we adjust the standard errors of the estimates to allow for clustering at the fund-family level. All the specifications include year dummies to control for time-fixed effects and category dummies to control for category-fixed effects.

The results show that contractual incentives reduce the probability of survival (i.e., increase in the hazard rate). This finding is robust across alternative specifications. The results are also economically significant. An increase of 1%

Table 3
Fund survival and incentives

	Cox proportional hazards model		Parametric (exponential) hazards model	
Dependent variable	(1)	(2)	(3)	(4)
Coles' incentive rate (CIR)	1.0754***	1.0754***	1.0846***	1.0846***
	(3.75)	(3.53)	(3.77)	(3.44)
Effective fee rate (EFR)	1.0484***	1.0484**	1.0526***	1.0526**
	(2.68)	(2.26)	(2.85)	(2.37)
ln (family TNA)	1.7277***	1.7277***	1.7500***	1.7500***
	(4.97)	(4.43)	(4.83)	(4.23)
ln (fund TNA)	0.6479***	0.6479***	0.6837***	0.6837***
	(−7.45)	(−6.70)	(−6.14)	(−5.57)
New money inflow	0.7399	0.7399	0.6907	0.6907
	(−1.22)	(−1.22)	(−1.24)	(−1.23)
Fund age	1.0807***	1.0807***	1.0935***	1.0935***
	(3.16)	(3.03)	(3.44)	(3.23)
Lagged volatility	1.0370	1.0370	1.0457	1.0457
	(0.93)	(0.85)	(1.16)	(1.10)
Lagged fund alpha	0.5544***	0.5544***	0.5941***	0.5941***
	(−5.55)	(−5.27)	(−4.25)	(−3.77)
Turnover ratio	0.8807*	0.8807	0.8313**	0.8313**
	(−1.93)	(−1.53)	(−2.49)	(−1.99)
12b-1 expense	1.2037**	1.2037**	1.2307***	1.2307***
	(2.43)	(2.50)	(2.71)	(2.70)
Minimum required investment	1.0004***	1.0004***	1.0004**	1.0004**
	(2.83)	(3.04)	(2.27)	(2.40)
Clustering	Fund level	Family level	Fund level	Family level
Number of observations	3,010	3,010	3,010	3,010

This table presents the results from survival analyses of mutual funds in which the Cox semiparametric hazards rate model and the parametric proportional hazards model are applied to fund closure data. The Cox regression model estimates the hazard rate for fund i as $h(t\,|Z_i) = h_0(t)\exp(Z_i\beta)$, where $h(t\,|Z_i)$ is the hazard rate for fund i at time t, Z is the vector of explanatory variables, and β are the maximum likelihood estimates of the coefficients. The Cox model does not impose any parameterization on the baseline hazard rate, $h_0(t)$, and leaves it unestimated. In the parametric proportional hazards model that we estimate, $h_0(t)$ is specified to have the following functional form: $h_0(t) = \exp(\gamma)$, where γ is a parameter to be estimated.

We use only the funds belonging to one of the following three categories according to the ICDI classification in the CRSP database—LG, AG, and GI—and with at least 80% of assets invested in equities. Index funds are excluded from the analysis. Columns 1 and 3 present the results of estimating the regression equation with standard errors adjusted for clustering at the fund level; in columns 2 and 4, the standard errors are adjusted to allow for clustering at the fund-family level. All specifications include year dummies to control for time-fixed effects and category dummies to control for category-fixed effects. We also include dummies (unreported) to control for funds that have their own performance-based fee or rival performance-based fee in all regressions. The t-statistics are reported in parentheses. The symbols ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively, for the two-tailed hypothesis test that the coefficient equals 0.

in incentives leads to an increase in the hazard rate of 7.54% in the Cox proportional model and 8.46% in the exponential hazards model. This is equivalent to a reduction in the probability of survival of about 2%. Results are similar when alternative measures of contractual incentives (WIR, DIR, or IR) are used.

Interestingly, family affiliation also reduces the probability of survival, with funds that belong to bigger families less likely to survive. The effect is similar in magnitude to the effect of the incentive variables and is robust when alternative definitions of the contractual incentives are used. A 1% increase in the log size of the family reduces the probability of survival by about 4%. This is consistent with findings in the literature, which suggest that families tend to proliferate funds and take on more risk to generate "stars" (Nanda, Wang, and Zheng, 2004).

Among the control variables, two of the most important factors in terms of increasing the probability of a fund's survival are the alpha of the fund in the prior year and the fund's size. In economic terms, an increase of 1% in the prior-year alpha increases the survival probability by 1.65%, while a 1% increase in the log of fund size leads to an increase of 1% in survival probability. This may be because of a "too big to fail" rationale: large established funds are likely to be flagship funds for families and, therefore, are less likely to be allowed to fail. Overall, these findings suggest that contractual incentives have a first-order effect in reducing the probability of a fund's survival.

2.2 Incentives and risk taking

We next analyze the impact of incentives on the risk-taking behavior of mutual funds. We test this by regressing the calendar year volatility of monthly fund returns (the commonly used measure of fund risk) on incentives while controlling for other factors that might influence risk taking. We estimate

$$\sigma_{it} = \alpha_\sigma + \beta_\sigma C_{it} + \gamma_\sigma F_{it} + \phi_\sigma X_{R,it} + \nu_{\sigma,it}, \tag{1}$$

where, for the ith fund at time t, σ_{it} is the annual volatility of monthly returns, C_{it} is the contractual incentives, F_{it} is the size of the family to which the fund belongs, and X_{it} is a vector of control variables including size, inflow, age, prior-year volatility, turnover, 12b-1 expense, minimum required investment, and estimated probability of a fund's survival.

The results of the test are reported in Table 4. We start with a specification based on a fixed effect at the fund level in column 1 to control for unobserved fund heterogeneity that might determine the level of fund risk. In columns 2–5, we cluster the standard errors of the estimated parameters at the fund level to account for the residual cross-correlation. We also include year dummies to control for time-series dependence[6] and category dummies to control for category-fixed effects.

Column 3 of Table 4 presents the results for the subsample of funds that have a concave contract. Column 4 uses an endogenous dummy variable that takes the value of 1 for linear contracts and 0 for concave contracts, and includes average account size and expense ratio as instruments. The specification in column 5 includes CIR and the dummy variable. We expect $\beta_\sigma > 0$, and our findings support our hypothesis. Indeed, contractual incentives increase risk taking, as β_σ is consistently positive and significant across the different specifications. The results are also economically significant. An increase of 1% in incentives increases the fund's return volatility, on average, by about 1.06% in the case of

[6] Petersen (2005) includes a detailed discussion of the appropriate methods under different assumptions about the correlation of the residuals.

Table 4
Fund risk and incentives

	Fund return volatility				
Dependent variable	(1)	(2)	(3)	(4)	(5)
Coles' incentive rate (CIR)	0.1100***	0.0613***	0.0596**	–	0.0617***
	(7.49)	(3.91)	(2.31)	–	(3.92)
Dummy (linear versus concave)	–	–	0.0054**		−0.0003
	–	–	–	(2.34)	(0.46)
Effective fee rate (EFR)	0.0546***	0.0474***	0.0327*	0.0130**	0.0473***
	(3.00)	(4.08)	(1.74)	(2.54)	(4.07)
Survival probability	0.0906***	0.0711***	0.0980***	0.0629***	0.0713***
	(4.69)	(6.24)	(4.62)	(4.89)	(6.24)
ln(family TNA)	0.0042***	0.0026***	0.0021*	0.0003	0.0026***
	(3.96)	(3.48)	(1.81)	(0.82)	(3.48)
ln(fund TNA)	0.0063***	0.0008*	0.0005	0.0001	0.0008
	(7.48)	(1.65)	(0.68)	(0.35)	(1.64)
New money inflow	−0.0013**	−0.0003	−0.0003	0.0011**	−0.0003
	(−2.06)	(−0.47)	(0.31)	(2.18)	(0.47)
Fund age	−0.0034***	0.0007***	0.0006**	0.0001**	0.0007***
	(−7.87)	(4.11)	(2.14)	(2.19)	(4.10)
Lagged volatility	0.1075***	0.5157***	0.4627***	0.5348***	0.5158***
	(4.47)	(27.15)	(17.18)	(27.22)	(27.13)
Turnover ratio	−0.0012	0.0000	0.0006	0.0007*	0.0000
	(−1.49)	(0.10)	(0.70)	(1.66)	(0.10)
12b-1 expense	0.0035***	0.0017***	0.0026***	0.0005	0.0017***
	(4.74)	(2.86)	(3.34)	(0.84)	(2.87)
Minimum required investment	−0.0032	0.0015**	0.0013	0.0002	0.0016**
	(−0.73)	(2.11)	(1.22)	(0.25)	(2.14)
Intercept	−0.2690***	−0.1731***	−0.1706***	−0.0683***	−0.1729***
	(−6.73)	(−5.00)	(3.32)	(4.79)	(4.99)
Clustering	No	Fund level	Fund level	Fund level	Fund level
Number of observations	2,867	2,867	1,094	2,867	2,867
R^2	0.43	0.53	0.51	–	0.53

This table presents the estimates of the following equation: $\sigma_i = \lambda_{\text{risk}} + \beta_{\text{risk}} C_i + \gamma_{\text{risk}} F_i + \delta_{\text{risk}} X_i + \nu_i$, where σ represents the volatility of monthly return of the fund over the 12 months in a calendar year, C represents Coles' incentive rate (CIR), which measures the incentives in the advisory contract, controlling for the effective fee rate (EFR), F is the size of the fund family in terms of the logarithm of total TNA of the family, and X represents other control variables.
We use only the funds belonging to one of the following three categories according to the ICDI classification in the CRSP database—LG, AG, and GI—and with at least 80% of assets invested in equities. Index funds are excluded from the analysis. Column 1 presents the results of fixed-effect regression at the fund level, while columns 2–5 use clustering of standard errors at the fund level. In column 3, we restrict the sample to only those funds with a concave fee structure. Column 4 uses an endogenous dummy variable that takes the value of 1 for linear contracts and 0 for concave contracts, with average account size and expense ratio as instruments. All specifications include year dummies to control for time-fixed effects and category dummies to control for category-fixed effects. We also include dummies (unreported) to control for funds that have own-performance-based fee or rival-performance-based fee in all the regressions. The t-statistics are reported in parentheses. The symbols ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively, for the two-tailed hypothesis test that the coefficient equals 0.

CIR,[7] and by 0.54% in the case of a linear rather than concave contract. The impact of the level of fees is also statistically and economically significant. A 1% increase in the level of fees increases the fund's return volatility by about 0.82%. Results are similar if the alternative measures of contractual incentives (WIR, DIR, and IR) are used.

[7] The value is calculated as follows: the mean fund return volatility is 0.0580 in the sample, while the coefficient of CIR in column 2 is 0.0613. Hence, the economic impact is $(0.0613 \times 0.01)/0.0580 = 1.06\%$.

Also, family affiliation increases risk taking: funds that belong to bigger families take more risk (that is, $\gamma_\sigma > 0$). An increase of 1% in the logarithm of the size of the family increases the fund's return volatility by about 0.04%. Furthermore, the probability of a fund's survival relates positively to the volatility of fund return. It is worth noting that the relation between incentives and fund risk remains robust even after controlling for the fund's fixed effect. The specification controls for any unobserved heterogeneity in fund characteristics that may lead to spurious correlation between incentives and the fund's return volatility. These findings lend strong support to our working hypothesis that contractual incentives increase the risk-taking behavior for mutual funds.

2.3 Incentives and performance

We now consider performance. We start by relating incentives to the annual risk-adjusted return of the funds. We regress fund return on our incentive variables and a set of control variables using

$$R_{it} = \alpha_R + \beta_R C_{it} + \gamma_R F_{it} + \phi_R X_{R,it} + \nu_{R,it}, \tag{2}$$

where, for the ith fund at time t, R_{it} is the fund's risk-adjusted return with respect to the four-factor model over the calendar year. The other variables are as defined for Equation (1).

The results are reported in Table 5. We start with a specification based on a fixed effect at fund level in column 1 to control for unobserved fund heterogeneity that might determine the level of fund risk. In columns 2–5, we cluster the standard errors of the estimated parameters at the fund level to account for the residual cross-correlation. We also include year dummies to control for time-series dependence,[8] and category dummies to control for category-fixed effects. Column 3 presents the results for the subsample of funds that have a concave contract. Column 4 uses an endogenous dummy variable that takes the value of 1 for linear contracts and 0 for concave contracts and includes average account size and expense ratio as instruments. The specification in column 5 includes CIR and the dummy variable.

The findings show that contractual incentives increase fund returns: β_R is consistently positive and significant across the different specifications. Moreover, the results are also significant economically: an increase in incentives of 1% increases risk-adjusted fund returns by more than 16 basis points, while funds with linear contracts have a risk-adjusted return 35 basis points higher than those with concave contracts. In addition, funds that belong to larger families have higher returns. Consistent with the theory of Berk and Green (2004), we find that inflows have a negative impact on risk-adjusted returns. Funds that experience significant inflows have a lower alpha. It is interesting to note that performance relates positively to the probability of the fund's survival.

[8] Petersen (2005) includes a detailed discussion of the appropriate methods under different assumptions about the correlation of the residuals.

Table 5
Risk-adjusted return and incentives

	Fund annual four-factor alpha				
Dependent variable	(1)	(2)	(3)	(4)	(5)
Coles' incentive rate (CIR)	0.0170***	0.0355***	0.0305**	–	0.0355***
	(2.73)	(4.70)	(2.45)	–	(4.73)
Dummy (linear versus concave)	–	–	–	0.0035*	−0.0000
	–	–	–	(1.76)	(0.04)
Effective fee rate (EFR)	0.0131	0.0192***	0.0149*	−0.0004	0.0192***
	(1.53)	(3.33)	(1.69)	(0.15)	(3.32)
Survival probability	−0.0041	0.0291***	0.0212**	0.0241***	0.0291***
	(−0.42)	(5.49)	(2.50)	(4.27)	(5.45)
ln(family TNA)	0.0005	0.0014***	0.0009*	0.0000	0.0014***
	(1.07)	(3.96)	(1.67)	(0.25)	(3.95)
ln(fund TNA)	−0.0029***	−0.0000	0.0001	−0.0004**	−0.0000
	(−7.19)	(−0.12)	(0.28)	(1.98)	(0.12)
New money inflow	−0.0004	−0.0009***	−0.0004	−0.0001	−0.0009***
	(−1.39)	(−3.09)	(0.75)	(0.31)	(3.09)
Fund age	−0.0006***	0.0004***	0.0003**	0.0000	0.0004***
	(−3.76)	(4.63)	(2.45)	(1.04)	(4.63)
Lagged volatility	−0.0539***	−0.0638***	−0.0733***	−0.0529***	−0.0638***
	(−4.45)	(−6.91)	(4.59)	(5.80)	(6.91)
Turnover ratio	−0.0000	−0.0009***	−0.0008**	−0.0005**	−0.0009***
	(−0.01)	(−3.60)	(2.33)	(2.09)	(3.60)
12b-1 expense	0.0007*	0.0007***	0.0008*	0.0000	0.0007***
	(1.90)	(3.64)	(1.72)	(0.20)	(3.63)
Minimum required investment	−0.0017	0.0000*	0.0008	0.0000	0.0008*
	(−0.78)	(1.83)	(1.42)	(0.07)	(1.84)
Intercept	0.0426**	−0.0783***	−0.0573**	−0.0184**	−0.0783***
	(2.39)	(−4.82)	(2.40)	(2.41)	(4.81)
Clustering	No	Fund level	Fund level	Fund level	Fund level
Number of observations	2,867	2,867	1,094	2,867	2,867
R^2	0.21	0.15	0.17	–	0.15

This table presents the estimates of the following equation: $\alpha_{\text{return}, i} = \lambda_{\text{return}} + \beta_{\text{return}} C_i + \gamma_{\text{return}} F_i + \delta_{\text{return}} X_i + \nu_i$, where α_{return} represents the risk-adjusted return of the fund for a calendar year (defined as the intercept from the regression of monthly excess fund return on the four risk factors of market, SMB, HML, and UMD), C is the incentive in the advisory contract, F is the size of the fund family, and X represents other control variables.

We use only the funds belonging to one of the following three categories according to the ICDI classification in the CRSP database—LG, AG, and GI—and with at least 80% of assets invested in equities. Index funds are excluded from the analysis. Column 1 presents the results of fixed effect regression at fund level while columns 2–5 use clustering of standard errors at the fund level. In column 3, we restrict the sample to only those funds that have a concave fee structure. Column 4 uses an endogenous dummy variable that takes the value of 1 for linear contracts and 0 for concave contracts; with Average Account Size and Expense Ratio as instruments. All specifications include year dummies to control for time-fixed effects and category dummies to control for category-fixed effects. We also include dummies (unreported) to control for funds that have own-performance-based fee or rival-performance-based fee in all the regressions. The t-statistics are reported in parentheses. The symbols ***, **, * denote significance levels of 1%, 5% and 10%, respectively, for the two-tailed hypothesis test that the coefficient equals 0.

Indeed, given the negative relation between survival and incentives and the positive relation between incentives and performance, we expect that the very funds that are less likely to survive are also the funds with higher performance *ex ante*. Therefore, an estimation that does not account for survival probability will lead to a downwardly biased estimate of the impact of incentives on performance. Furthermore, as in the previous specifications, the relation between incentives and performance holds after controlling for fund-fixed effects. The specification takes into account any unobserved heterogeneity that leads to a spurious correlation between incentives and performance.

Next, we employ a portfolio-based estimation to study the performance of portfolios of funds grouped on the basis of incentives. This method allows us to control for potential errors induced by separately estimating the risk-adjusted return for funds, as in the previous multivariate analysis. At the beginning of each year, we rank funds into quintile portfolios based on incentives. These portfolios are rebalanced every year. The portfolio returns are computed by equally weighting the returns of the funds in the portfolio. We also form a spread portfolio between the highest and lowest incentive quintiles. The result is a time series of the returns of portfolios for 96 months in our sample period. We then regress the portfolio returns on the three Fama-French risk factors and the momentum factor using the following equation:

$$R_i - r_f = \alpha + \beta_1(MKT - r_f) + \beta_2 SMB + \beta_3 HML + \beta_4 UMD + \varepsilon_i, \quad (3)$$

where R_i is the fund return net of expenses for fund i, r_f is the risk-free rate, and the four risk factors are denoted by *MKT* (market portfolio), *SMB* (size portfolio), *HML* (book-to-market portfolio), and *UMD* (momentum portfolio). The risk-adjusted return, a, is the intercept of this regression. This model has been used to analyze mutual fund performance from Carhart (1997) onward and has been shown to have good explanatory power for the observed cross section of fund returns.

We also account for the probability of survival by using incentives to produce a relative ranking within groups sorted on survival probability (Figure 2). First, funds are sorted into five groups on the basis of their survival probability. The funds within each group are then sorted into quintile portfolios on the basis of their incentives. The top incentive quintiles from each of the five groups are then combined to form the portfolio of the highest incentive funds. The other incentive quintiles are aggregated in a similar manner. The five resultant portfolios of mutual funds sorted on incentives have similar within group variations in survival probabilities. Then, we estimate performance as the intercept from a regression of excess portfolio returns on the four risk factors.

The results are reported in Table 6. Panel A reports the results before accounting for survival probability; panel B reports the results after accounting for survival probability. The average monthly excess return for the top quintile is significantly higher than for the bottom quintile—before and after controlling for survival probability. The return of the portfolio of the top incentive quintile of funds is 60 basis points per month higher than the risk-free rate (63 basis points after controlling for survival probability), while the return of the portfolio of the bottom incentive quintile of funds is only 38 basis points per month higher than the risk-free rate (37 basis points after controlling for

Table 6
Fund performance versus incentives in the advisory contract

Portfolio	Average monthly excess return (1)	Standard deviation of monthly excess return (2)	Four-factor model: Alpha (3)	$R_m - R_f$ (4)	SMB (5)	HML (6)	MOM (7)	Adj. R^2 (8)
Panel A: Before controlling for survival probability								
1 (high incentive)	0.0060	0.0536	−0.0005	1.0285	0.2163	0.0623	0.0124	98.31%
			(−0.65)	(55.88)	(11.97)	(2.63)	(1.01)	
2	0.0042	0.0533	−0.0022	1.0147	0.2703	0.1039	−0.0244	97.89%
			(−2.66)	(49.50)	(13.43)	(3.93)	(−1.80)	
3	0.0042	0.0527	−0.0027	1.0243	0.2734	0.1387	0.0019	97.55%
			(−3.02)	(46.99)	(12.77)	(4.94)	(0.13)	
4	0.0040	0.0512	−0.0026	1.0217	0.1715	0.1354	0.0070	96.66%
			(−2.57)	(41.31)	(7.06)	(4.25)	(0.43)	
5 (low incentive)	0.0038	0.0543	−0.0027	1.0430	0.1474	0.0126	0.0410	97.99%
			(−3.19)	(51.23)	(7.37)	(0.48)	(3.04)	
1–5 spread	0.0023	0.0070	0.0022	−0.0145	0.0689	0.0497	−0.0287	18.07%
			(3.15)	(−0.86)	(4.17)	(2.29)	(−2.57)	
Panel B: After controlling for survival probability								
1 (high incentive)	0.0063	0.0531	−0.0002	1.0239	0.2235	0.0780	0.0044	98.50%
			(−0.32)	(59.61)	(13.25)	(3.52)	(0.38)	
2	0.0043	0.0533	−0.0022	1.0137	0.2695	0.0989	−0.0146	97.73%
			(−2.51)	(47.81)	(12.94)	(3.62)	(−1.04)	
3	0.0038	0.0542	−0.0033	1.0389	0.2933	0.1236	0.0139	96.95%
			(−3.18)	(41.57)	(11.95)	(3.84)	(0.84)	
4	0.0041	0.0509	−0.0023	1.0140	0.1657	0.1229	0.0009	97.49%
			(−2.67)	(47.58)	(7.92)	(4.47)	(0.06)	
5 (low incentive)	0.0037	0.0537	−0.0027	1.0426	0.1258	0.0309	0.0336	97.83%
			(−3.10)	(49.88)	(6.13)	(1.15)	(2.43)	
1–5 spread	0.0026	0.0071	0.0024	−0.0187	0.0977	0.0471	−0.0293	31.70%
			(3.82)	(−1.20)	(6.41)	(2.35)	(−2.85)	

This table presents the average performance for quintile portfolios of mutual funds sorted on incentives. Portfolios are equally weighted monthly, so the weights are readjusted whenever a fund disappears. Performance is measured as the intercept from a regression of excess portfolio return on the four risk factors: market, SMB, HML, and UMD. In panel A, the funds are sorted into quintiles on the basis of their Coles' incentive measure. For panel B, funds are first sorted into five groups on the basis of the quintile values of survival probability. Within each of the five groups, these funds are sorted further into quintile portfolios on the basis of incentives. In the next step, the top incentive quintiles from each of the five groups are combined to form the portfolio of the highest incentive funds. Similar aggregation is done for the other incentive quintiles. The five resulting portfolios of mutual funds sorted on incentives have similar within group variance in survival probabilities. Both panels in the table also report the difference in performance between the top and bottom quintiles of funds sorted on their incentive measure. The *t*-statistics are reported in parentheses.

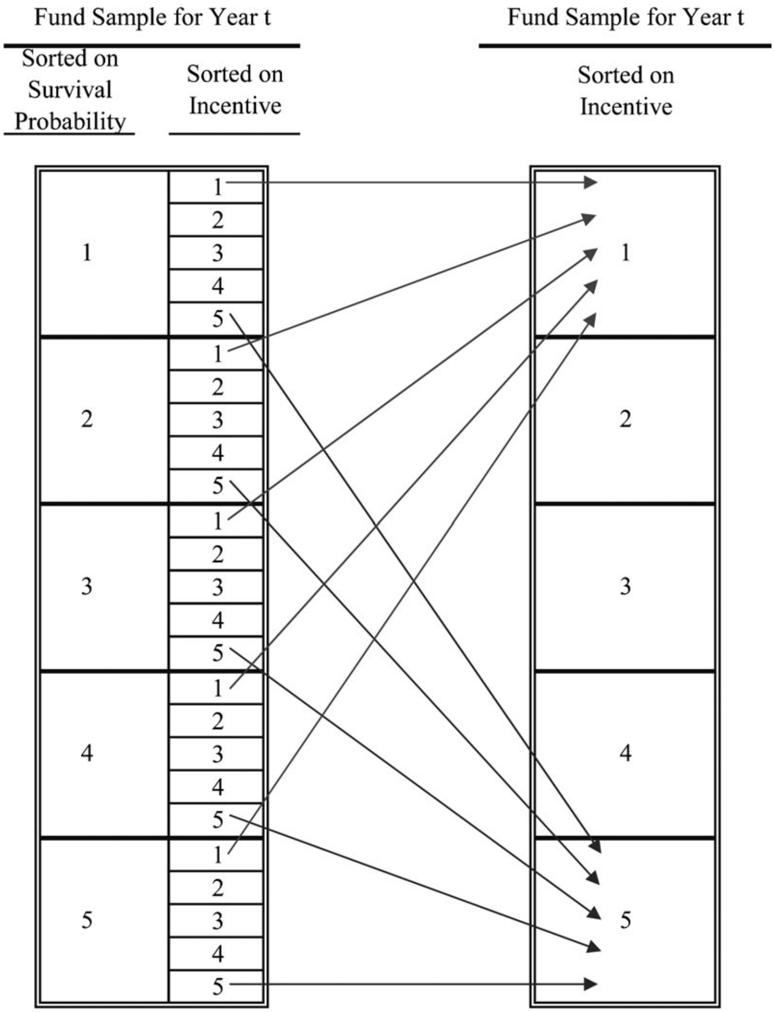

Figure 2
Illustration of the Double Sorting Procedure
The figure gives a graphical illustration of the double sorting procedure that is used to control for survival probability. Each year, we first sort the funds into five groups based on their survival probability. Then, within each of the five groups, the funds are further sorted into five subgroups based on their incentives. The top incentive subgroup from each of the survival groups is then aggregated to form the quintile portfolio of the highest incentive funds. Similar aggregation of the bottom incentive subgroups from each of the survival groups-leads to the quintile portfolio of the low-incentive funds.

survival probability). Indeed, the spread portfolio has a risk-adjusted return of 22 basis points per month (24 basis points after controlling for survival probability) above the four risk factors of market, SMB, HML, and UMD. The other interesting result is the loading on book-to-market and momentum factors. The high-incentive funds load significantly higher on the SMB and HML factors and significantly lower on the UMD factor than the low-incentive funds. Results are similar when the alternative measures of contractual incentives (WIR, DIR, and IR) are used.[9]

One potential issue is that the existence of a direct relation between fund-specific characteristics (e.g., size, age, or portfolio liquidity) and performance may induce a spurious correlation between incentives and performance.[10] To account for any nonlinear relation between fund characteristics and performance,[11] we analyze the relation between incentives and performance within different characteristics-based groups. We consider three main fund characteristics: size, age, and portfolio liquidity. Apart from the well-documented relation between size and performance, performance might also be related to the age of funds. Indeed, the families of young funds may help them generate higher performance, as younger funds have shorter track records that are easier to manipulate. The portfolio liquidity of mutual funds would indicate whether some funds generate superior performance by holding more illiquid stocks and thereby earning a liquidity premium.

We construct the average performance for quintile portfolios of mutual funds sorted according to incentives within tercile groups that are formed on the basis of three fund characteristics (size, age, and portfolio illiquidity). Mutual funds are first sorted into three groups on the basis of their characteristics; they are sorted further within each group into quintiles on the basis of CIR. Portfolios are weighted equally every month, so the weights are readjusted whenever a fund disappears. Performance is measured as the intercept of a regression of excess portfolio returns on the four risk factors commonly used: market, SMB, HML, and UMD.

The measure of illiquidity of the portfolio is based on the square-root version of the Amihud (2002) illiquidity ratio: $Illiq_{it} = \sum_j \theta_{jt} I2_{jt}$, where $\theta_{jt} = n_{jt} P_{jt} TNA_{it}$ is the portfolio weight in stock j at time t in the portfolio of fund i, and $I2$ is defined as the average of the square root of the ratio between absolute return and volume for a given stock (i.e., $I2_{jt} = \sqrt{|r_{jt}|/Vol_{jt}}$). The portfolio illiquidity of a mutual fund is then calculated as the value-weighted average of the individual stock's illiquidity in the fund's portfolio.

Table 7 reports the alphas of different portfolios formed on the basis of the above procedure. The difference in alphas between the high- and low-incentive funds is significantly positive, both before and after controlling for survival probability. This, in general, holds regardless of the breakdown in different

[9] It is worth mentioning that estimates of the intercept term of Equation (3) remain unchanged when we include Pástor and Stambaugh's (2003) liquidity factor as an additional risk factor. However, we report only the estimates of the four-factor model to make our results comparable with the literature.

[10] Deli (2002) shows a significant relationship between size and incentives. Chen et al. (2004) show that increases in funds' sizes lead to declines in fund performance.

[11] It is worth noting that we have controlled for fund characteristics in our multivariate analyses using a linear specification. Moreover, the use of fixed-effect regression methods helps us to control for any unobserved heterogeneity that remains constant over time.

Table 7
Fund performance and incentives within groups sorted on fund characteristics

	Size			Age			Illiquidity		
Portfolio	Large (1)	Medium (2)	Small (3)	Old (4)	Medium (5)	Young (6)	High (7)	Medium (8)	Low (9)
Panel A: Before controlling for survival probability									
1 (high incentive)	−0.0000	0.0003	−0.0016	−0.0019	−0.0009	−0.0019	0.0009	−0.0014	0.0001
	(−0.02)	(0.27)	(−1.57)	(−1.70)	(−1.07)	(−1.94)	(0.60)	(−1.14)	(0.16)
2	−0.0013	−0.0043	−0.0000	−0.0017	−0.0013	0.0011	−0.0047	−0.0027	−0.0006
	(−1.08)	(−3.70)	(−0.00)	(−1.65)	(−1.24)	(0.82)	(−3.26)	(−2.22)	(−0.93)
3	−0.0024	−0.0033	−0.0013	−0.0023	−0.0019	−0.0036	−0.0034	−0.0027	−0.0014
	(−2.45)	(−2.88)	(−1.31)	(−2.40)	(−2.01)	(−3.10)	(−1.86)	(−2.12)	(−2.23)
4	−0.0032	−0.0036	−0.0028	−0.0015	−0.0023	−0.0033	−0.0027	−0.0036	−0.0008
	(−3.06)	(−2.80)	(−2.15)	(−1.66)	(−2.51)	(−2.34)	(−1.76)	(−2.64)	(−1.28)
5 (low incentive)	−0.0023	−0.0024	−0.0037	−0.0030	−0.0033	−0.0046	−0.0043	−0.0035	−0.0012
	(−3.09)	(−1.82)	(−3.59)	(−3.19)	(−2.94)	(−3.52)	(−2.57)	(−3.02)	(−1.42)
1–5 spread	0.0023	0.0027	0.0021	0.0011	0.0024	0.0027	0.0052	0.0021	0.0013
	(2.25)	(2.06)	(1.76)	(0.96)	(1.77)	(2.36)	(3.34)	(2.31)	(1.41)
Panel B: After controlling for survival probability									
1 (high incentive)	0.0002	−0.0013	−0.0008	−0.0017	−0.0004	−0.0024	−0.0000	−0.0011	0.0004
	(0.26)	(−1.16)	(−0.79)	(−1.46)	(−0.40)	(−2.48)	(−0.02)	(−0.79)	(0.58)
2	−0.0008	−0.0022	−0.0003	−0.0016	−0.0013	0.0013	−0.0038	−0.0016	−0.0005
	(−0.83)	(−1.71)	(−0.28)	(−1.34)	(−1.28)	(0.92)	(−2.73)	(−1.25)	(−0.86)
3	−0.0015	−0.0030	−0.0027	−0.0024	−0.0022	−0.0032	−0.0042	−0.0025	−0.0018
	(−1.48)	(−2.65)	(−2.74)	(−2.28)	(−2.39)	(−3.17)	(−2.46)	(−1.97)	(−2.57)
4	−0.0027	−0.0028	−0.0043	−0.0015	−0.0028	−0.0033	−0.0031	−0.0033	−0.0012
	(−2.89)	(−2.21)	(−3.14)	(−1.60)	(−2.92)	(−2.11)	(−1.93)	(−2.26)	(−1.95)

(*continued overleaf*)

Table 7
(Continued)

	Size			Age			Illiquidity		
Portfolio	Large (1)	Medium (2)	Small (3)	Old (4)	Medium (5)	Young (6)	High (7)	Medium (8)	Low (9)
5 (low incentive)	−0.0019	−0.0030	−0.0049	−0.0027	−0.0031	−0.0048	−0.0037	−0.0040	−0.0015
	(−2.25)	(−2.58)	(−4.60)	(−2.98)	(−3.06)	(−3.58)	(−2.06)	(−3.27)	(−1.82)
1–5 spread	0.0021	0.0018	0.0041	0.0011	0.0027	0.0024	0.0037	0.0029	0.0019
	(2.25)	(1.75)	(3.61)	(0.91)	(1.98)	(2.11)	(2.39)	(2.26)	(2.00)

This table presents the average performance for quintile portfolios of mutual funds sorted on incentives within tercile groups formed on the basis of one of the three following fund characteristics: size, age, and portfolio illiquidity. We use the square-root version of the Amihud illiquidity ratio as the measure of stock illiquidity. The portfolio illiquidity of a mutual fund is then calculated as the value-weighted average of the individual stock's illiquidity in the portfolio of the fund. Specifically, $Illiq_{it} = \sum_j \theta_{jt} I2_{jt}$, where $\theta_{jt} = \frac{n_{jt} P_{jt}}{TNA_{it}}$ is the portfolio weight in stock j at time t in the portfolio of the fund i, and $I2$ is defined as the average of the square root of the ratio between absolute return and volume for a given stock, i.e., $I2_{jt} = \sqrt{\left|r_{jt}\right| / Vol_{jt}}$.

Mutual funds are sorted first into three groups on the basis of their characteristics, and within each group they are sorted further into quintiles on the basis of Coles' incentive rate. Portfolios are equally weighted monthly, so the weights are readjusted whenever a fund disappears. Performance is measured as the intercept from a regression of excess portfolio return on the four risk factors commonly used in the literature: market, SMB, HML, and UMD. $R_i - r_f = \alpha + \beta_1(MKT - r_f) + \beta_2 SMB + \beta_3 HML + \beta_4 UMD + \varepsilon_i$.

The table also reports the difference in performance between the top and bottom quintiles of funds sorted on their incentive measure. The table reports only the estimates of the intercept and their t-statistic.

sizes and illiquidity classes. In the case of age, higher incentives lead to higher performance, mostly in young funds. In addition, the results are similar when the alternative measures of contractual incentives (WIR, DIR, and IR) are used.

Overall, the findings reported in Tables 5–7 provide strong evidence for a positive impact of incentives on the risk-adjusted performance of mutual funds.

2.4 Incentives and performance persistence

An important dimension in our analysis is the persistence in fund performance. If incentives increase managerial efforts, this should translate to higher and *more stable* risk-adjusted performance. To study persistence in performance of mutual funds, we employ the standard test defined by Carhart (1997).

2.4.1 Incentives and performance persistence: main results. We start by confirming Carhart's (1997) results for our sample. On December 31, funds are sorted into decile portfolios on the basis of their risk-adjusted return for the calendar year, which is determined from a factor model using the three Fama-French factors and the momentum factor. For the following years, the returns on these alpha-sorted portfolios are calculated by equally weighting the returns of the funds in each of the portfolios. In addition, a spread portfolio is constructed as the difference between the top and bottom deciles. The time series of portfolio returns then are regressed on the risk factors, and a significant intercept in this regression provides evidence of persistence in performance. The (unreported) results show no evidence of significant persistence among the top decile of funds (the best funds from the previous year), while the intercept of the bottom decile continues to be negative and significant, which indicates that the worst funds have persistently poor performance, in line with the existing literature. The spread portfolio has a positive and significant intercept, which implies a significant performance differential between the best and worst funds from one year to the next. The results are robust when sorting is based on quintiles rather than deciles of the prior year's alpha. The results are qualitatively and quantitatively similar to those obtained by Carhart and others in the literature.

We next investigate whether incentives have an effect on performance persistence by modifying the standard test. As in the previous test, we first form quintile portfolios of funds on the basis of the prior year's risk-adjusted return. Within each performance quintile, we then separate the funds into five equal groups on the basis of their incentives. We define the funds with the highest incentives within each performance quintile as the high-incentive group and those with the lowest incentives as the low-incentive group. The procedure creates five alpha-sorted portfolios of high-incentive funds and another five alpha-sorted portfolios of low-incentive funds. For the next year, the portfolio returns are calculated by equally weighting the returns of the funds in the portfolios. We also form spread portfolios between the best- and worst-performing funds for both the high- and low-incentive groups.

To capture the difference in performance between funds with similar prior returns but different incentives, we also form two long-short portfolios. The first portfolio is long in funds that belong to the top alpha quintile of the high-incentive group, and short in funds that belong to the top alpha quintile of the low-incentive group. The second portfolio is long in funds that belong to the bottom alpha quintile of the high-incentive group, and short in funds that belong to the bottom alpha quintile of the low-incentive group. We then regress the portfolio returns on the four risk factors (Market, SMB, HML, and UMD).

In the next specification, we control for survival probability of the fund by modifying the sorting procedure. We first sort the funds each year into five groups on the basis of the survival probabilities estimated from our hazard rate model. Within each group, the funds are then sorted into quintiles on the basis of their prior-year risk-adjusted return. In the next step, the top performance quintiles from each of the five survival groups are aggregated to form the quintile portfolio of funds with the highest prior-year performance. The other quintiles of funds are obtained through similar aggregation. The resulting five quintiles of funds sorted on prior-year performance have similar within group variations in survival probabilities. The final step is to split the funds within each quintile into five groups on the basis of their incentives. We then proceed as before to form performance-sorted portfolios for both the high- and low-incentive groups.

The results are reported in Table 8. In panel B but not panel A, we control for the survival probability of the funds. The results show evidence of performance persistence among the funds with high-incentive contracts: the top performance quintile portfolio among the high-incentive funds has an alpha of 41 basis points per month in panel A and 37 basis points per month in panel B. On the other hand, the bottom performance quintile portfolio has a negative alpha of 77 basis points per month in panel A and a negative alpha of 67 basis points in panel B. The spread portfolio between the top and bottom quintiles has an alpha of 118 basis points per month in panel A and 104 basis points in panel B. We thus find strong evidence that performance persists not only for the worst-performing funds but also for the best-performing funds that have high incentives. No analogue for persistence is present for funds with low-incentive contracts.[12]

These results are quite striking. The failure of the previous literature to document performance persistence can be addressed by performing analyses that include conditioning based on funds' incentives. Indeed, the alleged lack of persistence previously reported may be simply due to the fact that funds with high and low incentives were grouped together. Our study provides one simple conditioning variable (incentive in the advisory contract) that fund investors can use to predict funds that are likely to generate superior performance.

[12] In fact, by being long in prior-year best-performing funds with high incentives and short in prior-year best-performing funds with low incentives, an investor can earn an alpha of 71 basis points per month in panel A (74 basis points in panel B).

Table 8
Performance persistence and incentives

Portfolio	Average monthly excess return (1)	Standard deviation of monthly excess return (2)	Four-factor model: Alpha (3)	$R_m - R_f$ (4)	SMB (5)	HML (6)	MOM (7)	Adj. R^2 (8)
			Panel A: Performance persistence and incentives					
High incentive								
1 (prior-year top performers)	0.0106	0.0637	0.0041	1.0167	0.3783	−0.1670	0.0915	93.74%
			(2.36)	(24.51)	(9.13)	(−3.15)	(3.32)	
2	0.0058	0.0549	−0.0000	1.0264	0.1468	−0.0272	0.0347	95.75%
			(−0.02)	(34.88)	(4.99)	(−0.72)	(1.77)	
3	0.0053	0.0468	−0.0004	0.9776	0.0535	0.2158	−0.0439	95.91%
			(−0.39)	(39.74)	(2.18)	(6.86)	(−2.69)	
4	0.0032	0.0540	−0.0028	1.0123	0.1854	0.0182	0.0271	94.67%
			(−2.08)	(31.25)	(5.73)	(0.44)	(1.26)	
5 (prior-year bottom performers)	0.0004	0.0565	−0.0077	1.0894	0.3158	0.2268	0.0371	89.03%
			(−3.79)	(22.39)	(6.50)	(3.64)	(1.15)	
1–5 spread	0.0102	0.0315	0.0118	−0.0727	0.0625	−0.3938	0.0544	28.69%
			(4.08)	(−1.05)	(0.91)	(−4.45)	(1.18)	
Low incentive								
1 (prior-year top performers)	0.0037	0.0611	−0.0030	1.0330	0.3320	−0.0782	0.0808	92.35%
			(−1.66)	(23.53)	(7.57)	(−1.39)	(2.77)	
2	0.0042	0.0509	−0.0011	1.0129	0.0380	0.0547	−0.0141	97.32%
			(−1.24)	(46.74)	(1.76)	(1.97)	(−0.98)	
3	0.0043	0.0510	−0.0007	1.0084	−0.0087	0.0127	0.0070	97.11%
			(−0.80)	(44.74)	(−0.39)	(0.44)	(0.47)	
4	0.0031	0.0507	−0.0028	1.0427	0.0075	0.1095	0.0222	96.03%
			(−2.53)	(39.71)	(0.29)	(3.26)	(1.27)	
5 (prior-year bottom performers)	0.0033	0.0592	−0.0035	1.1126	0.1903	0.0527	0.0315	91.34%
			(−1.83)	(24.56)	(4.20)	(0.91)	(1.05)	
1–5 spread	0.0004	0.0300	0.0004	−0.0796	0.1417	−0.1309	0.0492	9.48%
			(0.14)	(−1.07)	(1.91)	(−1.38)	(1.00)	
Long-short portfolio								

(*continued overleaf*)

Table 8
(Continued)

Portfolio	Average monthly excess return (1)	Standard deviation of monthly excess return (2)	Four-factor model					
			Alpha (3)	$R_m - R_f$ (4)	SMB (5)	HML (6)	MOM (7)	Adj. R^2 (8)
Top performance quintile: high incentive (1) − low incentive (1)	0.0069	0.0163	0.0071	−0.0164	0.0463	−0.0888	0.0107	5.74%
			(4.16)	(−0.40)	(1.13)	(−1.69)	(0.39)	
Bottom performance quintile: high incentive (5) − low incentive (5)	−0.0030	0.0220	−0.0042	−0.0232	0.1255	0.1741	0.0056	7.44%
			(−1.84)	(−0.42)	(2.28)	(2.47)	(0.15)	
Panel B: Performance persistence and incentives controlling for fund survival probability								
High incentive								
1 (prior-year top performers)	0.0107	0.0680	0.0037	1.0417	0.4501	−0.2029	0.1255	93.65%
			(2.00)	(23.38)	(10.12)	(−3.56)	(4.24)	
2	0.0069	0.0521	0.0016	0.9974	0.1172	0.0206	−0.0165	96.69%
			(1.52)	(40.49)	(4.76)	(0.65)	(−1.01)	
3	0.0036	0.0474	−0.0016	0.9820	0.0158	0.2178	−0.0819	96.79%
			(−1.75)	(44.47)	(0.72)	(7.71)	(−5.58)	
4	0.0040	0.0545	−0.0024	1.0056	0.2543	0.0168	0.0400	95.97%
			(−2.05)	(35.39)	(8.96)	(0.46)	(2.12)	
5 (prior-year bottom performers)	0.0013	0.0568	−0.0067	1.0895	0.2975	0.1867	0.0622	89.38%
			(−3.36)	(22.65)	(6.19)	(3.03)	(1.94)	
1–5 spread	0.0095	0.0342	0.0104	−0.0478	0.1526	−0.3895	0.0634	35.39%
			(3.51)	(−0.67)	(2.14)	(−4.26)	(1.33)	
Low incentive								
1 (prior-year top performers)	0.0032	0.0599	−0.0037	1.0659	0.3005	−0.0193	0.0660	93.71%
			(−2.29)	(27.28)	(7.70)	(−0.39)	(2.54)	
2	0.0029	0.0521	−0.0024	0.9942	0.1148	0.0097	−0.0164	97.27%
			(−2.54)	(44.45)	(5.14)	(0.34)	(−1.11)	
3	0.0054	0.0497	−0.0002	1.0134	−0.0152	0.0675	0.0342	96.35%
			(−0.18)	(41.03)	(−0.62)	(2.14)	(2.08)	
4	0.0033	0.0522	−0.0030	1.0631	0.0817	0.1478	0.0083	94.45%

			(−2.26)	(33.23)	(2.56)	(3.61)	(0.39)	
5 (prior-year bottom performers)	0.0027	0.0595	−0.0037	1.1075	0.1386	−0.0068	0.0508	91.29%
			(−1.94)	(24.26)	(3.04)	(−0.12)	(1.68)	
1–5 spread	0.0005	0.0273	−0.0000	−0.0416	0.1619	−0.0125	0.0152	4.47%
			(−0.01)	(−0.60)	(2.34)	(−0.14)	(0.33)	
Long-short portfolio								
Top performance quintile: high incentive (1) − low incentive (1)	0.0075	0.0202	0.0074	−0.0242	0.1497	−0.1835	0.0595	42.70%
			(4.48)	(−0.61)	(3.76)	(−3.60)	(2.25)	
Bottom performance quintile: high incentive (5) − low incentive (5)	−0.0015	0.0199	−0.0030	−0.0180	0.1589	0.1935	0.0113	14.08%
			(−1.53)	(−0.38)	(3.32)	(3.15)	(0.36)	

On December 31 of each year for the period 1996–2003, mutual funds are sorted first into quintile portfolios on the basis of their calendar year alphas from a four-factor model in panel A. Within each quintile portfolio, funds then are sorted further into five groups on the basis of the quintile values of Coles' incentive rate. For each alpha-based quintile portfolio, we classify the top incentive quintile as the high-incentive group and the bottom incentive quintile as the low-incentive group. For the following year ($t + 1$), funds with the highest alphas in year t comprise quintile 1 and funds with the lowest alphas comprise quintile 5.

In panel B, mutual funds are sorted first into five groups each year on the basis of the quintile values of survival probability. On December 31 of each year, mutual funds within each quintile group based on survival probability then are sorted further into quintile portfolios on the basis of their calendar year alphas from a four-factor model. In the next step, the top alpha quintiles from each of the five survival groups are combined to form the portfolio of the highest alpha funds. Similar aggregation is done for the other alpha-based quintile portfolios. The five resulting portfolios of mutual funds sorted on alphas have similar within group variance in survival probabilities. Then within each quintile portfolio, funds are further sorted into five groups based on the quintile values of Coles' incentive rate. For each alpha-based quintile portfolio, we classify the top incentive quintile as the high-incentive group and the bottom incentive quintile as the low-incentive group. For the following year ($t + 1$), funds with the highest alphas in year t comprise quintile 1 and funds with the lowest alphas comprise quintile 5.

The portfolios are equally weighted monthly, so that the weights are readjusted whenever a fund disappears. The portfolios of funds are rebalanced every year. To capture the difference in performance, we also form a spread portfolio between quintile 1 and quintile 5 for each of the two incentive groups. We also form two long-short portfolios. The first portfolio is long in funds that belong to the top alpha quintile in the high-incentive group and short in funds that belong to the top alpha quintile in the low-incentive group. The second portfolio is long in the funds that belong to the bottom alpha quintile in the high-incentive group and short in the funds that belong to the bottom alpha quintile in the low-incentive group.

The above procedure results in a total of 14 time series of returns. The excess returns of the quintile portfolios and the returns on the spread and long-short portfolios are then regressed on the four risk factors of market, SMB, HML, and UMD. The reported alphas in the table are the intercept of this model. We also report the average and standard deviation of raw excess returns for the portfolios. The t-statistics are reported in parentheses.

2.4.2 Incentives and performance persistence: robustness checks and more detailed analysis. As an additional check for robustness, we use an alternative method of sorting funds—sorting first on the basis of incentives and then on the basis of performance—rather than the usual method of sorting first on performance and then on incentives. We also control for survival probability. Similar to the method described above, we first sort funds into five groups on the basis of their survival probabilities. Within each group, we then sort funds into five groups on the basis of their incentives. Incentive groups are then aggregated from different survival groups, as described previously. The resulting groups of funds sorted on incentives have similar within group variation in survival probabilities. Finally, the funds within each of the highest- and lowest-incentive groups are further sorted into quintile portfolios on the basis of the prior year's risk-adjusted return. The (unreported) results are similar in economic and statistical magnitude to those described above.

Our results remain qualitatively and quantitatively robust when the Pástor and Stambaugh (2003) liquidity factor is included in the factor model. We report only the results of estimates based on the four-factor model for the sake of comparability with existing literature. In addition, the results are similar when alternative measures of contractual incentives (WIR, DIR, and IR) are used.

As an additional check for robustness, we also perform a multivariate analysis of performance persistence. We employ a probit model in which the dependent variable takes a value of 1 if the fund was a winner (a fund with a risk-adjusted return greater than the median fund for a given year) in the current and previous years and a value of 0 otherwise. The independent variables in the probit model include measures of incentives and other control variables as defined in previous sections. The (unreported) results show that the effect of the incentives is positive and significant. A 1% increase in incentive leads to an increased probability of winners' persistence of 4.33%. These findings confirm that incentives are related positively to higher performance and that this performance is stable.

Finally, we analyze the role of survivorship bias for the performance results in greater detail. Instead of aggregating across the survival probability quintiles, we provide a three by three table of the double sort. Mutual funds are sorted first into three groups each year on the basis of the tercile values of survival probability. Then, on December 31 each year, mutual funds within each (survival probability-based) tercile group are further sorted into tercile portfolios based on their calendar year alphas from a four-factor model. Within each tercile portfolio based on the prior year's performance, funds are sorted further into five groups on the basis of the quintile values of the contractual incentive. For each alpha-based tercile portfolio, we classify the top incentive quintile as the high-incentive group and the bottom incentive quintile as the low-incentive group.

The portfolios are equally weighted monthly, so the weights are readjusted whenever a fund disappears. The portfolios of funds are rebalanced every

Table 9
Performance persistence and incentives within survival terciles

	Survival probability					
	High-incentive funds			Low-incentive funds		
Prior-year performance	High	Medium	Low	High	Medium	Low
	Panel A					
Top performers	0.0013	0.0029	0.0048	−0.0028	−0.0034	−0.0010
	(0.51)	(2.02)	(2.23)	(−1.78)	(−2.21)	(−0.58)
Average performers	−0.0036	0.0001	−0.0006	−0.0021	−0.0018	−0.0005
	(−2.39)	(0.09)	(−0.53)	(−2.07)	(−1.05)	(−0.40)
Bottom performers	−0.0087	−0.0020	−0.0065	−0.0047	−0.0024	−0.0030
	(−3.13)	(−1.06)	(−2.78)	(−2.28)	(−1.30)	(−1.77)
Top-bottom spread	0.0101	0.0049	0.0113	0.0019	−0.0010	0.0020
	(2.58)	(2.13)	(3.69)	(0.63)	(−0.36)	(0.95)
	Panel B: Long-short portfolio (long in high-incentive funds, short in low-incentive funds)					
Top performers	0.0041	0.0063	0.0059			
	(2.09)	(3.50)	(2.79)			
Average performers	−0.0015	0.0019	−0.0001			
	(−1.04)	(1.05)	(−0.05)			
Bottom performers	−0.0040	0.0004	−0.0035			
	(−1.33)	(0.18)	(−1.50)			

Mutual funds are first sorted into three groups each year on the basis of the tercile values of survival probability. On December 31 of each year, mutual funds within each tercile group based on survival probability then are sorted further into tercile portfolios on the basis of their calendar year alphas from a four-factor model. Within each tercile portfolio based on prior-year performance, funds are sorted further into five groups on the basis of the quintile values of Coles' incentive rate. For each alpha-based tercile portfolio, we classify the top incentive quintile as the high-incentive group and the bottom incentive quintile as the low-incentive group. The portfolios are equally weighted monthly, so the weights are readjusted whenever a fund disappears. The portfolios of funds are rebalanced every year. To capture the difference in performance between prior-year top and bottom performers, we also form a spread portfolio for each of the two incentive groups. We also form long-short portfolios that are long in funds that belong to a given survival and prior-year performance tercile in the high-incentive group and short in funds that belong to the corresponding terciles in the low-incentive group. The above procedure results in a total of 14 time series of returns. The excess returns of the portfolios and the returns on the spread and long-short portfolios then are regressed on the four risk factors of market, SMB, HML, and UMD. We report only the intercepts of this model in the table. The t-statistics are reported in parentheses.

year. To capture the difference in performance between the prior year's top and bottom performers, we also form a spread portfolio for each of the two incentive groups. The alphas of the different portfolios are reported in Table 9 (panel A). Among the group of high-incentive funds, the top performers from one year continue to have superior risk-adjusted returns among the medium- and low-survival probability groups. Indeed, the performance differential between the best and worst funds is significant across all survival groups. There is, however, no evidence of persistence among funds with low-incentive contracts. This holds true regardless of the degree of survival probability.

To test for the difference in performance between high- and low-incentive funds with similar survival probability and prior-year performance, we form long-short portfolios. We go long in the funds belonging to a given survival tercile and prior-year performance tercile in the high-incentive group of funds and short in the funds that belong to the corresponding survival and prior-year performance terciles in the low-incentive group of funds. The results are reported in Table 9 (panel B). Regardless of the degree of survival probability, high-incentive winner funds in a given year significantly outperform low-incentive winner funds in the following year. This indicates that any observed outperformance by a high-incentive fund in a given year is more likely to be due to skill than luck. These results are similar when alternative measures of contractual incentives (WIR, DIR, and IR) are used.

2.4.3 Incentives and performance differential among mutual funds managed by the same manager or belonging to the same fund family. One interesting question is: As the same advisor may manage multiple funds for the same fund family, are there interactions between funds from the same family or under the same advisor? To address this issue, we estimate the performance differential between funds managed by the same manager or by the same fund family. We form pairs of funds managed by the same fund manager (or, alternatively, part of the same family) and go long in the fund with a linear contract and short in the fund with a concave contract.

The results are reported in Table 10. Columns 1–3 report the results where pairs are formed on the basis of funds managed by the same fund manager; columns 4–6 report the results with pairs formed on the basis of funds that are part of the same family (belonging to the same ICDI objective category). In columns 1 and 4, the pairs are aggregated to form a long-short portfolio, and then we regress the portfolio returns on the four risk factors of market, SMB, HML, and UMD. In columns 2 and 5, each individual pair's return is regressed on the four risk factors. In columns 3 and 6, we also include the differences in fund characteristics as explanatory variables. The results show that the performance differential between the high- and low-incentive funds is significantly positive and robust when controlling for unobserved managerial ability as well as family affiliation. Given the small sample size, however, the results are only indicative.

2.4.4 Incentives and managers' unobserved actions. We now examine in greater detail the channel through which incentives affect performance. We focus on the fund return, which is obtained by following a buy-and-hold strategy on the fund's disclosed portfolio, and the return gap, which is the difference between gross fund return and buy-and-hold fund return. The return gap captures the activism of mutual funds (Kacperczyk, Sialm, and Zheng, 2006), and is defined as the difference between the investor return and the buy-and-hold return from their disclosed portfolio.[13] A higher buy-and-hold return signals better portfolio allocation decisions by the fund manager, while a higher return gap indicates a higher positive contribution to fund performance by the trading and dynamic rebalancing of the funds' portfolio. It has been shown that "unobserved actions of some funds persistently create value, while the actions of

[13] Kacperczyk, Sialm, and Zheng (2006) provide a detailed description of the construction of the return gap.

Table 10
Performance differential among mutual funds managed by the same manager/fund family

	Fund return					
	Manager			Family		
		Pairs			Pairs	
Dependent variable	Portfolio (1)	(2)	(3)	Portfolio (4)	(5)	(6)
Average monthly return	0.0025	0.0007	0.0007	0.0018	0.0027	0.0027
Standard deviation of monthly return	0.0167	0.0178	0.0178	0.0112	0.0368	0.0368
Intercept	0.0037*	0.0019*	0.0028**	0.0020*	0.0026**	0.0024**
	(1.94)	(1.66)	(2.09)	(1.70)	(2.48)	(1.97)
$R_m - R_f$	−0.0738*	−0.0487*	−0.0465*	−0.0038	−0.0405	−0.0393
	(−1.66)	(−1.81)	(−1.72)	(−0.13)	(−1.53)	(−1.49)
SMB	−0.1519***	−0.0792***	−0.0765***	−0.0103	0.0208	0.0210
	(−3.49)	(−2.94)	(−2.83)	(−0.36)	(0.53)	(0.53)
HML	−0.0956*	−0.0390	−0.0325	0.0450	0.0079	0.0084
	(−1.75)	(−1.21)	(−1.00)	(1.21)	(0.15)	(0.16)
UMD	0.0129	−0.0067	−0.0068	−0.0342*	−0.0182	−0.0181
	(0.45)	(−0.41)	(−0.42)	(−1.80)	(−0.54)	(−0.54)
Effective fee rate	–	–	−0.0001	–	–	−0.0000
			(−1.53)			(−0.01)
Ln(Fund TNA)	–	–	0.0014	–	–	−0.0002
			(1.36)			(−0.48)
Fund age	–	–	−0.0001	–	–	0.0001
			(−1.03)			(0.19)
Turnover ratio	–	–	−0.0002	–	–	−0.0008
			(−0.17)			(−0.99)
Number of observations	72	276	276	96	1848	1848
R^2	0.1411	0.0385	0.0352	0.0477	0.0027	0.0034

The table reports the performance differential between funds that are managed by the same manager (columns 1–3) or the same fund family (columns 4–6). In the case of fund families, we put a further restriction that the funds belong to the same ICDI objective category.
In columns 1–3, we form pairs of funds managed by the same fund manager and go long in the fund with a linear contract and short in the fund with a concave contract. In column 1, the pairs are aggregated to form a long-short portfolio, and we regress the portfolio returns on the four risk factors of market, SMB, HML, and UMD. In column 2, each individual pair's return is regressed on the four risk factors. In column 3, we also include the differences in fund characteristics as explanatory variables.
In columns 4–6, we form pairs of funds managed by the same fund family that belong to the same ICDI objective category. We go long in the fund with a linear contract and short in the fund with a concave contract. In column 4, the pairs are aggregated to form a long-short portfolio and we regress the portfolio returns on the four risk factors of market, SMB, HML, and UMD. In column 5, each individual pair's return is regressed on the four risk factors. In column 6, we also include the differences in fund characteristics as explanatory variables. The t-statistics of the regression estimates are reported in parentheses. The symbols ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

others destroy value" (Kacperczyk, Sialm, and Zheng, 2006). The return gap measure has been created as a proxy for the unobserved actions of managers in the absence of direct information on their short-term trading strategies. Indeed, despite extensive disclosure requirements, it is not possible to observe all of the actions of fund managers. The exact timing of the trades, transaction costs, and dynamic trading strategies all are unknown.

Similar to our analysis on risk-adjusted fund returns, we form quintile portfolios sorted according to incentives. We calculate the portfolio buy-and-hold return as the equally weighted buy-and-hold return of the funds in the portfolio. The portfolio return gap is the equally weighted return gap of the funds in the portfolio. We regress the portfolio buy-and-hold returns and portfolio return gaps on the risk factors.

Table 11 reports the results for the return gap (panel A) and the buy-and-hold returns (panel B). The results indicate that there is no significant performance differential among the incentive-sorted portfolios in terms of buy-and-hold return: the spread portfolio has alphas that are statistically insignificantly different from zero. When we consider the return gap, however, there is a sizable and statistically significant difference among the incentive-sorted portfolios: before risk adjustment, the high-incentive portfolio has a positive return gap of 6 basis points per month, while the low-incentive portfolio has a negative return gap of 4 basis points per month. The spread portfolio between the high- and low-incentive funds has a positive and statistically significant alpha of 13 basis points per month. Results are similar when alternative measures of contractual incentives (WIR, DIR, and IR) are used.

As an additional check for robustness, we also perform a multivariate analysis on the return gap. We regress the annual risk-adjusted return gap on incentives, as well as the set of control variables defined previously. The (unreported) results show that the coefficients on incentive are positive and significant regardless of the proxy used to define the incentives.

These findings suggest that managers with higher incentives take actions that are beneficial to the funds' investors. The value created by their dynamic trading strategies more than offsets the cost. In addition, taken together with the lack of significance for the case of the buy-and-hold strategies, these findings suggest that the main channel through which incentives affect fund performance involves trading strategies and portfolio rebalancing. An investor who simply mimics the observed holdings of other high-incentive funds and rebalances every quarter would not be able to generate a significantly positive alpha.

2.4.5 Discussion. Overall, these findings show that contractual incentives play an important role in increasing risk taking by mutual funds. However, this does not translate into "poor man's alpha." Quite the opposite occurs, in fact: higher incentives are related to higher performance. The higher performance is due not only to the higher risk of the fund strategies but also to a genuine improvement in fund management.

One possible explanation lies in the relation between the fund manager and the fund family. Indeed, the advisory contract links the fund to the family and directly quantifies the benefits that accrue to the family from increased risk taking and higher performance. The fact that higher incentives provide a persistently higher performance may suggest that better information or support is provided to high-incentive funds. Fund families may provide managers with ways to perform better through cross-fund support and/or by smoothing the adverse effects of worse performance (e.g., by reducing the employment risk through job rotation within the family).

Table 11
Decomposition of fund return into return gap and buy-and-hold return

Portfolio	Average monthly return gap	Standard deviation of monthly return gap	Four-factor model: Alpha	$R_m - R_f$	SMB	HML	MOM	Adj. R^2
Panel A: Fund return gap and incentives								
1 (high incentive)	0.0006	0.0028	0.0008	−0.0172	0.0001	−0.0060	−0.0040	2.25%
			(2.50)	(−2.31)	(0.01)	(−0.63)	(−0.81)	
2	−0.0002	0.0026	−0.0001	−0.0075	−0.0030	0.0004	−0.0058	0.07%
			(−0.19)	(−1.11)	(−0.45)	(0.05)	(−1.30)	
3	0.0004	0.0024	0.0005	−0.0151	0.0029	−0.0106	−0.0019	3.09%
			(2.01)	(−2.45)	(0.48)	(−1.33)	(−0.47)	
4	0.0003	0.0026	0.0004	−0.0222	0.0043	−0.0050	0.0094	22.75%
			(1.51)	(−3.64)	(0.71)	(−0.63)	(2.33)	
5 (low incentive)	-0.0004	0.0029	−0.0005	−0.0072	0.0151	−0.0002	0.0118	13.53%
			(−1.88)	(−1.02)	(2.18)	(−0.02)	(2.52)	
1–5 spread	0.0010	0.0035	0.0013	−0.0100	−0.0150	−0.0058	−0.0158	9.16%
			(3.66)	(−1.15)	(−1.76)	(−0.52)	(−2.74)	
Panel B: Fund buy and hold return and incentives								
1 (high incentive)	0.0069	0.0535	0.0003	1.0401	0.1979	0.0787	0.0162	97.96%
			(0.31)	(51.54)	(9.99)	(3.02)	(1.21)	
2	0.0057	0.0534	−0.0011	1.0256	0.2755	0.1137	−0.0060	98.17%
			(−1.34)	(53.81)	(14.72)	(4.63)	(−0.47)	
3	0.0055	0.0528	−0.0015	1.0334	0.2639	0.1418	0.0063	97.54%
			(−1.62)	(47.17)	(12.27)	(5.02)	(0.44)	
4	0.0052	0.0523	−0.0013	1.0402	0.1595	0.1364	−0.0094	96.28%
			(−1.16)	(39.03)	(6.09)	(3.97)	(−0.53)	
5 (low incentive)	0.0055	0.0544	−0.0007	1.0473	0.1196	0.0124	0.0265	97.82%
			(−0.83)	(49.31)	(5.73)	(0.45)	(1.89)	
1–5 spread	0.0014	0.0067	0.0010	−0.0073	0.0783	0.0663	−0.0103	22.05%
			(1.51)	(−0.46)	(5.07)	(3.27)	(−0.99)	

This table presents the results from the analysis of impact of incentives on fund performance where fund returns are decomposed into return gap and buy-and-hold return. The portfolios are formed on the basis of the quintile values of Coles' incentive rate. Portfolios are equally weighted monthly, so the weights are readjusted whenever a fund disappears. Performance is measured as the intercept from a regression of return gap (or buy-and-hold return) on the four risk factors commonly used in the literature: market, SMB, HML, and UMD. Panel A presents the results with return gap, while panel B presents the results with buy-and-hold return. The t-statistics of the estimates are reported in parentheses.

In addition, these findings suggest that advisory contracts contain information useful for selecting funds. This, however, asks the question of how it could be possible in equilibrium. Indeed, if any observable fund-specific characteristic were useful to forecast fund performance, rational investors would be investing massively in funds with those characteristics and driving the other funds away from the market (Berk and Green, 2004). It can be argued that this does not happen because higher incentives, by increasing risk, also affect a fund's probability of survival. Given that funds with high-incentive contracts tend to be riskier, they are also more likely to disappear. So, attrition would actually eliminate the very funds for which higher incentives imply higher performance. In other word, incentives, by affecting risk and survival, would make it less likely for fund performance to persist. However, our analysis of survival, risk, and performance suggests that this is not the case. We therefore leave this as a puzzle that provides additional evidence in favor of predictability of fund performance (Gruber, 1996).

3. Conclusion

We test how incentives affect performance and risk taking in the US mutual fund industry. We hypothesize that incentives increase risk taking as well as performance and provide evidence to support our hypothesis. Incentives directly affect the unobserved actions of the fund managers, with higher incentives improving performance by increasing the return gap. By affecting performance and risk taking, incentives also affect the survival probability of the fund. When past performance is controlled for, an increase in incentives reduces the survival probability of the funds. We also show evidence of performance persistence among high-incentive funds, even after controlling for the survival probabilities of the funds.

These findings not only provide direct support for predictions of the theory on fund manager compensation but also quantify the role played by the type of compensation in the mutual fund industry. They also have implications in terms of the recent debate on mutual fund fees and managers' compensation in the United States. Indeed, if higher incentives increase both performance and risk in such a way that higher performance does not persist, the effect of higher incentives is likely to be neutral for investors and can be justified, most likely, in terms of producer surplus for the mutual fund management families. If, instead, they increase the risk-adjusted performance—as seems to be the case—incentives turn out to be a useful tool to motivate fund managers and increase welfare.

Appendix. Variable definitions

Variable	Database	Data items used	Explanation
Contract Variables:			
Coles' incentive rate	N-SAR-B	048A–048K, 075A, 075B	Difference between the last and the first fee rates divided by the effective fee rate.
Weighted incentive rate	N-SAR-B	048A–048K	Weighted average of the fee rates divided by the first applicable fee rate.
Dollar incentive rate	N-SAR-B	048A–048K	Difference between the last and the first fee rates multiplied by the TNA of the fund times the flow-performance sensitivity of the category that the fund belongs to in a given year.
Incentive ratio	N-SAR-B	048A–048K	Ratio of the fee rates that would be applicable due to a 10% increase in TNA versus a 10% decrease in TNA of the fund.
Effective fee rate	N-SAR-B	048A–048K, 075A, 075B	Effective marginal compensation rate based on the current reported total net assets of the fund.
Exogenous Variables :			
Family TNA	CRSP Mutual Funds	MGMT_NO, TNA	Total TNA of the family calculated from CRSP database.
Fund TNA	CRSP Mutual Funds	TNA	Total net assets.
New money inflow	CRSP Mutual Funds	TNA, RET	Net inflow into the fund as a percentage of TNA.
Fund age	CRSP Mutual Funds	YEAR, F_DATE	Time in years since the mutual fund began trading. If different classes have different age, the highest value is taken.
Fund return volatility	CRSP Mutual Funds	RET	Standard deviation of returns of the fund in the 12 months prior to the reported date of N-SAR filing.
Turnover	CRSP Mutual Funds	TURNOVER	Fund turnover ratio. Weighted average of turnovers of different classes of the fund.
12b-1 expense	N-SAR-B	043	Total expense of the mutual fund in pursuant of 12b-1 plan.
Minimum required investment	N-SAR-B	061	Lowest minimum initial investment required to become a shareholder of the mutual fund.
Performance based fee	N-SAR-B	051	A dummy variable that indicates if the mutual fund has an own-performance-based fee in the contract.
Fee on rival performance	N-SAR-B	052	A dummy variable that indicates if the mutual fund has a rival-performance-based fee in the contract.
Instruments:			
Average account size	N-SAR-B	075A, 075B, 074X	Total net assets divided by the number of shareholder accounts as reported by the mutual fund.
Expense ratio	CRSP Mutual Funds	EXPENSES	Average of the expense ratios for different classes of the fund.

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