Mutual Funds and Bubbles: The Surprising Role of Contractual Incentives

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This article studies one of the potential causes of the financial market bubble of the late 1990s: the herding behavior of mutual funds. We show that the incentives contained in the mutual funds' advisory contracts induce managers to overcome their tendency to herd. We argue that investing in bubble stocks amounts to herding and contracts with high incentives induce managers to diverge from the herd, thus reducing their holding of bubble stocks. The differential exposure to bubble stocks significantly impacted the funds' performance both in the period prior to March 2000, as well as afterwards. (*JEL* G23, G30, G31, G32)

Following the stock market bubble of the late-1990s, investment companies have attracted attention due to their potential role in exacerbating the situation by riding the bubble. In particular, Brunnermeier and Nagel (2004) find evidence that hedge funds did ride the technology bubble. The intuition for this apparently irrational behavior has been traced back to the limits to arbitrage. If agency issues require fund managers to keep a short-term perspective, then it is optimal for them to invest in overvalued stocks even though they are aware of the bubble. This argument is even more potent if fund managers are evaluated on the basis of relative performance because with relative evaluation, underperformance would mean losing future inflows. Even if a fund manager expects the stock market to collapse in the future, the manager would not be able to properly arbitrage away the mispricing because short-term underperformance would prevent him from having the assets needed to hold on to the position Shleifer and Vishny (1997).

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However, the seemingly irrational behavior described above is not a characteristic of the entire fund-management industry. There still were many managers who followed a contrarian strategy or at least held a cautious/prudent view toward the rising stock market.[1] In this article, we focus on a twofold question: whether the mutual fund industry contributed to the technology bubble of the late 1990s, and if so, what would have induced mutual fund managers to abstain from participating in the bubble frenzy. This has important implications in terms of whether fund managers can actually serve as a correcting force in an exuberant market.

We argue that contrarian behavior can exist within the mutual fund industry and it is a result of the trade-off between reputation concerns and the incentives contained in the advisory contract. In general, managers, uncertain about their own ability and concerned about their reputation, have a natural tendency to herd [Scharfstein and Stein (1990); Zwiebel (1995)]. In the mutual fund industry, reputation concerns are enhanced by the fact that investors select funds on the basis of the reputation of managers, as well as the performance record of the fund. Evidence of fund herding is abundant [Grinblatt et al. (1995); Wermers (1999)].

At the same time, the natural tendency to herd can be contrasted by the way compensation is structured. "Managers who care only about their reputation will always herd . . . but managers who care about profits ['compensation'] will have to trade off the loss of reputation against profits . . . Put differently, as the weight on profits increases, the range of parameter values over which there is herd behavior shrinks," [Scharfstein and Stein (1990)]. In the mutual fund industry, the effect of contractual incentives is magnified by the nonlinear relation between flow and performance such that winners receive a disproportionately high amount of future inflows [Chevalier and Ellison (1997)]. Given that compensation is based on the amount of assets under management, this increases the impact of the contractual incentives.

If the incentives are large enough to offset the negative effects of a loss of reputation, the manager will adopt a strategy leaning more toward risk-taking than herding. Therefore, in line with the theory on managerial herding, we expect to see less herding and more risk taking in the presence of a more incentives-loaded compensation structure. In other words, unless the payoff from superior performance is high, managers with reputation concerns will prefer to herd.[2]

This trade-off between incentives and reputation concerns provides interesting insights into the behavior of mutual fund managers, which in turn has important implications vis-à-vis stock market bubbles. Investing

[1] See Dow Jones News Service (1997), for instance.

[2] This can also be seen in a winner-takes-all or tournament context. If reputation and career concerns more than offset the gain from superior performance, managers will prefer to herd [Gaba et al. (2004)].

in “bubble stocks”[3] during the bubble period implies holding the same stocks that the other market participants are holding, which suggests a *herding* behavior. If the fund-manager’s objective is to minimize the chance of ranking at the bottom, then riding the bubble is the safe strategy.

What would be a riskier strategy? To diverge from the pack! In fact, this is the only strategy that would allow a fund manager to rank at the top.[4] This would be truer as the bubble reaches its peak and comes closer to the end because a higher probability of the bubble bursting increases the chances of being able to achieve the payoff resulting from the divergent behavior.[5]

In a general setting, if the managers have a tendency to herd, then the willingness to join the herd or to diverge from it will be related to the incentives contained in the advisory contract. In the specific case of a “bubble period,” since herding amounts to investing more in bubble stocks, greater contractual incentives effectively induce managers to invest less in bubble stocks and more in other—“old economy”—stocks. With high enough contractual incentives, the prospect of ranking at the top by diverging from the bubble would more than offset the incentives for having a high, but not the best, performance from riding the bubble.

We test this intuition using data on American mutual funds. We investigate the relationship between mutual funds’ holdings of bubble stocks and the incentives contained in their advisory contracts.[6] For this, we consider two periods: the bubble period (1997–1999) and the post-bubble period (2001–2003), that is, the period after the bubble burst. Year 2000 is pivotal because the major stock markets started their decline in 2000, and so we analyze periods around it. Since the NASDAQ Stock Market reached its peak in March 2000, we regard this as the point in time when the bubble burst.

We use three definitions of bubble stocks based on the stocks’ fundamental characteristics. These include the price-to-sales ratio, similar to Brunnermeier and Nagel (2004), the market-to-book ratio and the price-to-earnings ratio.[7] We first sort all the stocks in NASDAQ based on one of

[3] We will define “bubble stocks” more precisely further on, but it is worth noting that one of our definition is similar to the “technology stocks” that Brunnermeier and Nagel (2004) refer to.

[4] The prospect of ranking at the bottom still remains, but it’s the relatively higher payoff from ranking at the top that would make them ignore the downside.

[5] We have no reason to believe that this incentives-induced herding/diverging behavior of the mutual-fund managers described above does not persist in other periods; however, the reason we are focusing on the bubble-period of the late 1990s is that we are looking at this specific stock market event from a mutual funds perspective.

[6] We follow the literature [Coles et al. (2000); Deli (2002); Deli and Varma (2002); Kuhnen (2004); Warner and Wu (2004)] in using the compensation specified in these contractual arrangements as a proxy for the actual incentives received by the fund manager.

[7] We thank the referee for pointing out the latter two measures.

the three measures and define "bubble stocks" as those that are in the top quintile. We find that the higher the incentives in fund-managers' advisory contracts, the lesser these funds invest in bubble stocks. In particular, a one percentage increase in the incentives reduces the standardized portfolio weight in bubble stocks by almost 3%. As an alternative measure, we ignore the characteristics of the stocks and define bubble stocks based directly on the degree of observed herding. That is, NASDAQ stocks are ranked according to the degree of herding on them by mutual funds and the top quintile is defined as the bubble stocks. We then relate the holding of these stocks in a fund's portfolio to its incentives. Also in this case, higher incentives appear to directly and strongly reduce funds' portfolio weight in bubble stocks.

These findings have implications for the fund's performance as well. There is a statistically and economically significant difference between the performance of high-incentive and low-incentive funds, and this difference is related to the difference in their holdings of bubble stocks. If we compare low-incentive funds with "similar" high-incentive funds (i.e., matched on the basis of their main characteristics), we find that *before* the bubble burst, a smaller weight on bubble stocks in the portfolio of high-incentive funds results in lower returns relative to the matching low-incentive fund. The opposite effect is found in the period *after* the bubble burst—a smaller weight on bubble stocks in the portfolio of high-incentive funds leads to better performance relative to the matching low-incentive fund. That is, not holding bubble stocks was detrimental to their performance during the bubble period while the same proved beneficial after the bubble had burst. If the standardized holdings in bubble stocks of a high-incentive fund are 10% lower than those of the matching low-incentive fund, then this translates into a *loss* in performance of 2% per quarter during the bubble period and a *gain* in performance of 2.7% per quarter after the bubble burst, for the high-incentive fund relative to the low-incentive fund's performance.

This is consistent with the fact that managers with high incentives assign a bigger weight to the payoff in the event the bubble bursts. This induces them to optimally choose a strategy that delivers higher payoffs in that event, even if their assessment about the probability of it bursting is not different from that of the rest of the market. Of course, this may generate an *ex post* loss.

Our findings relate to four strands of literature. The first is the standard literature on bubbles, which has mostly focused on the macro [Flood and Garber (1994)] and micro [Abreu and Brunnermeier (2003)] conditions under which a bubble arises. This theoretical literature, however, has not considered the role of the delegated portfolio management industry in either initiating or aggravating a bubble.

The second piece of literature is the one on reputation and career concerns. Scharfstein and Stein (1990) and Zwiebel (1995) model the incentives for the managers to herd with their peers in order to preserve their reputation in a labor market with asymmetric information. These articles put forth the intuition that reputation concerns may affect managerial behavior. We build upon this literature by taking this basic intuition to explain mutual fund managers' behavior during the bubble.

The third body of literature that we relate to is the one that deals with the herding of institutional investors. Grinblatt et al. (1995) and Wermers (1999) document herding among mutual fund managers and Lakonishok et al. (1992) document herding among pension funds.

Finally, we also relate to the recent work on the characteristics of advisory contracts in the mutual fund industry. We build on the extensive literature that has studied advisory compensation and used it as a proxy for the actual incentives received by the fund managers [Coles et al. (2000); Deli (2002); Deli and Varma (2002); Kuhnen (2004); and Warner and Wu (2004)]. In particular, Deli (2002) looks at differences in advisory contracts offered to mutual fund managers and finds two types of contracts prevalent in the mutual fund industry: linear contracts and concave contracts. Differences in compensation are attributed to the differences in marginal product offered by the managers, differences in monitoring performance, and scale economies. Kuhnen (2004) and Warner and Wu (2004) look at changes in the advisory contract. Though the number of cases in which the contract changed is very small, it is shown that such changes benefit the investors. In a similar vein, Almazan et al. (2004) look at the constraints imposed on mutual fund managers in terms of trading restrictions.

We build on the main findings of these areas of research to explain fund managers' investment strategy during stock market bubbles. This allows us to make several important contributions. First, we show that, unlike what common wisdom would suggest, advisory contracts with high incentives *do not* induce investment in bubble stocks. On the contrary, fund managers with greater incentives invest less in bubble stocks. This suggests that high-incentive contracts do not exacerbate the bubbles, and instead may provide a useful counterweight to offset them. This has important normative implications for both, the investors and the market as a whole.

Second, from a more general perspective, our findings also contribute to the debate on executive compensation. There is a wide body of literature, starting with Murphy (1985) and Jensen and Murphy (1990), about the optimal incentive structure in the compensation of managers. The mutual fund industry provides a unique opportunity to study such an issue in a context in which it is possible to directly observe the action of the agents (fund managers), as well as instrument for the principal (investors) side of the market. Our findings show that the positive externalities in terms of restraining the development of the bubble may be quite sizeable.

Moreover, most of the recent debate on executive compensation has been cast in terms of demonizing managerial incentives. We provide a case in which incentives help to stabilize the market instead of destabilizing it.

The third contribution is more specific to the mutual fund industry. The recent debate on compensation has focused on the optimal fee setting and has considered the incentive structures that seem to favor advisory companies at the expense of the investors in the funds, as pathological. Our results show that there is another aspect to this compensation that has been largely ignored: the "stabilizing" effect on the market.

Last but not least, our results contribute to the literature on "limits of arbitrage" [Shleifer and Vishny (1997)]. It has been argued that riding a bubble could be the best strategy for an investment manager, as comparatively poor performance (due to not riding the bubble) would reduce the flow of new money into the fund. Therefore, even if the fund manager knows that stock prices are irrationally high and that there might be a stock market bubble, the manager will deliberately ride it. However, as mentioned above, the situation changes in the presence of incentives-loaded compensation: if the incentives are high enough, then the fund manager would prefer to deviate from the herd as the prospect of ranking at the top (in case the bubble bursts) more than offsets the incentives to have a high, but not the best, performance from riding the bubble.

The rest of the article is structured as follows. In Section 1, we lay out some testable restrictions. Section 2 describes the data and the construction of the variables. Sections 3 and 4 report the analysis of the relation between incentives and investment in bubble stocks, and the impact of investment in bubble stocks on fund performance, respectively. Section 5 contains a discussion of the results. A brief conclusion follows.

1. Hypotheses

Our goal is to investigate the role of mutual funds in perpetuating the stock market bubble of the late 1990s and to see how contractual incentives might have influenced the investment decision of fund-managers during this period. We start by describing two main features of the industry.

First, managerial performance contains "systematically unpredictable components of investment value" [Scharfstein and Stein (1990)]. Fund managers care about reputation. The track record provides information about the historical performance and bestows bargaining power vis-à-vis the fund family. Second, compensation is primarily related to the amount of assets under management.

The first characteristic implies the existence of reputation concerns. "Managers will be more favorably evaluated if they follow the decisions of others than if they behave in a contrarian fashion. Thus, an unprofitable decision is not as bad for reputation when others make the same mistake—they can share blame if there are systematically unpredictable shocks'' [Scharfstein and Stein (1990)]. This induces herding.[8]

The second characteristic defines the incentives not to herd. Compensation is linked to the assets under management. Moreover, the relation between future inflows and performance is nonlinear: outperforming funds receive a disproportionately high amount of inflows. This implies that the impact of compensation is magnified by the nonlinear flow-performance relation. An increase in compensation (i.e., higher fees as a percentage of assets under management) raises managers' incentives to take on more risk and reduces ''the range of parameter values over which there is herd behavior'' [Scharfstein and Stein (1990)].

Overall, these features suggest the existence of a trade-off between reputation concerns and compensation in line with Scharfstein and Stein (1990). The main implication is that, unless the payoff from higher performance is particularly high, managers trying to minimize their reputation concerns prefer to herd [Scharfstein and Stein (1990); Zwiebel (1995)].[9] With the lack of proper incentives, the manager will rather preserve his reputation through herding. If, however, the incentives embedded in the compensation structure are high enough to offset the negative effects of a loss of reputation, the manager will refrain from herding.[10]

What does all of this imply for the investment decision of the fund? During a stock market bubble, investing in bubble stocks effectively corresponds to *herding* because it implies holding the very same stocks that other market participants are holding. If the objective is to minimize the chance of ranking at the bottom, then riding the bubble is a safe strategy. To diverge from this pack is a risky strategy, but the only one that can allow a fund manager to come out at the top, especially as the bubble reaches the peak and the probability of it bursting becomes sizable.

Incentives will induce a different managerial behavior. Given that managers with high incentives assign a higher weight to the payoff in case the bubble bursts, they will optimally prefer an investment strategy that delivers higher payoffs in the event of the bubble bursting, even if their assessment about the probability of the bubble bursting is not different from that of the rest of the market. This generates a cross-sectional difference. If the contractual incentives induce managers to herd less,

[8] The tendency to herd is reinforced by the fact that mutual fund families evaluate their managers on the basis of the performance net of risk. It means, given that promotion and demotion are based on risk-adjusted measures Evans (2003), risk-taking is effectively sanctioned. This makes it more difficult to outperform by taking excessive risk.

[9] This result can be obtained also in a framework in which performance evaluation is relative (with respect to other managers) as opposed to absolute [see Gaba et al. (2004)].

[10] If the incentives in the compensation are high enough, the managers behave as in a standard winner-takes-all contest, increasing risk-taking in order to maximize the probability of ranking at the top.

they should also make managers invest less in bubble stocks and more in "old-economy" stocks.

Hypothesis 1. *The higher the contractual incentives, the less the managers invest in bubble stocks.*

We can therefore describe the decision to invest in bubble stocks as:

$$B = \alpha + \beta C + \gamma X, \tag{1}$$

where B represents the fraction of bubble stocks held in the portfolio of the fund, standardized by the weight of those bubble stocks in NASDAQ,[11] C is the incentive structure contained in the advisory contract, and X represents the fund characteristics that we control for. We expect $\beta < 0$ during the bubble period. That is, greater incentives induce funds to invest less in bubble stocks during the bubble period. The intuition is that higher incentives make it more desirable to outperform the competitors.

What does this imply in terms of fund performance? The fact that high-incentive funds invest less in bubble stocks should induce, *ex post*, a lower performance as long as the bubble persists. That is, during the bubble period these funds should exhibit poorer performance relative to other, similar funds that invest more in bubble stocks.

Hypothesis 2. *Higher incentives, by reducing the investment in bubble stocks, also hurt the performance of the funds during the bubble.*

At the same time, we would expect those high-incentive funds to perform better after the bubble has burst. We can therefore write:

$$R_H - R_L = \alpha + \beta(B_H - B_L), \tag{2}$$

where B_L and B_H represent the portfolio weights of bubble stocks held by a low-incentive fund and its matching high-incentive fund, respectively, while R_L and R_H represent the returns (or performance) of the same two funds.

We expect that $\beta > 0$ during the bubble period and $\beta < 0$ after the bubble has burst. This implies that relatively smaller holdings of bubble stocks by high-incentive funds would translate into relatively poor performance during the bubble period and better performance after the

[11] Alternatively, we standardized the fund's portfolio weight by the portfolio weight of the median fund in the fund's category. The standardization is done to account for the natural propensity of "growth" style funds to invest in growth stocks, which would be obvious candidates for bubble stocks, given our definitions.

bubble has burst. Of course, vice versa would be true for relatively larger holdings.

2. Data and Construction of the Main Variables

2.1 The data and the control variables

The data were gathered from several sources: fund advisory contract data from NSAR filings were available from the Securities and Exchange Commission's EDGAR database, fund performance data from the Center for Research in Security Prices (CRSP) Mutual Fund Monthly database, holdings of mutual funds from CDA/Spectrum Mutual Fund Holdings database, stock price data from the CRSP Monthly Stock database, and the accounting data were from the CRSP/Compustat Annual database. Mutual funds and other regulated investment management companies are required to file two NSAR forms annually: NSAR-A and NSAR-B. NSAR-A covers the first six months of the fiscal year for the particular investment management company, whereas NSAR-B covers the full year. NSAR forms have detailed information about contractual arrangement between the investors of the fund and the advisors (i.e., the managers). In this article, we only look at the annual NSAR-B filings that are reported during the years 1997–2003. We follow the literature [e.g., Deli (2002); Deli and Varma (2002); Kuhnen (2004); Warner and Wu (2004)] by using the compensation specified in these contractual arrangements as a proxy for the actual incentives received by the fund manager. The assumption is that, the higher the percentage of performance that accrues to the fund advisor, the higher should be the compensation of the manager.[12] The measure of compensation does not include the selling, marketing or administrative expenses of the fund.[13]

The NSAR dataset is then matched by fund name with the CRSP Mutual Fund Monthly database. We take observations only if the fund existed in the CRSP database in the same calendar year as the report date of NSAR-B filing. Also, as we are focusing on the stock market bubble, we pick only those funds that invest mainly in equity; such funds are identified by their ICDI Objective in the CRSP Mutual Fund Monthly database. One of the features of the mutual fund advisory contracts is that they are rarely changed [Kuhnen (2004); Warner and Wu (2004)]. Therefore, we

[12] Moreover, the relation between the fee's sensitivity to asset size and the fund's return is tight. Indeed, the fee is related to the assets under management and, therefore, to fund flows. The literature has shown that flows are strongly related to performance [Brown et al. (1996); Chevalier and Ellison (1997); Sirri and Tufano (1998); Nanda et al. (2004)].

[13] Indeed, one potential objection is that it may be possible that when a fund goes through a good period, it increases sales effort because clients are more open to buying shares. Thus, compensation should be shared between those generating the returns and those selling the funds. Our measure of compensation allows us to partly control for this concern as the measure captures the part of the overall fees paid by the fund that is not used to remunerate the selling efforts or to pay for the administrative or marketing expenses.

interpolated the structure of the advisory contract for years when we could not match the NSAR data to the CRSP data.[14] We also removed index funds and closed-end funds from our sample.

Next, this NSAR/CRSP merged-dataset is matched with the CDA/Spectrum Mutual Fund Holdings database [Wermers (1999)] using a link between CRSP Mutual Fund Monthly and CDA/Spectrum Mutual Fund Holdings. The resulting dataset merges characteristic information about individual funds and their quarterly stock holdings. It now includes information about advisory contracts, returns, flows, turnover, and stock holdings of the funds, among other things. The variables are defined in the Appendix and their summary statistics are presented in Table 1.

Since CRSP Fund data is reported at the funds' class-level, we follow the existing literature [e.g., Chen et al. (2004); Gaspar et al. (2006); Nanda et al. (2004)] and aggregate the return data at the fund level, weighting each class by its total net assets (TNA). The volatility of the funds' return is constructed as the standard deviation of returns in a calendar year. Fund size is the logarithm of TNA of the fund (summed for funds with multiple classes). The turnover and 12b-1 expenses are from the CRSP database and again aggregated at the fund level by weighting each class by its TNA. The fund's age is the number of years that the fund has traded for. If different classes of a fund have different ages, then we pick the highest among those. To control for the characteristics of the family that the mutual funds belong to, we use the total number of distinct funds in the family after combining different fund classes. The net inflow is calculated as the change in TNA from year $t-1$ to t after accounting for the fund's return.

From the NSAR dataset, we can identify the number of portfolio accounts that a mutual fund has, that is, the number of investors in the fund. Dividing the TNA by the number of investors, we get the size of an average shareholder account. Together with the expense ratio (weighted by TNA for multiple classes) of a fund, these represent our identifying variables that capture the causal relationship between the advisory contract and the funds' holdings, as well as performance. From the NSAR database, we also take the minimum initial investment required as an additional control variable in the subsequent analysis. Additionally, we control for explicit performance-based incentives. About 0.52% of the funds have a performance-based component of compensation and about 0.75% have a part of their compensation linked directly to their rivals' performance.

The accounting items are taken from CRSP/Compustat Merged Annual database. We use the following accounting items in our study: sales (DATA12), book value of equity (DATA60), and earnings per share

[14] For example, if we found matches for a fund in 1998 and 2000 but not in 1999, then we assume the structure of the contract to be the same in 1999 as it was in 1998.

Table 1
Summary statistics

Variable	N	Mean	Median	Std. Dev.
Coles' incentive rate	3852	−0.1003	0.0000	0.1786
Weighted incentive rate	3852	0.9640	1.0000	0.1370
Effective fee rate (in percentage)	3852	0.7698	0.7500	0.2561
ln (fund size)	3852	18.9715	18.9634	1.7406
Turnover	3852	0.9786	0.7300	0.9561
Fund return (annual)	3852	0.0806	0.1057	0.2814
Volatility of fund return	3852	0.0557	0.0526	0.0234
NASDAQ R-square	3852	0.6906	0.7456	0.2057
Number of funds in family	3852	48.9829	31.0000	51.6389
Age	3852	8.8294	6.0000	8.5605
Net inflow into the fund	3852	0.2498	−0.0084	1.1119
12b-1 expense	3852	0.1045	0.0025	0.2879
Minimum required investment (in millions of dollars)	3852	0.0561	0.0010	0.4345
Performance based fee	3852	0.0052	—	—
Fee on rival performance	3852	0.0075	—	—

This table presents the summary statistics of the variables. 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.

(EPS) (DATA58). For each of the three items, we take their moving average over the prior three years. We calculate price-to-sales as the ratio between current market value over sales; market-to-book as the ratio between current market value and book value; and price-to-earnings as the ratio between current price and EPS.

2.2 The measures of contractual incentives

We consider two aspects of the contract offered to the fund advisors: the shape and the slope. Mutual funds typically have either a linear contract that pays the advisory company a fixed percentage of assets under management ("fee rate"), or a concave contract that remunerates the advisor progressively less as the assets under management increase (a decreasing "fee rate"). Analysis of managerial compensation using this data has already been carried out by Deli (2002), Kuhnen (2004), and Warner and Wu (2004), among others. As is typical in the literature, about two-thirds of our sample funds have a linear contract and the remaining one-third have a concave contract.

For the slope of the advisory contract, we use the Effective Fee Rate (henceforth, EFR), which is defined as the fee rate being paid to the advisory company based on the current net assets of the fund.

For the shape of the contract—the one that better defines the incentive structure and on which we will mostly focus—we follow the literature. Deli (2002) uses a measure of "incentives" developed by Coles et al. (2000) that accounts for the shape of the contract. We construct this measure of incentives (henceforth, Coles' Incentive Rate or CIR) as the difference between the last and the first marginal fee rates, divided by the effective marginal fee rate. Thus, this measure takes a value of zero for linear contracts and negative values for concave contracts; accordingly, concavity decreases and incentives increase as the CIR measure increases.

However, this measure of incentives only takes the first and the last fee rate into account, and not the entire shape of the contract. Therefore, we develop a second measure of incentives (henceforth, Weighted Incentive Rate or WIR) as follows: the ratio of the weighted average of the marginal fee rates (i.e., the linearized fee rates) to the first applicable marginal fee rate. This measure is equal to one for a linear contract and less than one for concave contracts. Like the CIR described above, a higher WIR also implies greater incentives.

2.3 The measures of bubble investing

We now describe how we construct the variable that proxies for the fraction of the fund's portfolio invested in bubble stocks (B). We start by defining a "bubble stock." We consider alternative measures of "bubble-ness" of stocks. In order to relate to the existing literature [Brunnermeier and Nagel (2004)] we start by considering a measure based on the price-to-sales ratio. We also consider alternative measures that have traditionally been used to identify over-valued securities. These are based on market-to-book and price-to-earnings ratios.

In particular, we proceed as follows. In each year of our sample, we rank all the NASDAQ stocks on the basis of our definition of bubble-ness. We then define "bubble stocks" as the ones belonging to the top quintile. To determine the representation of these bubble stocks in a fund's portfolio (B), we standardize the sum of the weights of all the bubble stocks in the fund's portfolio by the portfolio weight of all the bubble stocks in the NASDAQ. We use this as a benchmark to see whether mutual funds herded by deviating from the NASDAQ towards certain favorite stocks.

As an alternative standardization, we also consider the sum of the weights of the bubble stocks in a given fund's portfolio divided by the portfolio weight of the bubble stocks in the median fund of the particular fund's category. This alternative standardization is done to account for the natural propensity of "growth" style funds to invest in growth stocks, which would be obvious candidates for bubble stocks, given our definition of bubble-ness. The results (unreported) based on this alternative standardization are consistent with our main set of results.[15]

A potential problem with this first set of measures of investment in bubble stocks (B) is that it is affected by the level of stock prices—once the bubble bursts, the price of what were bubble stocks drops, thus reducing their relative representation in the portfolio of the fund, regardless of any

[15] As a further robustness check, we also consider a sample based on defining bubble stocks as only those stocks that belong to the top decile, as opposed to top quintile, of the characteristic-sorted stocks. The results are qualitatively similar.

deliberate buying or selling by the fund. Therefore, as a robustness check, we also construct an alternative measure of the funds' holdings in bubble stocks. The bubble stocks are still defined as above, but to determine the representation of bubble stocks in the fund portfolio, we calculate the portfolio weights using the stock prices as of January, 1997 (which is the beginning of our 1997–2003 sample period) while adjusting the number of shares held for any stock-splits. So, the alternative measure for fund j's investment in bubble stocks is given by:

$$B^j = \left[\left(\sum_i P_i^{97} \times B_i^j \right) \Big/ TNA_j \right] \Big/ \left[\left(\sum_i P_i^{97} \times B_i^N \right) \Big/ MKT^N \right], \tag{3}$$

where P_i^{97} is the price of stock i in January, 1997 (or the first available price for stocks that had an initial public offering(IPO) after January 1997), B_i^j is the number of shares (adjusted for stock splits) of bubble stock i held by fund j, TNA_j are the TNA of fund j, B_i^N is the number of shares (adjusted for stock splits) of stock i traded in the NASDAQ and MKT^N is the overall NASDAQ capitalization in January 1997. It is worth noting that the first measure, mentioned above, is constructed in a manner similar to Equation (3), except that the contemporaneous price is used instead of the January 1997 price and contemporaneous NASDAQ capitalization is used instead of January 1997 capitalization. The alternative measure using the January 1997 price helps remove any price effects that might contaminate the first measure, thus capturing the effect on the investment behavior of mutual fund managers more cleanly.

Finally, we also consider a more agnostic definition of bubble stocks that ignores the fundamental characteristics of the stocks. We rely on the literature on herding by institutional investors [Lakonishok et al. (1992); Grinblatt et al. (1995)] to construct a measure of herding at the stock level. Then, we rank the stocks based on this herding measure and define the bubble stocks as the top quintile of the ranked stocks in NASDAQ.

We proceed as follows. We construct a measure of stock herding using the holdings data from CDA/Spectrum. This measure is constructed as in Lakonishok et al. (1992) and Grinblatt et al. (1995). It is defined as the Unsigned Herding Measure (*UHM*) and is based on trades conducted by a subset of market participants over a period of time. In our case, this subset is represented by the mutual funds that are matched to the NSAR database. Let $Buy(j,t)$ [$Sell(j,t)$] be the number of funds in the subset who buy [sell] stock j in quarter t. Then $UHM(j,t)$ is given by:

$$UHM(j,t) = |p(j,t) - p(t)| - E[|p(j,t) - p(t)|], \tag{4}$$

where $p(j,t) = Buy(j,t)/[Buy(j,t) + Sell(j,t)]$, and $p(t)$ is the average of $p(j,t)$ over all stocks j that were traded in quarter t. The second term is an adjustment factor (AF) that accounts for bias in $|p(j,t) - p(t)|$ that may arise in stock-quarters that are not traded by a larger number of funds. AF is calculated under the null hypothesis that $Buy(j,t)$ follows a binomial distribution with parameter $N(j,t)$ [$= Buy(j,t) + Sell(j,t)$] and $p(t)$. Under the null hypothesis, AF will go towards zero as the number of funds active in a stock-quarter increase. This defines a herding measure at the *stock level* and allows us to construct the portfolio weight in bubble stocks of the fund (B), where bubble stocks are defined as the top quintile of stocks sorted on their herding measure (UHM).

We also construct a herding measure at the *individual fund* level. We follow a methodology similar to Grinblatt et al. (1995). We define the Signed Herding Measure (SHM) that provides an indication of whether a mutual fund is following the crowd or going against it. For fund i, the SHM measure is given by:

$$SHM(i,j,t) = I(i,j,t) \times UHM(j,t) - E[I(i,j,t) \times UHM(j,t)], \quad (5)$$

where $I(i,j,t) = 0$ if $|p(j,t) - p(t)| < E[|p(j,t) - p(t)|]$; $I(i,j,t) = 1$ if $(p(j,t) - p(t)) > E[|p(j,t) - p(t)|]$ and the mutual fund is a buyer of the stock j in quarter t, or—$(p(j,t) - p(t)) > E[|p(j,t) - p(t)|]$ and the mutual fund is a seller; $I(i,j,t) = -1$ if $(p(j,t) - p(t)) > E[|p(j,t) - p(t)|]$ and the mutual fund is a seller of the stock j in quarter t, or—$(p(j,t) - p(t)) > E[|p(j,t) - p(t)|]$ and the mutual fund is a buyer. We put the restriction that $SHM(i,j,t) = 0$ if fewer than 10 funds are active in that stock-quarter. The indicator variable $I(i,j,t)$ captures the fact of whether the mutual fund is buying (selling) stock j when there are more buyers (sellers) in the same category, i.e., whether the mutual fund is herding with the crowd. The expectation term is calculated as in Grinblatt et al. (1995) and the explanation below replicates the Footnote (20) in their article.

Under the null hypothesis of independent trading decisions among funds, the number of trading funds that are buyers is binomially distributed. We can calculate the value of $E[I \text{ x } UHM]$ for stock j in quarter t using as parameters of the binomial distribution the number of funds trading stock j in quarter t ($N(j,t)$) and the proportion of trading funds in the population that are buyers ($p(t)$). Then for stock j in quarter t, we have:

$$\begin{aligned} E[I \times UHM] = & \sum_{p:\, p-p(t)>E|p-p(t)|} (2p-1) \times UHM(p) \times \Pr(p) \\ & - \sum_{p:\, -p-p(t)>E|p-p(t)|} (2p-1) \times UHM(p) \times \Pr(p), \quad (6) \end{aligned}$$

where, for the $N(j,t)$ discrete values that p can assume,

$$\Pr(p) = \binom{N}{Np} p(t)^{Np}\{1 - p(t)\}^{N-Np} \tag{7}$$

Finally, the Fund Herding Measure for the ith fund (FHM) in a calendar year is calculated as:

$$FHM_{i,t,q} = \sum_j w(j,t) - w(j,t-1) \times SHM(i,j,t), \tag{8}$$

$$FHM_{i,t} = \frac{1}{Q}\sum_q FHM_{i,t,q}, \tag{9}$$

where $w(j,t)$ is the portfolio weight on stock j at time t and Q is the number of quarters in a calendar year that we have the FHM measure of herding for fund i.

3. Incentives and Bubble Investing

3.1 Preliminary findings

We start with some preliminary evidence. In Table 2, we report the univariate differences in the portfolio weights in bubble stocks (unstandardized) between the high-incentive and the low-incentive funds. The separation between high- and low-incentive funds is based on the median value of concavity in the sample. We use all three measures of bubble stocks. The results show significant differences in portfolio weight between the high-incentive and the low-incentive funds, both statistically and economically. These differences are consistent for both mean and median values across different definitions of bubble stocks and for the three different time-periods. Panel A present the results for the period 1997–1999, Panel B for the period 2001–2003, while Panel C present the results the period 1997–2003, excluding 2000.

Table 3 provides a simple snapshot of the relation between the holdings of bubble stocks and the contractual incentives just before the bubble burst in a multivariate setting. For this purpose, we consider the last reported holdings of the funds before the end of the bubble period (i.e., either fourth quarter of 1999 or else the third quarter of 1999, if the fourth quarter data is not available) and we regress these on the funds' contractual characteristics. The incentive in the contract is measured either using the CIR or the WIR. The evidence from this simple cross-sectional regression helps us focus on what the mutual fund managers were holding during the peak of the bubble period, right before the bubble burst in March, 2000.

Table 2
Univariate differences of portfolio weight in bubble stocks

Panel A: Portfolio weight in bubble stocks 1997–1999

	Price/sales		Market/book		Price/earnings	
	(1) Mean	(2) Median	(3) Mean	(4) Median	(5) Mean	(6) Median
Low incentive funds	0.1097	0.0675	0.1215	0.0762	0.0774	0.0494
High incentive funds	0.0865	0.0506	0.0992	0.0558	0.0673	0.0413
Test statistic	3.93***	3.58***	3.62***	3.64***	2.41**	2.03**

Panel B: Portfolio weight in bubble stocks 2001–2003

	Price/sales		Market/book		Price/earnings	
	Mean	Median	Mean	Median	Mean	Median
Low incentive funds	0.1143	0.0748	0.1285	0.0794	0.0754	0.0510
High incentive funds	0.0960	0.0535	0.1093	0.0629	0.0659	0.0438
Test statistic	4.28***	5.38***	4.09***	4.71***	3.48***	3.35***

Panel C: Portfolio weight in bubble stocks 1997–2003

	Price/sales		Market/book		Price/earnings	
	Mean	Median	Mean	Median	Mean	Median
Low incentive funds	0.1128	0.0724	0.1261	0.0785	0.0760	0.0507
High incentive funds	0.0928	0.0528	0.1058	0.0598	0.0663	0.0426
Test statistic	5.76***	6.48***	5.42***	5.95***	4.23***	3.88***

This table presents the summary statistics of portfolio weight in bubble stocks for the high-incentive funds and for the low-incentive funds, as well as univariate tests for differences in means and medians between the two groups of funds. The separation between high-incentive and low-incentive funds is made based on the median value of concavity in the sample. Bubble stocks are defined as the top quintile of Price/Sales stocks in Columns (1)–(2), as the top quintile of Market/Book stocks in Columns (3)–(4), and as the top quintile of Price/Earnings stocks in Columns (5)–(6). Panel A presents the estimates from the pre-bubble period (1997–1999), Panel B from the post-bubble period (2001–2003), and Panel C from the overall sample period (1997–2003, excluding 2000). In each panel, the Test Statistic represents the two-tailed t-test in the case of means, and the two-tailed Wilcoxon test in the case of medians. The symbols ***, **, and * denote significance levels of 1%, 5%, and 10% respectively.

In Table 3, the price-to-sales ratio is the measure of bubble stocks in Columns (1)–(2), market-to-book ratio is the measure in Columns (3)–(4), while price-to-earnings ratio is the measure in Columns (5)–(6). The main finding is that during the peak of the bubble period, funds with higher incentives in the advisory contract were holding a relatively smaller fraction of their portfolio in bubble stocks. Fund managers with higher incentives in the form of a less concave advisory contract invested less in bubble stocks relative to the other funds in their category. This result holds whether we use the CIR measure of incentives (Columns 1, 3, and 5) or the WIR measure of incentives (Columns 2, 4, and 6). The results are also robust to controlling for various fund characteristics.

The impact of the incentives is not only statistically significant, but also economically significant. Indeed, if we focus on the price-to-sales ratio, a one percentage increase in the CIR leads to about a 1.19% (2.98% and 1.91% for the case of market-to-book and price-to-earnings ratios,

Table 3
Cross-sectional regression of portfolio weight in bubble stocks on concavity and effective fee rate

	Portfolio weight in bubble stocks					
	Price/sales		Market/book		Price/earnings	
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Coles' incentive rate	−1.5560***		−3.8279*		−2.5620***	
	(−4.43)		(−1.89)		(−4.12)	
Weighted incentive rate		−3.3726***		−14.4322*		−5.6245***
		(−4.42)		(−1.88)		(−4.16)
Effective fee rate	−0.4143	−0.4101	−1.1095	−1.9251	−0.4945	−0.7042
	(−0.77)	(−0.77)	(−1.31)	(−1.50)	(−0.80)	(−1.10)
ln (fund size)	−0.1325***	−0.1705***	−0.2382***	−0.5707**	−0.2149***	−0.2898***
	(−3.34)	(−3.76)	(−2.58)	(−2.14)	(−4.54)	(−4.78)
Turnover	0.1150	0.1083	0.0623	0.0788	0.0454	0.0597
	(1.45)	(1.36)	(0.98)	(1.23)	(0.55)	(0.72)
Fund return	0.5737	0.5455	0.3527	0.3307	0.0044	0.0068
	(1.43)	(1.36)	(1.07)	(0.99)	(0.01)	(0.02)
Volatility of fund return	4.7129	4.6578	9.0803*	7.7374	10.9183**	9.4519*
	(1.03)	(1.02)	(1.85)	(1.58)	(2.12)	(1.83)
NASDAQ R-square	0.5261*	0.5966**	0.2140	0.2731	0.4165	0.5388*
	(1.82)	(2.09)	(0.48)	(0.63)	(1.44)	(1.92)
Number of funds in family	0.0022**	0.0020**	0.0061**	0.0087**	0.0034***	0.0028***
	(2.55)	(2.42)	(2.14)	(2.07)	(3.20)	(2.91)
Age	−0.0063	−0.0077	−0.0334	−0.0549	−0.0181*	−0.0136
	(−0.91)	(−1.08)	(−1.48)	(−1.63)	(−1.80)	(−1.48)
Net inflow into the fund	0.0238	0.0136	0.0653	0.1268	0.0043	0.0049
	(0.88)	(0.51)	(1.13)	(1.43)	(0.11)	(0.13)
12b-1 expense	−0.0322	−0.0394*	−0.0786*	−0.1629*	−0.0659***	−0.0752***
	(−1.64)	(−1.93)	(−1.69)	(−1.82)	(−3.01)	(−3.24)
Minimum required investment	4.3891***	7.9177***	17.2784*	52.2252*	8.8943***	16.1369***
	(4.23)	(4.36)	(1.88)	(1.88)	(4.01)	(4.12)
Intercept	3.5666***	7.8046***	6.5531**	29.0689**	5.5066***	12.9404***
	(3.37)	(4.33)	(2.36)	(1.98)	(4.17)	(4.58)
Number of observations	445	442	462	456	444	439
R-square	16.07%	16.01%	15.18%	15.12%	12.88%	12.63%

This table presents the estimates of the following equation:

$$B = \alpha + \beta C + \gamma F + \varepsilon.$$

Here, B represents the portfolio weight in bubble stocks of the fund, standardized by the weight of those bubble stocks in the NASDAQ; C is the incentive structure contained in the advisory contract; and F represents fund characteristics. For each fund, we take the last reported observation before March 2000, but no earlier than the third quarter of 1999.

Bubble stocks are defined as the top quintile of Price/Sales stocks in Columns (1)–(2), as the top quintile of Market/Book stocks in Columns (3)–(4), and as the top quintile of Price/Earnings stocks in Columns (5)–(6). Coles' Incentive Rate (CIR) is the measure of concavity of advisory contract in Columns (1), (3), and (5), while Weighted Incentive Rate (WIR) is the measure of concavity in Columns (2), (4), and (6). The Effective Fee Rate (EFR) represents the level of advisory fee and is included in all the regressions.

Both equations are estimated using a two-step procedure. Since CIR is right-censored at 0 and WIR is right-censored at 1 in the sample, Tobit regressions of concavity regressed on the instruments and controls variables are used to calculate the estimated values of concavity. Similarly, the estimated value of EFR is obtained from an OLS regression of EFR on the instruments and control variables. Following Massa and Patgiri (2005), the "average account size" and the "expense ratio" are used as instruments for concavity and for EFRs. The estimated values of EFR and concavity are made orthogonal by regressing estimated EFR on estimated concavity and taking the residual. The residual, i.e., the part of estimated EFR that is orthogonal to concavity and the estimated concavity are then used in the second stage estimation that is reported below. 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 zero.

respectively) drop in our measure of relative bubble holdings. Similarly, a one percentage increase in WIR leads to a reduction of at least 2.5% in the bubble stock holdings depending on the definition of bubble stocks.

If we consider the other explanatory variables, we find that the size of the fund is significantly negatively correlated in all specifications with the holdings of bubble stocks. This means that larger funds had lower exposure to bubble stocks just before the bubble burst. However, it is interesting to note that funds belonging to larger families had a higher portfolio weight in bubble stocks. Although we remove funds that are identified as index funds in the NSAR filing from our sample, a potential issue is the degree of product differentiation in the mutual fund industry. Some mutual funds have an investment policy that mandates them to follow a particular benchmark (beta fund), while other funds are mandated to beat the benchmark and behave more like alpha funds. The first type of funds potentially has lower incentives in their advisory contract than the latter type, which would lead to their observed behavior.[16] To control for this, we regress monthly fund returns on the return of the NASDAQ Index over a calendar year and take the R-square from this regression as a control variable in our main multivariate regression. A fund with a higher R-square is more likely to be a beta fund and there is some evidence that they indeed hold more bubble stocks relative to their peers.

These results clearly indicate the presence of a relationship between the structure of fund managers' advisory contract and their holdings of bubble stocks. Although these findings are a good starting point, they provide only a static picture of the incentives–holdings relationship during the peak of the bubble. Moreover, we have not yet controlled for the potential endogeneity of the contractual structure. So, as the next step, we look at the bubble stock holdings of mutual fund managers in the three years prior to the bubble collapse and three years after, using a pooled-regression framework with proper control for endogeneity.

3.2 Methodology

Before reporting the results of our analyses, we lay out our methodology. Our goal is to assess whether the type of compensation affects the choice to invest in bubble stocks. We therefore estimate:

$$B_{it} = \alpha + \beta C_{it} + \gamma X_{it} + \delta C_{it} D + \varepsilon_{\text{it}}, \tag{10}$$

where B_{it} represents the fraction of the portfolio of the i^{th} fund invested in bubble stocks relative to the weight of all the bubble stocks in the NASDAQ capitalization, C_{it} represents the incentive structure of the

[16] We thank the referee for pointing out the alternative explanation.

advisory contract, and X_{it} is a vector of control variables. The dummy D takes a value of 0 in the period prior to year 2000 and is equal to 1 after year 2000. To control for fund characteristics, we use a full-fledged set of control variables. These include: size defined in terms of assets under management [*ln(Fund Size)*]; the turnover of the fund [*Turnover*]; its return [*Fund Return*], volatility of returns in the previous 12 months [*Volatility of Fund Return*]; the size of the fund's family measured by the number of funds it manages [*Number of Funds in Family*]; the number of years that the fund has been in existence [*Age*]; its inflows in the previous year [*Net Inflow into the Fund*]; level of its marketing fees [*12b-1 Expense*]; the minimum investment amount required to become an investor in the fund [*Minimum Required Investment*]; a dummy for whether the fund charges performance fees [*Performance-Based Fee*]; a dummy for whether fees are determined as a function of the performance of rival funds [*Fee on Rival Performance*]; and a dummy to account for exogenous geo-political events that occurred during our sample period.

A problem we have to deal with is the endogeneity of the contract. Both the advisory contract and the type of compensation structure may be affected by the investment strategy of the fund. For instance, greater incentives in the advisory contract may be due to the fact that the fund is operating in a particular category and investing more in stocks from a certain sector. Moreover, managers can self-select themselves. That is, less herd-prone managers can self-select themselves in running funds that invest in less herding-prone stocks.[17]

A first answer to the problem is related to a characteristic of the mutual fund industry: advisory contracts change very rarely [Kuhnen (2004); Warner and Wu (2004)]. This leads us to believe that greater incentives in the advisory contract may influence investment in bubble stocks, while the converse is less likely, that is, the development of a bubble in stock prices is less likely to induce a change in the contract written at the time the fund was established. A second control is due to the fact that we run our analysis in terms of investment in bubble stocks relative to all the other stocks in which funds in the same investment style invest. That is, the choice of the type of investment style of the fund—the most likely thing to be jointly determined with the contract—does not affect our analysis. Despite all these caveats, we acknowledge that compensation is effectively endogenous because advisors are able to negotiate the type of compensation they receive. We therefore perform a two-stage least squares estimation in which we first project the incentive features of the contract on the fund characteristics, as well as some identifying variables that define the choice of the contract. We then use the predicted values from the first

[17] Massa and Patgiri (2005) explores this issue in greater detail.

stage as the measures of advisory contract and test how these affect the funds' holdings of bubble stocks.

The identifying variables used in the first stage include the average size of the investors' accounts [*Average Account Size*] and the overall expense for the investors [*Expense Ratio*]. We expect that the bigger the stake, the greater will be the investor's awareness and/or incentive to monitor.[18] Therefore, the contract is more likely to be structured in a way that produces the highest incentives per unit of compensation (i.e., a lower average fee rate and a higher incentive component).

The level of overall expense should also be related to the incentives component of the contract. More specifically, the investors may find it optimal to structure the contract so that the incentives component is negatively related to the overall expense. This would make the incentives even more powerful as the manager will have to take more risk and herd less to guarantee the same level of compensation. As a result, we expect a negative correlation between incentives and the expense ratio.[19] As a robustness check, we repeat the analysis using average account size as the only instrument; the results do not differ.

Since CIR is right-censored at 0 and the WIR is right-censored at 1 in the sample, Tobit regressions of contract-concavity on the above two instruments and the aforementioned control variables are used to calculate the estimated values of concavity. Similarly, the estimated value of Effective Fee Rate is obtained from an OLS regression of EFR on the same instruments and control variables. Furthermore, the estimated values of the EFR and the CIR (WIR) are made orthogonal by using the residual from regressing the estimated-EFR on the estimated-CIR (estimated-WIR). The residual-EFR thus obtained and the estimated CIR (WIR) are then interacted with a dummy variable [*Dummy*] that takes a value of 0 before year 2000 and a value of 1 after year 2000.

The estimated CIR (WIR), the residual EFR, and the two interaction terms are then used in the second stage estimation of Equation (10), which characterizes the relationship between bubble stock holdings and incentives in advisory contracts. According to our hypothesis, we expect that $\beta < 0$, i.e., high incentives reduce the tendency to invest in bubble stocks during the bubble period.

[18] And indeed, to ascertain this assumption, we regress fund flows on past performance, average account size, an interaction between average account size and past performance. The (unreported) results support our hypothesis that the bigger the account size, the higher the sensitivity of outflows to past performance. That is, the bigger the average account size, the faster the investors pull money out of the fund. This suggests that these investors are more sophisticated.

[19] It is worth noting that this variable accounts for the other expenses of the funds (e.g., postage, transaction fees), as well as the remuneration for the manager. What really matters is the overall level of expense. We get similar results by using only the expense net of the remuneration part. These results are available upon request from the authors.

3.3 Main findings

Note that the holdings of mutual funds contained in the CDA/Spectrum database are at quarterly frequency while the details of the advisory contract are from NSAR-B filings that are submitted only annually. Due to this discrepancy in the frequency of the two data sources, we use the average of the four quarterly holdings for the calendar year in which the NSAR-B filing was submitted. In line with the resultant annual frequency of our data, we take year 2000 as the year when the bubble burst (because NASDAQ peaked on March 10, 2000), and collect data for the three years before and the three years after 2000. This gives us two sub-periods: 1997–1999 and 2001–2003.

The estimation of Equation (10) is performed by regressing our alternative measures of bubble stock holdings on the structure of fund-manager's advisory contracts and a set of control variables. The results are reported in Table 4. Panel A contains results for the specification based on CIR and EFR incentives, while Panel B contains results for the specification based on WIR and EFR incentives. We recall that for all the three measures—CIR, WIR, and EFR—an increase in the variable indicates higher incentives. Columns (1) and (2) present the results for the measure of bubble-ness based on the price-to-sales ratio, Columns (3) and (4) presents the results for the measure of bubble-ness based on the market-to-book ratio, and Columns (5) and (6) presents the results for the measure of bubble-ness based on the price-to-earnings ratio. Additionally, Columns 1 (2), 3 (4), and 5 (6) report the results from correcting the standard errors for clustering at the fund (family) level.

Column (1) of Table 4, Panel A shows that *during* the bubble period, higher incentives were correlated with a *smaller* portfolio weight of the fund in bubble stocks. Moreover, the value of the coefficient on the interaction of CIR and EFR with the "Dummy" reveals that *after* the bubble burst, the bubble stock holdings of these funds with higher contractual incentives increased relative to the previous period. These results are robust to controlling for various fund characteristics, as well as to clustering observations at the fund and at the fund's family level. Moreover, the results hold across the alternative definitions of bubble stocks (price-to-sales ratio, market-to-book ratio and price-to-earnings ratio).

Economically, a one percentage increase in CIR leads to a decrease in bubble stock holdings by about 3% in the case where bubble stocks are defined in terms of price-to-sales ratio (2.70% and 3.20% respectively for the case of market-to-book and price-to-earnings ratios). Similarly, a one basis point increase in EFR leads to a decrease of about 1.20% in the bubble stock holdings in the case bubble-ness is defined in terms of the price-to-sales ratio (0.75% and 1.10% respectively for the case of market-to-book and price-to-earnings ratios).

Table 4
Portfolio weight in bubble stocks versus concavity and effective fee rate

Panel A. Portfolio weight in bubble stocks versus Coles' incentive rate and effective fee rate

	Portfolio weight in top quintile of bubble stocks					
	Price/sales		Market/book		Price/earnings	
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Coles' incentive rate	−1.3285***	−1.3285***	−1.1847***	−1.1847***	−1.4254***	−1.4254***
	(−9.01)	(−8.11)	(−7.07)	(−6.46)	(−8.73)	(−7.36)
Coles' incentive rate × dummy	0.3274***	0.3274***	0.3469***	0.3469***	0.1683**	0.1683**
	(4.77)	(4.23)	(4.71)	(4.28)	(2.23)	(2.11)
Effective fee rate	−0.5279***	−0.5279***	−0.3273**	−0.3273**	−0.4740***	−0.4740***
	(−3.50)	(−3.21)	(−2.17)	(−1.97)	(−2.84)	(−2.51)
Effective fee rate × dummy	0.0232	0.0232	0.0062	0.0062	−0.1289	−0.1289
	(0.23)	(0.20)	(0.06)	(0.05)	(−1.09)	(−0.98)
ln (fund size)	−0.0451***	−0.0451***	−0.0399***	−0.0399***	−0.0573***	−0.0573***
	(−6.69)	(−6.53)	(−5.34)	(−5.23)	(−7.24)	(−6.76)
Turnover	0.0629***	0.0629***	0.0582***	0.0582***	0.0613***	0.0613***
	(6.07)	(5.56)	(5.54)	(4.79)	(5.41)	(5.08)
Fund return	0.2982***	0.2982***	0.2765***	0.2765***	0.3490***	0.3490***
	(11.57)	(9.85)	(10.46)	(8.99)	(11.69)	(10.55)
Volatility of fund return	10.6065***	10.6065***	9.5782***	9.5782***	10.9766***	10.9766***
	(16.49)	(14.91)	(14.75)	(13.31)	(15.20)	(13.17)
NASDAQ R-square	−0.2850***	−0.2850***	−0.2090***	−0.2090***	−0.4118***	−0.4118***
	(−4.57)	(−4.15)	(−3.27)	(−2.98)	(−5.74)	(−4.91)
Number of funds in family	−0.0001	−0.0001	0.0000	0.0000	−0.0003	−0.0003
	(−0.48)	(−0.39)	(0.28)	(0.25)	(−1.35)	(−1.24)
Age	−0.0107***	−0.0107***	−0.0096***	−0.0096***	−0.0135***	−0.0135***
	(−6.60)	(−6.12)	(−5.06)	(−4.70)	(−7.25)	(−6.64)
Net inflow into the fund	0.0003	0.0003	0.0030	0.0030	0.0087	0.0087
	(0.06)	(0.06)	(0.56)	(0.56)	(1.22)	(1.28)
12b-1 expense	0.1912***	0.1912***	0.1726***	0.1726***	0.1791***	0.1791***
	(7.34)	(6.75)	(6.48)	(6.05)	(6.22)	(5.17)
Minimum required investment	−0.0142	−0.0142	0.0028	0.0028	−0.0184	−0.0184
	(−0.89)	(−0.75)	(0.16)	(0.15)	(−1.06)	(−0.99)
Performance based fee	0.3642***	0.3642***	0.4292***	0.4292***	0.4131***	0.4131***
	(5.77)	(5.36)	(4.60)	(4.07)	(5.44)	(5.29)
Fee on rival performance	0.6044***	0.6044***	0.4981***	0.4981***	0.6754***	0.6754***
	(6.27)	(5.68)	(4.62)	(4.41)	(6.42)	(5.60)
Intercept	0.6522***	0.6522***	0.5806***	0.5806***	0.9821***	0.9821***
	(5.65)	(5.22)	(4.51)	(4.25)	(7.10)	(6.25)
Clustering	Fund	Family	Fund	Family	Fund	Family
Number of observations	3699	3699	3852	3852	3621	3621
R-square	32.71%	32.71%	27.73%	27.73%	28.06%	28.06%

Among the other explanatory variables, fund size has a negative impact on the dependent variable, i.e., larger funds hold less of the bubble stocks—a finding that confirms the result from Table 3. On the other hand, the bubble stock holdings are positively correlated with the fund's return and volatility, turnover of the fund, and 12b-1 expenses, while fund age and the NASDAQ R-square variable are negatively correlated with the holdings in bubble stocks. We also see some evidence that, relative to the bubble stock holdings during the bubble period, the higher incentives induce the funds to increase their holdings of bubble stocks after the bubble burst.

Table 4
(Continued)

Panel B. Portfolio weight in bubble stocks versus weighted incentive rate and effective fee rate

	Portfolio weight in top quintile of bubble stocks					
	Price/sales		Market/book		Price/earnings	
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Weighted incentive rate	−3.0218***	−3.0218***	−2.5453***	−2.5453***	−2.6626***	−2.6626***
	(−11.01)	(−9.95)	(−8.40)	(−7.71)	(−9.18)	(−7.70)
Weighted incentive rate × dummy	0.1704***	0.1704***	0.1590***	0.1590***	0.0771***	0.0771***
	(10.47)	(9.03)	(9.43)	(8.19)	(4.39)	(3.85)
Effective fee rate	−0.8997***	−0.8997***	−0.6136***	−0.6136***	−0.5461***	−0.5461***
	(−5.64)	(−5.16)	(−3.98)	(−3.63)	(−3.19)	(−2.82)
Effective fee rate × dummy	0.0183	0.0183	0.0075	0.0075	−0.1406	−0.1406
	(0.18)	(0.16)	(0.08)	(0.06)	(−1.19)	(−1.06)
ln (fund size)	−0.0804***	−0.0804***	−0.0688***	−0.0688***	−0.0752***	−0.0752***
	(−9.57)	(−9.30)	(−7.44)	(−7.26)	(−8.12)	(−7.34)
Turnover	0.0502***	0.0502***	0.0505***	0.0505***	0.0545***	0.0545***
	(5.04)	(4.67)	(4.95)	(4.35)	(4.90)	(4.58)
Fund return	0.4225***	0.4225***	0.3885***	0.3885***	0.3706***	0.3706***
	(14.39)	(12.88)	(12.87)	(11.59)	(10.95)	(10.11)
Volatility of fund return	11.9845***	11.9845***	10.6944***	10.6944***	10.9972***	10.9972***
	(16.90)	(15.34)	(15.15)	(13.62)	(14.54)	(12.56)
NASDAQ R-square	−0.4101***	−0.4101***	−0.2782***	−0.2782***	−0.3793***	−0.3793***
	(−6.65)	(−6.19)	(−4.72)	(−4.26)	(−5.52)	(−4.79)
Number of funds in family	−0.0008***	−0.0008***	−0.0006***	−0.0006***	−0.0008***	−0.0008***
	(−4.07)	(−3.58)	(−2.72)	(−2.57)	(−3.41)	(−3.09)
Age	−0.0129***	−0.0129***	−0.0108***	−0.0108***	−0.0120***	−0.0120***
	(−8.42)	(−8.01)	(−6.37)	(−6.09)	(−7.09)	(−6.64)
Net inflow into the fund	0.0050	0.0050	0.0087	0.0087	0.0140*	0.0140**
	(0.94)	(0.96)	(1.58)	(1.62)	(1.87)	(1.98)
12b-1 expense	0.1755***	0.1755***	0.1470***	0.1470***	0.1832***	0.1832***
	(6.43)	(6.02)	(5.18)	(4.96)	(5.87)	(4.92)
Minimum required investment	−0.0295*	−0.0295	−0.0117	−0.0117	−0.0272	−0.0272
	(−1.86)	(−1.54)	(−0.67)	(−0.60)	(−1.57)	(−1.45)

All these results are consistent in the case in which we consider the specification based on WIR and EFR incentives (Table 4, Panel B). WIR is significantly negatively related to the holding of bubble stocks, while the interaction term is positive and significant. A one percentage increase in incentives, measured in terms of WIR, led to a reduction of 6.9% in the case of the price-to-sales ratio, 5.8% in the case of market-to-book ratio, and 6% in the case where bubble stocks are defined based on the price-to-earnings ratio. Moreover, similar to the previous panel, fund size, NASDAQ R-square, and fund age are negatively related to bubble stock holdings, while fund's return, volatility, turnover, and 12b-1 expenses are positively related to bubble stock holdings.

These findings support our working hypothesis and show that there is a significant negative impact of the incentives embedded in the advisory contract on bubble stock holdings during the bubble period. The impact is still negative, even if less so, after the bubble burst. This suggests that both

Table 4
(Continued)

Panel B. Portfolio weight in bubble stocks versus weighted incentive rate and effective fee rate

	Portfolio weight in top quintile of bubble stocks					
	Price/sales		Market/book		Price/earnings	
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Performance based fee	0.3571***	0.3571***	0.4164***	0.4164***	0.3188***	0.3188***
	(6.17)	(5.94)	(4.48)	(3.94)	(4.36)	(4.19)
Fee on rival performance	0.7250***	0.7250***	0.5935***	0.5935***	0.5992***	0.5992***
	(8.18)	(7.59)	(6.13)	(5.95)	(6.31)	(5.53)
Intercept	4.2139***	4.2139***	3.5283***	3.5283***	3.9118***	3.9118***
	(10.31)	(9.41)	(7.83)	(7.26)	(8.83)	(7.48)
Clustering	Fund	Family	Fund	Family	Fund	Family
Number of observations	3672	3672	3820	3820	3593	3593
R-square	34.40%	34.40%	29.16%	29.16%	28.12%	28.12%

This table presents the estimates of the following equation:

$$B = \alpha + \beta C + \delta I + \gamma F + \varepsilon.$$

Here, B represents the portfolio weight in bubble stocks of the fund, standardized by the weight of those bubble stocks in the NASDAQ; C is the incentive structure contained in the advisory contract; I is the interaction of C with a dummy that takes the value of 0 before year 2000 and value of 1 after year 2000; and F represents fund characteristics.

Bubble stocks are defined as the top quintile of Price/Sales stocks in Columns (1)–(2), as the top quintile of Market/Book stocks in Columns (3)–(4), and as the top quintile of Price/Earnings stocks in Columns (5)–(6). Coles' Incentive Rate (CIR) is the measure of concavity of advisory contract in Panel A, while Weighted Incentive Rate (WIR) is the measure of concavity in Panel B. All observations are at fund-year level.

Both equations are estimated using a two-step procedure. Since CIR is right-censored at 0 and WIR is right-censored at 1 in the sample, Tobit regressions of concavity regressed on the instruments and controls variables are used to calculate the estimated values of concavity. Similarly, the estimated value of effective fee rate (EFR) is obtained from an OLS regression of EFR on the instruments and control variables. Following Massa and Patgiri (2005), the "average account size" and the "expense ratio" are used as instruments for concavity and for EFRs. The estimated values of EFR and concavity are made orthogonal by regressing estimated EFR on estimated concavity and taking the residual. The residual, i.e., the part of estimated EFR that is orthogonal to concavity and the estimated concavity are interacted with the dummy that takes the value of 0 before year 2000 and value of 1 after year 2000. The estimated concavity, the residual and the two interaction terms are then used in the second stage estimation that is reported below.

In both Panel A and Panel B, Columns (1), (3), and (5) present the results of estimation with standard errors adjusted for clustering at fund level. In Columns (2), (4), and (6), the standard errors are adjusted for clustering at the mutual fund family level. In all specifications, we use a dummy for year 2001 (unreported in the table) to separate out the effects of exogenous geo-political events. 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 zero.

during the bubble period and after the bubble burst the fund managers with higher incentives moved against the general trend and did not herd with the rest of the mutual fund industry.[20]

[20] It should be noted that the definition of bubble stocks is updated every year and therefore, after the bubble burst, the *new* "bubble stocks" are effectively the ones the market is moving to buy. So, a negative coefficient implies that the funds are again diverging from the herd.

These results are robust and consistent but the definition of the bubble stock holdings, even if standard in the literature is not immune to criticism. Indeed, as mentioned earlier, a change in the representation of the bubble stocks in the portfolio may just be due to a change in stock prices—this is more so for the bubble stocks than for the rest of the market. For instance, if the prices of bubble stocks crashed in the post-bubble period, then the first measure might wrongly deflate the bubble stock holdings of the fund. Therefore, we now consider a specification that defines the representation of bubble stocks in the portfolio by fixing January, 1997 prices and adjusting the number of shares held for stock-splits, as described in Equation (3).[21] This helps us capture the true trading behavior of the fund managers, without letting the price movements misleadingly affecting the results.

The results based on this alternative definition of bubble stock holdings are reported in Table 5. As in the previous case, Panel A contains results for the specification based on CIR and EFR incentives, while Panel B contains results for the specification based on WIR and EFR incentives. Columns (1) and (2) exhibit results for the measures of bubble-ness based on the price-to-sales ratio, Columns (3) and (4) exhibit results for the measures of bubble-ness based on the market-to-book ratio, and Columns (5) and (6) exhibit results for the measures of bubble-ness based on the price-to-earnings ratio. Additionally, Columns 1 (2), 3 (4), and 5 (6) report the results from correcting the standard errors for clustering at the fund (family) level.

Also in this case, the results show that the structure of the advisory contract has a significantly negative impact on the bubble stock holdings of the funds before the bubble burst, i.e., the greater the incentives, the lower is the investment in bubble stocks during the bubble period. One percentage increase in CIR leads to a reduction of 3% in bubble stock holdings in the case where bubble stocks are defined in terms of their price-to-sales ratio, 2.9% in the case of market-to-book ratio, and 2.3% in the case of price-to-earnings ratio. Similarly, one percentage increase in WIR leads to a decrease in portfolio weights in bubble stocks of 5.4% in the case of price-to-sales ratio, 5.7% in the case of market-to-book ratio, and 3.7% in the case of price-to-earnings ratio. Moreover, after the bubble had burst, these managers increased the fraction of their portfolio held in bubble stocks relative to the previous period. Also, all the additional control variables have similar effect on bubble stock holdings, as was found in Table 4. Effectively, the above results support our claim that fund managers with greater incentives followed a contrarian strategy.

[21] We use the January 1997 price only for calculating the portfolio weights of bubble stocks; for identifying the bubble stocks, we still use the contemporaneous price while calculating the P/S, M/B, and P/E ratios. In the case where a stock had its IPO after 1997, we take the first available price.

Table 5
Portfolio weight in bubble stocks versus concavity and effective fee rate using 1997 stock price

Panel A. Portfolio weight in bubble stocks versus Coles' incentive rate and effective fee rate using 1997 stock prices

	Portfolio weight in top quintile of bubble stocks					
	Price/sales		Market/book		Price/earnings	
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Coles' incentive rate	−0.6404***	−0.6404***	−0.6000***	−0.6000***	−0.4750***	−0.4750***
	(−5.12)	(−4.55)	(−5.72)	(−5.13)	(−4.38)	(−3.73)
Coles' incentive rate × dummy	0.2980***	0.2980***	0.2257***	0.2257***	0.2234***	0.2234***
	(5.99)	(5.26)	(4.91)	(4.43)	(4.46)	(4.34)
Effective fee rate	−0.2248*	−0.2248	−0.1575*	−0.1575	−0.0222	−0.0222
	(−1.88)	(−1.64)	(−1.69)	(−1.58)	(−0.21)	(−0.20)
Effective fee rate × dummy	0.2592***	0.2592***	0.1776***	0.1776***	0.1865**	0.1865**
	(3.26)	(2.86)	(2.95)	(2.59)	(2.48)	(2.14)
ln (fund size)	−0.0233***	−0.0233***	−0.0233***	−0.0233***	−0.0221***	−0.0221***
	(−4.60)	(−4.35)	(−5.06)	(−4.96)	(−4.37)	(−4.09)
Turnover	0.0256***	0.0256***	0.0277***	0.0277***	0.0221***	0.0221***
	(3.33)	(2.82)	(4.19)	(3.66)	(3.47)	(3.20)
Fund return	0.1338***	0.1338***	0.1186***	0.1186***	0.1774***	0.1774***
	(7.70)	(6.76)	(7.43)	(6.46)	(9.47)	(8.11)
Volatility of fund return	6.3991***	6.3991***	4.9834***	4.9834***	5.1723***	5.1723***
	(10.36)	(9.50)	(11.46)	(10.56)	(11.88)	(11.02)
NASDAQ R-square	−0.1052**	−0.1052*	−0.0484	−0.0484	−0.0855**	−0.0855**
	(−2.04)	(−1.87)	(−1.22)	(−1.11)	(−2.06)	(−1.98)
Number of funds in family	−0.0000	−0.0000	0.0001	0.0001	0.0001	0.0001
	(−0.06)	(−0.06)	(0.67)	(0.67)	(0.67)	(0.66)
Age	−0.0042***	−0.0042***	−0.0044***	−0.0044***	−0.0032**	−0.0032**
	(−3.10)	(−2.83)	(−3.62)	(−3.44)	(−2.53)	(−2.37)
Net inflow into the fund	−0.0006	−0.0006	0.0008	0.0008	0.0029	0.0029
	(−0.17)	(−0.17)	(0.24)	(0.24)	(0.71)	(0.72)
12b-1 expense	0.0893***	0.0893***	0.0912***	0.0912***	0.0792***	0.0792***
	(4.24)	(4.17)	(5.32)	(5.13)	(4.18)	(4.05)
Minimum required investment	−0.0008	−0.0008	0.0056	0.0056	0.0024	0.0024
	(−0.08)	(−0.06)	(0.54)	(0.49)	(0.23)	(0.19)
Performance based fee	0.1486**	0.1486*	0.2196***	0.2196***	0.1441***	0.1441***
	(2.12)	(1.80)	(3.63)	(3.63)	(2.76)	(3.07)
Fee on rival performance	0.1848**	0.1848**	0.2038***	0.2038***	0.0752	0.0752
	(2.42)	(2.19)	(3.16)	(2.91)	(1.15)	(0.97)
Intercept	0.2754***	0.2754***	0.3149***	0.3149***	0.3428***	0.3428***
	(3.13)	(2.85)	(4.05)	(3.79)	(3.90)	(3.54)
Clustering	Fund	Family	Fund	Family	Fund	Family
Number of observations	3703	3703	3827	3827	3613	3613
R-square	27.97%	27.97%	24.31%	24.31%	24.12%	24.12%

In Table 6, we present the univariate statistics of the characteristics of the average stock held in the portfolio of the mutual funds, separated into two groups based on incentives. The separation between high-incentive and low-incentive funds is made based on the median value of concavity in the sample. The characteristics presented in the table are: price-to-sales in Columns (1)–(2), market-to-book in Columns (3)–(4), and price-to-earnings in Columns (5)–(6). In each year for each fund, the price/sales value of the average stock in its portfolio is calculated

Table 5
(Continued)

Panel B. Portfolio weight in bubble stocks versus weighted incentive rate and effective fee rate using 1997 stock prices

	Portfolio weight in top quintile of bubble stocks					
	Price/sales		Market/book		Price/earnings	
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Weighted incentive rate	−1.1340***	−1.1340***	−1.1859***	−1.1859***	−0.7723***	−0.7723***
	(−4.82)	(−4.28)	(−5.91)	(−5.53)	(−3.90)	(−3.42)
Weighted incentive rate × dummy	0.0926***	0.0926***	0.0897***	0.0897***	0.0763***	0.0763***
	(6.80)	(5.86)	(7.87)	(7.19)	(6.16)	(5.64)
Effective fee rate	−0.3412***	−0.3412**	−0.2845***	−0.2845***	−0.0790	−0.0790
	(−2.60)	(−2.29)	(−2.84)	(−2.71)	(−0.73)	(−0.69)
Effective fee rate × dummy	0.2602***	0.2602***	0.1777***	0.1777***	0.1842**	0.1842**
	(3.26)	(2.92)	(2.91)	(2.62)	(2.44)	(2.14)
ln (fund size)	−0.0349***	−0.0349***	−0.0365***	−0.0365***	−0.0283***	−0.0283***
	(−5.26)	(−4.89)	(−6.19)	(−6.00)	(−4.70)	(−4.36)
Turnover	0.0208***	0.0208**	0.0240***	0.0240***	0.0188***	0.0188***
	(2.83)	(2.45)	(3.74)	(3.34)	(3.02)	(2.85)
Fund return	0.1830***	0.1830***	0.1759***	0.1759***	0.2124***	0.2124***
	(8.58)	(8.01)	(9.19)	(8.30)	(9.34)	(8.12)
Volatility of fund return	6.8398***	6.8398***	5.4865***	5.4865***	5.4592***	5.4592***
	(10.34)	(9.49)	(11.76)	(11.05)	(11.90)	(11.25)
NASDAQ R-square	−0.1364***	−0.1364**	−0.0781**	−0.0781*	−0.0983**	−0.0983**
	(−2.71)	(−2.47)	(−2.06)	(−1.87)	(−2.45)	(−2.42)
Number of funds in family	−0.0003*	−0.0003	−0.0002	−0.0002	−0.0001	−0.0001
	(−1.69)	(−1.56)	(−1.58)	(−1.59)	(−0.69)	(−0.64)
Age	−0.0047***	−0.0047***	−0.0049***	−0.0049***	−0.0033***	−0.0033***
	(−3.77)	(−3.43)	(−4.30)	(−4.24)	(−2.89)	(−2.81)
Net inflow into the fund	0.0008	0.0008	0.0034	0.0034	0.0051	0.0051
	(0.24)	(0.24)	(1.01)	(1.01)	(1.19)	(1.21)
12b-1 expense	0.0768***	0.0768***	0.0729***	0.0729***	0.0639***	0.0639***
	(3.36)	(3.34)	(3.97)	(3.82)	(3.02)	(2.94)
Minimum required investment	−0.0052	−0.0052	−0.0007	−0.0007	−0.0011	−0.0011
	(−0.50)	(−0.41)	(−0.07)	(−0.06)	(−0.11)	(−0.09)

as the equally-weighted mean of the price/sales values of all the stocks in the portfolio of the fund. Similarly, we calculate the market/book and price/earnings of the average stock in the portfolio of a fund in a given year. Panel A presents the estimates from the pre-bubble period (1997–1999), Panel B from the post-bubble period (2001–2003), and Panel C from the overall sample period (1997–2003, excluding 2000). The results clearly show that the average stock in the portfolio of low-incentive funds has a higher price-to-sales ratio, a higher market-to-book ratio, as well as a higher price-to-earnings ratio. The results are statistically and economically significant across the whole sample period, and especially during the bubble period.

Finally, as a robustness check, we consider the *FHM* that ignores the characteristics of the stocks the in the funds' portfolios and relate it to the incentives of the fund. As we mentioned above, this is a more agnostic

Table 5
(Continued)

Panel B. Portfolio weight in bubble stocks versus weighted incentive rate and effective fee rate using 1997 stock prices

	Portfolio weight in top quintile of bubble stocks					
	Price/sales		Market/book		Price/earnings	
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Performance based fee	0.1441**	0.1441*	0.2133***	0.2133***	0.1332***	0.1332***
	(2.22)	(1.93)	(3.64)	(3.77)	(2.66)	(3.04)
Fee on rival performance	0.2224***	0.2224***	0.2488***	0.2488***	0.0877	0.0877
	(3.28)	(2.98)	(4.20)	(3.98)	(1.54)	(1.32)
Intercept	1.5614***	1.5614***	1.6744***	1.6744***	1.1797***	1.1797***
	(4.55)	(4.06)	(5.69)	(5.31)	(3.96)	(3.50)
Clustering	Fund	Family	Fund	Family	Fund	Family
Number of observations	3676	3676	3796	3796	3584	3584
R-square	28.45%	28.45%	25.42%	25.42%	24.54%	24.54%

This table presents the estimates of the following equation:

$$B = \alpha + \beta C + \delta I + \gamma F + \varepsilon.$$

Here, B represents the portfolio weight in bubble stocks of the fund, standardized by the weight of those bubble stocks in the NASDAQ; C is the incentive structure contained in the advisory contract; I is the interaction of C with a dummy that takes the value of 0 before year 2000 and value of 1 after year 2000; and F represents fund characteristics.

Bubble stocks are defined as the top quintile of Price/Sales stocks in Columns (1)–(2), as the top quintile of Market/Book stocks in Columns (3)–(4), and as the top quintile of Price/Earnings stocks in Columns (5)–(6). Coles' Incentive Rate (CIR) is the measure of concavity of advisory contract in Panel A, while Weighted Incentive Rate (WIR) is the measure of concavity in Panel B. To account for the price-effect in the construction of the dependent variable B, the portfolio weight is calculated by multiplying, for each stock, the share price from the first month in the sample with the number of shares held after adjusting for stock-splits. Similarly, the total market capitalization of the NASDAQ is also held constant at the level in the first month of our sample period to calculate the standardization factor. All observations are at the fund-year level.

Both equations are estimated using a two-step procedure. Since CIR is right-censored at 0 and WIR is right-censored at 1 in the sample, Tobit regressions of concavity regressed on the instruments and controls variables are used to calculate the estimated values of concavity. Similarly, the estimated value of effective fee rate (EFR) is obtained from an OLS regression of EFR on the instruments and control variables. Following Massa and Patgiri (2005), the "average account size" and the "expense ratio" are used as instruments for concavity and for EFRs. The estimated values of EFR and concavity are made orthogonal by regressing estimated EFR on estimated concavity and taking the residual. The residual, i.e., the part of estimated EFR that is orthogonal to concavity and the estimated concavity are interacted with the dummy that takes the value of 0 before year 2000 and value of 1 after year 2000. The estimated concavity, the residual and the two interaction terms are then used in the second stage estimation that is reported below.

In both Panel A and Panel B, Columns (1), (3), and (5) present the results of estimation with standard errors adjusted for clustering at fund level. In Columns (2), (4), and (6), the standard errors are adjusted for clustering at the mutual fund family level. In all specifications, we use a dummy for year 2001 (unreported in the table) to separate out the effects of exogenous geo-political events. 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 zero.

measure based on a definition of herding that ignores any measure of bubble stocks. The *FHM* measure for the funds within each category is standardized and normalized. The standardized *FHM* measure is then regressed on the incentive variables of *CIR* (*WIR*) and *EFR*, while controlling for fund characteristics. We see from Table 7 that incentives are strongly negatively correlated with the *FHM*. Both concavity and

Table 6
Characteristics of the average stock in the portfolios of mutual funds

Panel A: 1997–2000

	Price/sales		Market/book		Price/earnings	
	(1)	(2)	(3)	(4)	(5)	(6)
	Mean	Median	Mean	Median	Mean	Median
Low incentive funds (LIF)	8.3990	5.6665	8.8400	8.1075	33.2547	29.3723
High incentive funds (HIF)	6.8551	4.0422	7.3312	6.2792	29.9841	26.1281
Test statistic	2.85***	6.41***	4.65***	6.07***	2.40**	3.98***

Panel B: 2001–2003

	Price/Sales		Market/Book		Price/Earnings	
	Mean	Median	Mean	Median	Mean	Median
Low incentive funds (LIF)	6.7075	4.1311	4.0908	4.6912	34.7756	25.9126
High incentive funds (HIF)	6.0267	3.3877	2.9452	4.0150	29.5498	22.9595
Test statistic	1.72*	6.09***	3.17***	6.44***	4.03***	4.48***

Panel C: 1997–2003

	Price/sales		Market/book		Price/earnings	
	Mean	Median	Mean	Median	Mean	Median
Low incentive funds (LIF)	7.2888	4.5258	5.7229	5.3541	34.2530	28.0171
High incentive funds (HIF)	6.3066	3.5676	4.4275	4.4486	29.6966	24.1372
Test statistic	3.06***	8.53***	4.74***	7.92***	4.69***	5.92***

This table presents the summary statistics of the average stock in the portfolios of the high-incentive funds and of the low-incentive funds, as well as univariate tests for differences in means and medians between the two groups. The separation between the high-incentive and low-incentive funds is made based on the median value of concavity in the sample. The characteristics presented in the table are: Price/sales in Columns (1)–(2), Market/Book in Columns (3)–(4), and price/earnings in Columns (5)–(6). In each year for each fund, the Price/Sales value of the average stock in its portfolio is calculated as the equally-weighted mean of the Price/Sales values of all the stocks in the portfolio of the fund. Similarly, we calculate the Market/Book and Price/Earnings of the average stock in the portfolio of a fund in a given year. Panel A presents the estimates from the pre-bubble period (1997–1999), Panel B from the post-bubble period (2001–2003), and Panel C from the overall sample period (1997–2003, excluding 2000). In each panel, the Test statistic represents the two-tailed t-test in the case of means, and the two-tailed Wilcoxon test in the case of medians. The symbols ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

the level of fee rate are statistically significant. Also, most of the control variables have similar sign as in the previous specifications.

Next, we define the bubble stocks as the top quintile of stocks sorted on their herding measure (*UHM*), constructed as in Lakonishok et al. (1992) and look at the portfolio weight of the funds in these stocks. The results are reported in Table 8. In Columns (1)–(3), the portfolio weight is regressed on the fund characteristics, while in Columns (4)–(6), the portfolio weight is standardized by the weight of those herded stocks in the NASDAQ Index before regressing on the fund characteristics. Panel A contains results for the specification based on CIR and EFR incentives, while Panel B contains results for the specification based on WIR and EFR incentives. In both Panel A and Panel B, Columns (2) and (5) present the results of estimation with standard errors adjusted for

Table 7
Fund herding measure versus concavity and effective fee rate

	Category standardized fund herding measure					
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Coles' incentive rate	-2.0962^{**}	-2.0962^{**}	-2.0962^{**}			
	(−2.36)	(−2.08)	(−2.15)			
Weighted incentive rate				-5.5495^{**}	-5.5495^{**}	-5.5495^{**}
				(−2.36)	(−2.09)	(−2.16)
Effective fee rate	-1.8788^{***}	-1.8788^{***}	-1.8788^{***}	-2.2998^{***}	-2.2998^{***}	-2.2998^{***}
	(−3.50)	(−3.02)	(−3.06)	(−3.22)	(−2.80)	(−2.86)
ln (fund size)	-0.1216^{***}	-0.1216^{***}	-0.1216^{***}	-0.1935^{***}	-0.1935^{***}	-0.1935^{***}
	(−3.43)	(−3.01)	(−3.04)	(−2.93)	(−2.59)	(−2.65)
Turnover	-0.1002^{***}	-0.1002^{***}	-0.1002^{***}	-0.1144^{***}	-0.1144^{***}	-0.1144^{***}
	(−5.22)	(−4.40)	(−4.75)	(−5.17)	(−4.44)	(−4.70)
Fund return	0.9133^{***}	0.9133^{***}	0.9133^{***}	1.0258^{***}	1.0258^{***}	1.0258^{***}
	(5.16)	(4.58)	(4.55)	(4.61)	(4.07)	(4.11)
Volatility of fund return	9.7888^{***}	9.7888^{***}	9.7888^{***}	11.9302^{***}	11.9302^{***}	11.9302^{***}
	(4.53)	(4.06)	(4.08)	(3.94)	(3.51)	(3.56)
NASDAQ *R*-square	-0.9447^{***}	-0.9447^{***}	-0.9447^{***}	-1.0638^{***}	-1.0638^{***}	-1.0638^{***}
	(−4.10)	(−3.63)	(−3.69)	(−3.85)	(−3.40)	(−3.47)
Number of funds in family	-0.0020^{***}	-0.0020^{***}	-0.0020^{***}	-0.0029^{***}	-0.0029^{***}	-0.0029^{***}
	(−3.56)	(−3.04)	(−3.12)	(−3.15)	(−2.74)	(−2.85)
Age	-0.0223^{***}	-0.0223^{**}	-0.0223^{**}	-0.0240^{**}	-0.0240^{**}	-0.0240^{**}
	(−2.60)	(−2.28)	(−2.40)	(−2.57)	(−2.25)	(−2.37)
Net inflow into the fund	0.0094	0.0094	0.0094	0.0139	0.0139	0.0139
	(0.67)	(0.66)	(0.66)	(0.97)	(0.95)	(0.96)
12b-1 expense	0.3298^{***}	0.3298^{**}	0.3298^{**}	0.5644^{***}	0.5644^{**}	0.5644^{**}
	(2.70)	(2.48)	(2.56)	(2.60)	(2.32)	(2.42)
Minimum required investment	-0.1249^{**}	-0.1249^{**}	-0.1249^{*}	-0.1249^{**}	-0.1249^{**}	-0.1249^{*}
	(−2.26)	(−1.97)	(−1.88)	(−2.25)	(−1.96)	(−1.87)
Performance based fee	0.3732	0.3732	0.3732	0.3487	0.3487	0.3487
	(1.04)	(0.93)	(1.03)	(0.98)	(0.88)	(0.98)
Fee on rival performance	0.5418	0.5418	0.5418	0.5625	0.5625	0.5625
	(1.41)	(1.23)	(1.27)	(1.42)	(1.24)	(1.29)
Intercept	1.7724^{***}	1.7724^{***}	1.7724^{***}	8.4022^{**}	8.4022^{**}	8.4022^{**}
	(3.25)	(2.87)	(2.91)	(2.51)	(2.22)	(2.29)
Clustering	None	Fund	Family	None	Fund	Family
Number of observations	3514	3514	3514	3494	3494	3494
R-square	4.61%	4.61%	4.61%	4.62%	4.62%	4.62%

This table presents the estimates of the following equation:

$$FHM = \alpha + \beta C + \gamma F + \nu.$$

FHM represents the fund herding measure for each fund, similar to the measure in Grinblatt et al. (1995). It is calculated at quarterly frequency, which is then averaged across the four quarters in a calendar year for the measure of stock herding used in Columns (1)–(4). *C* is the incentive structure contained in the advisory contract and *F* represents fund characteristics. Coles' Incentive Rate (CIR) is the measure of the concavity of advisory contract in Panel A, while Weighted Incentive Rate (WIR) is the measure of concavity in Panel B. All observations are at the fund-year level. Both equations are estimated using a two-step procedure. Since CIR is right-censored at 0 and WIR is right-censored at 1 in the sample, Tobit regressions of concavity regressed on the instruments and controls variables are used to calculate the estimated values of concavity. Similarly, the estimated value of effective fee rate (EFR) is obtained from an OLS regression of EFR on the instruments and control variables. Following Massa and Patgiri (2005), the "average account size" and the "expense ratio" are used as instruments for concavity and for EFRs. The estimated values of EFR and concavity are made orthogonal by regressing estimated EFR on estimated concavity and taking the residual. The estimated concavity and the residual, i.e., the part of estimated EFR that is orthogonal to concavity are then used in the second stage estimation reported below. Columns (2) and (5) present the results of estimation with standard errors adjusted for clustering at fund level. In Columns (3) and (6), the standard errors are adjusted for clustering at the mutual fund family level. In all specifications, we use a dummy for year 2001 (unreported in the table) to separate out the effects of exogenous geo-political events. 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 zero.

Table 8
Portfolio weight in bubble stocks based on herding versus concavity and effective fee rate

Panel A. Portfolio weight in bubble stocks based on herding versus Coles' incentive rate and effective fee rate

	Portfolio weight in bubble stocks			Standardized portfolio weight bubble stocks		
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Coles' incentive rate	−0.1125***	−0.1125***	−0.1125***	−0.3984***	−0.3984***	−0.3984***
	(−7.14)	(−6.57)	(−6.09)	(−6.09)	(−5.69)	(−4.91)
Effective fee rate	−0.0778***	−0.0778***	−0.0778***	−0.3925***	−0.3925***	−0.3925***
	(−6.42)	(−5.98)	(−5.34)	(−7.59)	(−7.02)	(−6.36)
ln (fund size)	−0.0059***	−0.0059***	−0.0059***	−0.0226***	−0.0226***	−0.0226***
	(−8.20)	(−7.32)	(−6.88)	(−7.27)	(−6.52)	(−5.93)
Turnover	0.0024***	0.0024**	0.0024**	0.0102**	0.0102**	0.0102**
	(2.84)	(2.43)	(2.57)	(2.22)	(2.09)	(2.01)
Fund return	0.0177***	0.0177***	0.0177***	0.0813***	0.0813***	0.0813***
	(6.18)	(6.38)	(5.78)	(5.49)	(5.54)	(4.85)
Volatility of fund return	0.4860***	0.4860***	0.4860***	3.4297***	3.4297***	3.4297***
	(8.48)	(8.18)	(7.08)	(13.53)	(13.15)	(11.53)
NASDAQ R-square	0.0031	0.0031	0.0031	−0.1026***	−0.1026***	−0.1026***
	(0.49)	(0.48)	(0.46)	(−3.60)	(−3.44)	(−3.08)
Number of funds in family	−0.0001***	−0.0001***	−0.0001**	−0.0004***	−0.0004***	−0.0004***
	(−4.33)	(−3.23)	(−2.47)	(−4.83)	(−3.55)	(−2.83)
Age	−0.0010***	−0.0010***	−0.0010***	−0.0035***	−0.0035***	−0.0035***
	(−5.67)	(−5.14)	(−4.64)	(−4.66)	(−4.21)	(−3.70)
Net inflow into the fund	−0.0002	−0.0002	−0.0002	0.0017	0.0017	0.0017
	(−0.25)	(−0.25)	(−0.25)	(0.66)	(0.65)	(0.68)
12b-1 expense	0.0428***	0.0428***	0.0428***	0.0309**	0.0309**	0.0309**
	(11.02)	(10.78)	(9.69)	(2.39)	(2.36)	(2.13)
Minimum required investment	−0.0058***	−0.0058***	−0.0058***	−0.0284***	−0.0284***	−0.0284***
	(−5.13)	(−4.61)	(−5.04)	(−6.63)	(−5.86)	(−6.23)
Performance based fee	0.0379***	0.0379***	0.0379***	0.0984***	0.0984***	0.0984***
	(4.13)	(3.91)	(3.26)	(3.29)	(3.13)	(3.24)
Fee on rival performance	0.0750***	0.0750***	0.0750***	0.2736***	0.2736***	0.2736***
	(5.89)	(5.93)	(5.20)	(5.81)	(5.76)	(4.99)
Intercept	0.1075***	0.1075***	0.1075***	0.4548***	0.4548***	0.4548***
	(7.99)	(7.19)	(6.98)	(7.84)	(7.13)	(6.49)
Clustering	None	Fund	Family	None	Fund	Family
Number of observations	3727	3727	3727	3727	3727	3727
R-square	14.42%	14.42%	14.42%	12.90%	12.90%	12.90%

clustering at fund level. In Columns (3) and (6), the standard errors are adjusted for clustering at the mutual fund family level. Consistent with the previous findings, it appears that *during* the bubble period, higher incentives were correlated with a *smaller* portfolio weight of the fund in bubble stocks. These results are robust to controlling for various fund characteristics, as well as to clustering observations around the fund and fund's family.

Overall these findings tell a consistent story of mutual fund managers reducing their holdings of bubble stocks the higher their incentives. That is, the fund managers with higher incentives moved against the general trend and did not herd with the rest of the mutual fund industry.

Table 8
(Continued)

Panel B. Portfolio weight in bubble stocks based on Herding versus weighted incentive rate and effective fee rate

	Portfolio weight in bubble stocks			Standardized portfolio weight in bubble stocks		
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Weighted incentive rate	−0.2813***	−0.2813***	−0.2813***	−0.8288***	−0.8288***	−0.8288***
	(−8.78)	(−8.19)	(−7.48)	(−6.50)	(−6.18)	(−5.44)
Effective marginal rate	−0.0994***	−0.0994***	−0.0994***	−0.4186***	−0.4186***	−0.4186***
	(−7.86)	(−7.45)	(−6.64)	(−7.91)	(−7.44)	(−6.79)
ln (fund size)	−0.0091***	−0.0091***	−0.0091***	−0.0298***	−0.0298***	−0.0298***
	(−9.67)	(−8.82)	(−8.25)	(−7.60)	(−6.96)	(−6.39)
Turnover	0.0015*	0.0015	0.0015*	0.0084*	0.0084*	0.0084
	(1.82)	(1.58)	(1.67)	(1.81)	(1.70)	(1.63)
Fund return	0.0176***	0.0176***	0.0176***	0.0784***	0.0784***	0.0784***
	(6.15)	(6.37)	(5.85)	(5.27)	(5.33)	(4.66)
Volatility of fund return	0.5392***	0.5392***	0.5392***	3.4673***	3.4673***	3.4673***
	(9.62)	(9.38)	(8.14)	(13.85)	(13.64)	(12.13)
NASDAQ R-square	−0.0018	−0.0018	−0.0018	−0.0942***	−0.0942***	−0.0942***
	(−0.32)	(−0.31)	(−0.30)	(−3.54)	(−3.44)	(−3.13)
Number of funds in family	−0.0001***	−0.0001***	−0.0001***	−0.0005***	−0.0005***	−0.0005***
	(−6.67)	(−5.27)	(−4.19)	(−5.85)	(−4.53)	(−3.77)
Age	−0.0011***	−0.0011***	−0.0011***	−0.0030***	−0.0030***	−0.0030***
	(−6.90)	(−6.28)	(−5.60)	(−4.60)	(−4.16)	(−3.73)
Net inflow into the fund	0.0006	0.0006	0.0006	0.0032	0.0032	0.0032
	(0.98)	(0.97)	(1.00)	(1.23)	(1.21)	(1.26)
12b-1 expense	0.0507***	0.0507***	0.0507***	0.0452***	0.0452***	0.0452***
	(12.15)	(11.86)	(10.65)	(3.17)	(3.14)	(2.83)
Minimum required investment	−0.0068***	−0.0068***	−0.0068***	−0.0292***	−0.0292***	−0.0292***
	(−6.04)	(−5.45)	(−5.86)	(−6.84)	(−6.08)	(−6.44)

4. Incentives and Performance

4.1 Returns, incentives, and bubble holdings

We now move on to see how the mutual funds' returns are affected by their incentives-induced investment behavior. This provides an important positive, as well as normative insight on the effects of incentives for the investors in the fund. We start with some preliminary evidence. We perform the following pooled regression of fund returns on a group of explanatory variables:

$$R_{it} = \alpha + \beta B_{it} + \gamma C_{it} + \delta(B_{it} \times C_{it}) + \lambda X_t + \varepsilon_{it}, \qquad (11)$$

where R_{it} represents the returns of fund i in period t, B_{it} are the standardized bubble stock holdings (calculated using the contemporaneous stock price) of fund i in period t, C_{it} is a vector that controls for the structure of the advisory contract for fund i in period t (i.e., C_{it} includes both, EFR and a dummy for whether the contract is concave or not), X_t is a set of control variables including fund size, family size in terms of the number of funds belonging to the family, turnover of the fund in the previous year, fund's age, net inflow in the previous year, and 12b-1

Table 8
(Continued)

Panel B. Portfolio weight in bubble stocks based on Herding versus weighted incentive rate and effective fee rate

	Portfolio weight in bubble stocks			Standardized portfolio weight in bubble stocks		
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
Performance based fee	0.0360***	0.0360***	0.0360***	0.0721***	0.0721***	0.0721***
	(4.22)	(4.09)	(3.35)	(2.68)	(2.58)	(2.77)
Fee on rival performance	0.0817***	0.0817***	0.0817***	0.2510***	0.2510***	0.2510***
	(6.85)	(7.04)	(6.11)	(5.92)	(6.05)	(5.35)
Intercept	0.4465***	0.4465***	0.4465***	1.4008***	1.4008***	1.4008***
	(9.10)	(8.47)	(7.84)	(7.10)	(6.70)	(5.99)
Clustering	None	Fund	Family	None	Fund	Family
Number of observations	3696	3696	3696	3696	3696	3696
R-square	15.44%	15.44%	15.44%	13.24%	13.24%	13.24%

This table presents the estimates of the following equation:

$$B = \alpha + \beta C + \gamma F + \varepsilon.$$

Here, B represents the portfolio weight in bubble stocks of the fund, where bubble stocks are defined as the top quintile of stocks sorted on their herding measure, constructed as in Lakonishok et al. (1992). In Columns (1)–(3), the portfolio weight is regressed on the fund characteristics, while in Columns (4)–(6), the portfolio weight is standardized by the weight of those herded stocks in the NASDAQ Index before regressing on the fund characteristics. C is the incentive structure contained in the advisory contract and F represents fund characteristics. Coles' Incentive Rate (CIR) is the measure of concavity of advisory contract in Panel A, while Weighted Incentive Rate (WIR) is the measure of concavity in Panel B. All observations are at the fund-year level.

Both equations are estimated using a two-step procedure. Since CIR is right-censored at 0 and WIR is right-censored at 1 in the sample, Tobit regressions of concavity regressed on the instruments and controls variables are used to calculate the estimated values of concavity. Similarly, the estimated value of effective fee rate (EFR) is obtained from an OLS regression of EFR on the instruments and control variables. Following Massa and Patgiri (2005), the "average account size" and the "expense ratio" are used as instruments for concavity and for EFRs. The estimated values of EFR and concavity are made orthogonal by regressing estimated EFR on estimated concavity and taking the residual. The estimated concavity and the residual, i.e., the part of estimated EFR that is orthogonal to concavity are then used in the second stage estimation reported below.

In both Panel A and Panel B, Columns (2) and (5) present the results of estimation with standard errors adjusted for clustering at fund level. In Columns (3) and (6), the standard errors are adjusted for clustering at the mutual fund family level. In all specifications, we use a dummy for year 2001 (unreported in the table) to separate out the effects of exogenous geo-political events. 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 zero.

expenses. We also include the three Fama-French factors and Carhart's momentum factor in our pooled regression framework.

Equation (11) is estimated both, with a Fama-Macbeth type methodology (i.e., performing a cross-sectional regression for each time-period followed by a univariate analysis of the time-series of the estimated coefficients to assess their significance), as well as with a pooled regression methodology, while correcting the standard errors for clustering at either the fund or the family level. The results are reported in Table 9-A for the

Fama-Macbeth specification and in Table 9-B for the pooled specification. According to Hypothesis 2, we would expect $\delta < 0$.

From Table 9-A, we find that for funds with higher incentives, bubble stock holdings have a negative effect on the returns. Since these funds hold a smaller fraction of their portfolio in bubble stocks during the bubble period—exactly when such stocks were giving higher returns—this result is intuitive. Similarly, in Table 9-B, we find that the joint effect of higher incentives, in terms of shape or slope of the contract, and bubble stock holdings is negative. Economically, this amounts to a loss of about 70 basis points per quarter (23 basis points per month) by a fund with linear advisory contract, as opposed to a concave contract. Similarly, a one standard deviation increase in the EFR reduces the fund's return by 21 basis points per quarter for the holdings of bubble stocks.

4.2 Differential returns, incentives, and bubble holdings

The previous finding only tells us what the marginal impact of holdings in bubble stocks is on the returns of an individual fund. A more stringent test of the impact of bubble stock holdings on fund performance would be to see how the *difference* in performance between high-incentive and low-incentive funds is affected by the *difference* in their holdings of bubble stocks. We therefore estimate:

$$(R^H_{i,t} - R^L_{i,t}) = \alpha + \beta(B^H_{i,t} - B^L_{i,t}) + \gamma(B^H_{i,t} - B^L_{i,t}) \times D + \delta D + \lambda(X^H_{i,t} - X^L_{i,t}) + \varepsilon_{it}, \quad (12)$$

where subscript i refers to a pair of matched high- and low-incentive funds, D is a dummy that is zero during the bubble period and equal to one after the bubble burst, and the rest of the notation is same as above.

The difference between this specification and the previous one [(in Equation (11)] is that now we focus on the difference between a pair of otherwise identical high- and low-incentives funds. Therefore, the first task now is to match funds by finding pairs of funds that are identical along the main characteristics except for the contractual incentives. We match funds on four main characteristics: category, fund size, family size, and return in the previous year.[22]

For the purpose of identifying the matching pair of high- and low-incentive funds, we use two different methods: one based on the shape of the contract and the other on its EFR. According to the first method, we

[22] Although not reported here, our results are robust to a match based on fewer characteristics.

Table 9
Regression of fund returns on bubble stock holdings, incentives, and fund characteristics

Panel A. Fama-McBeth regression of fund returns on bubble stock holdings, compensation and fund characteristics

	Quarterly fund returns		Monthly fund returns	
Dependent variable:	(1)	(2)	(5)	(6)
Portfolio weight in bubble stocks	0.0083	0.0166	0.0006	0.0038
	(0.11)	(0.22)	(0.02)	(0.17)
Contract dummy (Linear/concave)	0.0056***	0.0056***	0.0019***	0.0020***
	(2.68)	(3.03)	(3.03)	(3.41)
Effective fee rate	0.0048	0.0067	0.0012	0.0019
	(0.49)	(0.69)	(0.47)	(0.76)
Weight × contract dummy	−0.0392**	−0.0428**	−0.0112**	−0.0135***
	(−2.15)	(−2.38)	(−2.24)	(−2.70)
Weight × effective fee rate	0.0166	0.0160	0.0057	0.0054
	(0.28)	(0.28)	(0.35)	(0.34)
Size		0.0018***		0.0007***
		(2.92)		(3.46)
Number of funds in family		−0.00003**		−0.00001**
		(−2.47)		(−2.36)
Turnover		−0.0014		−0.0005
		(−0.76)		(−0.99)
Age		−0.0002*		−0.0001**
		(−1.72)		(−2.19)
Net inflow		0.0014***		0.0004***
		(2.83)		(3.91)
12b-1 expense		−0.2754		−0.0847
		(−1.18)		(−1.15)
Intercept	0.0186	−0.0135	0.0059	−0.0057
	(0.92)	(−0.78)	(1.08)	(−1.10)
Number of observations	24	24	72	72

Table 9
(Continued)

Panel B. Pooled regression of fund returns on bubble stock holdings, compensation, factors and fund characteristics

	Quarterly fund returns				Monthly fund returns			
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Portfolio weight in bubble stocks	0.0934***	0.0934***	0.0989***	0.0989***	0.0239***	0.0239**	0.0257***	0.0257**
	(3.84)	(3.47)	(4.13)	(3.68)	(2.70)	(2.32)	(2.92)	(2.50)
Contract dummy (Linear/concave)	0.0146***	0.0146***	0.0156***	0.0156***	0.0050***	0.0050***	0.0053***	0.0053***
	(4.31)	(3.97)	(4.84)	(4.59)	(4.36)	(3.95)	(4.79)	(4.48)
Effective fee rate	0.0145***	0.0145***	0.0163***	0.0163***	0.0050***	0.0050***	0.0054***	0.0054***
	(3.99)	(3.81)	(4.72)	(4.67)	(4.07)	(3.96)	(4.58)	(4.65)
Weight × contract dummy	−0.0646***	−0.0646**	−0.0649***	−0.0649**	−0.0228**	−0.0228**	−0.0229**	−0.0229**
	(−2.65)	(−2.40)	(−2.72)	(−2.43)	(−2.41)	(−1.98)	(−2.45)	(−2.01)
Weight × effective fee rate	−0.0739**	−0.0739**	−0.0745**	−0.0745**	−0.0268**	−0.0268**	−0.0275***	−0.0275**
	(−2.46)	(−2.36)	(−2.52)	(−2.40)	(−2.52)	(−2.36)	(−2.61)	(−2.43)
Market	0.9368***	0.9368***	0.9330***	0.9330***	0.9845***	0.9845***	0.9837***	0.9837***
	(115.71)	(110.05)	(113.00)	(106.89)	(127.23)	(108.70)	(125.82)	(107.39)
SMB	0.2525***	0.2525***	0.2529***	0.2529***	0.2481***	0.2481***	0.2475***	0.2475***
	(16.85)	(15.33)	(16.95)	(15.59)	(20.71)	(18.89)	(20.61)	(18.82)
HML	−0.0104	−0.0104	−0.0121	−0.0121	0.0151	0.0151	0.0150	0.0150
	(−0.70)	(−0.59)	(−0.81)	(−0.69)	(1.22)	(1.02)	(1.21)	(1.02)
Momentum	0.0203**	0.0203*	0.0222**	0.0222*	0.0434***	0.0434***	0.0435***	0.0435***
	(1.99)	(1.70)	(2.17)	(1.85)	(7.37)	(6.68)	(7.40)	(6.70)
Size			0.0019***	0.0019***			0.0007***	0.0007***
			(5.49)	(5.16)			(6.13)	(5.34)
Number of funds in family			−0.00004***	−0.00004*			−0.00001***	−0.00001
			(−2.98)	(−1.95)			(−2.66)	(−1.57)
Turnover			−0.0021*	−0.0021*			−0.0005	−0.0005
			(−1.91)	(−1.69)			(−1.32)	(−1.15)
Age			−0.0003***	−0.0003***			−0.0001***	−0.0001***
			(−3.53)	(−3.20)			(−3.59)	(−3.21)

Net inflow			0.0003	0.0003			0.0002^{*}	0.0002
			(1.22)	(1.10)			(1.70)	(1.48)
12b-1 expense			0.0088^{***}	0.0088^{***}			0.0010^{**}	0.0010^{*}
			(6.14)	(5.40)			(2.17)	(1.89)
Intercept	-0.0266^{***}	-0.0266^{***}	-0.0601^{***}	-0.0601^{***}	-0.0082^{***}	-0.0082^{***}	-0.0207^{***}	-0.0207^{***}
	(−8.82)	(−8.16)	(−8.12)	(−7.44)	(−8.33)	(−7.69)	(−8.57)	(−7.65)
Number of observations	9312	9312	9312	9312	27,988	27,988	27,988	27,988
Clustering	Fund	Family	Fund	Family	Fund	Family	Fund	Family
R-square	80.30%	80.30%	80.47%	80.47%	74.78%	74.78%	74.85%	74.85%

This table presents the estimates of the following equation:

$$R_{i,t} = \alpha + \beta.B_{i,t} + \gamma.C_{i,t} + \delta.(B \times C)_{i,t} + \phi.F_{i,t} + \varepsilon.$$

Here, R is the quarterly (monthly) return of the fund; B is the portfolio weight in bubble stocks for the fund; C is the incentive structure contained in the advisory contract; and F represents fund characteristics. Since mutual funds report their holdings at quarterly frequency at best, their holding information is assumed to be constant over the quarter in the regressions using monthly returns. The contract dummy captures the shape of the advisory contract and takes a value of 0 for concave contracts and 1 for linear contracts. The EFR is made orthogonal to the contract dummy by regressing the EFR on the dummy and taking the residual. The residual and the contract dummy are then interacted with B, the portfolio weight in bubble stocks.

In Panel A, we estimate the above equation by a Fama-Mcbeth type procedure. For each quarter (month), a cross-sectional regression of the fund returns on the contract variables and fund characteristics is performed. Then univariate analyses of the time-series of estimated coefficients are done to assess the significance. In Columns (1)–(2), the dependent variable is the quarterly return, and in Columns (3)–(4), the dependent variable is the monthly return for each fund. The sample period consists of 24 quarters, or equivalently, 72 months.

In Panel B, the above equation is estimated by a pooled regression of quarterly (monthly) returns of the funds on their characteristics and the four factors of market, size, book-to-market, and momentum. In Columns (1)–(4), the dependent variable is the quarterly return, and in Columns (5)–(8), the dependent variable is the monthly return for each fund. The standard errors are adjusted for clustering at the fund or the family level.

For all specifications, 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 zero.

assign the funds with concave contracts to the low incentive group and the ones with linear contracts to the high incentive group.[23] Then, for each low-incentive fund, a high-incentive fund is found by matching the two based on the four criteria listed earlier, as well as on the EFR. According to the second methodology, we assign funds with EFR above (below) the median to the high (low) incentive group. Then, for each low-incentive fund, a matching high-incentive fund is found by matching on the four criteria.

The results from the first matching procedure are reported in Table 10 and those from the second matching procedure are in Table 11. Panel A of both tables uses contemporaneous stock prices for calculating the portfolio weights of the funds in bubble stocks while the portfolio weights in Panel B are constructed using either the stock price of January, 1997 or the earliest stock price available in our sample period, if the stock's IPO is after January 1997. The results in both Tables 10 and 11 are based on bubble stocks identified as the ones in the top quintile of price-to-sales sorted stocks.

The emphasis in Equation (12) is on the estimates of β and γ. β gives us the marginal impact of differential bubble stock holdings on the relative performance of high-incentive funds, while γ indicates how this marginal effect changes *after* the bubble burst.

We focus on Columns (1)–(4) of all four panels (Panels 10A -11B), which report the results based on quarterly data, because the mutual funds report their holdings at quarterly frequency at best. The results using monthly fund returns (while keeping holdings constant through the three months of every quarter) are consistent with the ones based on quarterly data, and are reported in Columns (5)–(8) of all four panels. In the simplest specification, only β, γ, and δ are estimated. These estimates are reported in Column (1). We then consider other expanded specifications where we include fund specific characteristics and/or Fama-French and Momentum factors (Columns 2–4 and 5–8).

The main finding is that the difference in bubble stock holdings of high- and low-incentive funds is positively correlated with differences in their returns during the bubble period, and that this correlation turns negative after the bubble burst. This is consistent across different specifications and robust to the inclusion of the control variables. This shows that not holding bubble stocks was detrimental to their performance during the bubble period while the same proved beneficial after the bubble burst. In terms of economic significance, if the style-standardized holdings in bubble stocks of a high-incentive fund are 10% lower than those of the matching low-incentive fund, then this translates into a *loss* in performance of 2%

[23] Recall that greater concavity implies lower incentives while a higher CIR (or equivalently, a higher WIR) implies higher incentives.

Table 10
Regression of difference in fund returns on difference in bubble stock holdings, fund characteristics, and risk factors

Panel A. Difference in returns versus difference in portfolio weight in bubble stocks for high- and low-incentive funds based on concavity using nominal price

	Difference in quarterly returns between high- and low-incentive funds				Difference in monthly returns between high- and low-incentive funds			
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Portfolio weight in bubble stocks	0.1838***	0.2056***	0.1862***	0.2109***	0.0620***	0.0728***	0.0625***	0.0741***
	(5.48)	(4.90)	(5.58)	(5.10)	(6.14)	(5.71)	(6.19)	(5.87)
Portfolio weight in bubble stocks × dummy	−0.2458***	−0.2698***	−0.2482***	−0.2737***	−0.0920***	−0.1021***	−0.0921***	−0.1031***
	(−5.76)	(−5.33)	(−5.74)	(−5.46)	(−5.15)	(−5.28)	(−5.15)	(−5.36)
Dummy	0.0001	−0.0001	−0.0056	−0.0077**	0.0001	0.0004	−0.0019	−0.0021
	(0.03)	(−0.03)	(−1.51)	(−1.97)	(0.09)	(0.27)	(−1.56)	(−1.62)
Turnover		−0.0002		−0.0002		−0.0005		−0.0006
		(−0.29)		(−0.26)		(−0.95)		(−1.02)
Age		−0.00002		−9.83e-06		0.00003		0.00003
		(−0.14)		(−0.07)		(0.57)		(0.56)
Net inflow		−3.05e-06		−3.03e-06		−1.00e-06		−9.49e-07
		(−0.92)		(−0.92)		(−0.77)		(−0.74)
12b-1 expense		0.0034		0.0050		−0.0866		−0.0674
		(1.02)		(1.49)		(−0.60)		(−0.47)
Market			0.0001	−0.0001			−0.0555***	−0.0697***
			(0.35)	(−0.43)			(−3.72)	(−4.64)
SMB			0.00003	0.0002			−0.0012	0.0064
			(0.11)	(0.80)			(−0.07)	(0.38)
HML			0.0008***	0.0009***			0.0068	0.0078
			(2.60)	(2.83)			(0.27)	(0.31)
Momentum			0.0412*	0.0411*			−0.0070	−0.0138
			(1.75)	(1.79)			(−0.41)	(−0.78)
Intercept	0.0012	0.0017	0.0027	0.0036	−0.00003	−0.0002	0.0011	0.0013
	(0.35)	(0.28)	(0.84)	(1.01)	(−0.03)	(−0.15)	(1.09)	(1.09)
Number of observations	2988	2682	2902	2682	6303	5778	6303	5778
R-square	4.22%	4.52%	4.75%	5.16%	2.81%	3.09%	3.34%	3.86%

Table 10
(Continued)

Panel B. Difference in returns versus difference in portfolio weight in bubble stocks for high- and low-incentive funds based on concavity using 1997 stock price and number of shares adjusted for stock-splits

	Difference in quarterly returns between high- and low-incentive funds				Difference in monthly returns between high- and low-incentive funds			
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Portfolio weight in bubble stocks	0.1810***	0.1468*	0.1817***	0.1493*	0.0747***	0.0650**	0.0750***	0.0661**
	(2.63)	(1.90)	(2.65)	(1.94)	(2.97)	(2.14)	(3.00)	(2.21)
Portfolio weight in bubble stocks × dummy	−0.2272***	−0.1913**	−0.2203***	−0.1923**	−0.1221***	−0.1141***	−0.1231***	−0.1157***
	(−2.98)	(−2.26)	(−2.87)	(−2.27)	(−4.03)	(−3.28)	(−4.07)	(−3.35)
Dummy	0.0029	0.0026	−0.0013	−0.0022	0.0007	0.0008	−0.0005	−0.0008
	(0.66)	(0.54)	(−0.36)	(−0.59)	(0.43)	(0.48)	(−0.38)	(−0.57)
Turnover		0.0002		0.0002		−0.0006		−0.0006
		(0.19)		(0.21)		(−0.94)		(−0.97)
Age		0.00004		0.00004		0.0001		0.0001
		(0.26)		(0.28)		(1.08)		(1.04)
Net inflow		−2.42e-06		−2.33e-06		−6.14e-07		−6.19e-07
		(−0.60)		(−0.57)		(−0.39)		(−0.40)
12b-1 expense		0.0034		0.0040		−0.0517		−0.0404
		(1.06)		(1.26)		(−0.35)		(−0.28)
Market			0.0001	0.00002			−0.0437***	−0.0560***
			(0.57)	(0.08)			(−2.96)	(−3.78)
SMB			0.0001	0.0001			−0.0057	−0.0010
			(0.17)	(0.49)			(−0.33)	(−0.06)
HML			0.0006*	0.0006*			−0.0072	−0.0078
			(1.87)	(1.88)			(−0.28)	(−0.30)

Momentum			0.0276	0.0259			−0.0092	−0.0163
			(1.14)	(1.09)			(−0.53)	(−0.90)
Intercept	−0.0015	−0.0013	−0.0006	0.0001	−0.0004	−0.0003	0.0004	0.0009
	(−0.38)	(−0.31)	(−0.18)	(0.03)	(−0.34)	(−0.18)	(0.37)	(0.70)
Number of observations	2834	2541	2754	2541	5997	5490	5997	5490
R-square	0.52%	0.39%	0.69%	0.62%	0.57%	0.62%	0.83%	1.02%

This table presents the estimates of the following equation:

$$(R^H - R^L)_{i,t} = \alpha + \beta.(B^H - B^L)_{i,t} + \gamma.D + \delta.D \times (B^H - B^L)_{i,t} + \phi.(F^H - F^L)_{i,t} + \eta.X_t + \varepsilon.$$

Here, R^H is the quarterly (monthly) return of a fund in the high-incentive group; R^L is the quarterly (monthly) return of the matching fund in the low-incentive group; B^H is the portfolio weight in bubble stocks for a fund in high incentive group; B^L is the portfolio weight in bubble stocks for the matching fund in the low-incentive group; the dummy D takes the value of 0 before 2000 and value of 1 after 2000; F represents fund characteristics; and X represents the four priced risk factors of market, size, book-to-market, and momentum.

The split between high- and low-incentive groups is done on the basis of concavity of the advisory contract. A fund with concave contract is assigned to the low-incentive group and the matching high-incentive fund is drawn from the pool of funds with linear contracts. The matching is done on five criteria: category, EFR, size, family size, and return in the previous year.

Since mutual funds report their holdings at quarterly frequency at best, their holding information is assumed to be constant over the quarter in the regressions using monthly returns.

In Panel A, the portfolio weight in bubble stocks is calculated using the nominal stock price. In Panel B on the other hand, we use the first reported price of the stock in the sample and adjust the number of shares held for any stock-splits in calculating the portfolio weight in bubble stocks. For both panels, the dependent variable in Columns (1)–(4) is the difference in quarterly return, and in Columns (5)–(8), the difference in monthly return for each fund-pair. The standard errors are adjusted for clustering at the fund-pair level.

For all specifications, 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 zero.

Table 11
Regression of difference in fund returns on difference in bubble stock holdings, fund characteristics, and risk factors

Panel A. Difference in returns versus difference in portfolio weight in bubble stocks for high- and low-incentive funds based on effective fee rate using nominal price

	Difference in quarterly returns between high- and low-incentive funds				Difference in monthly returns between high- and low-incentive funds			
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Portfolio weight in bubble stocks	0.1916***	0.2305***	0.1927***	0.2315***	0.0647***	0.0770***	0.0652***	0.0772***
	(5.42)	(5.04)	(5.34)	(4.93)	(5.63)	(4.98)	(5.54)	(4.86)
Portfolio weight in bubble stocks × dummy	−0.2256***	−0.2638***	−0.2265***	−0.2649***	−0.0785***	−0.0902***	−0.0791***	−0.0905***
	(−6.05)	(−5.59)	(−5.96)	(−5.47)	(−6.20)	(−5.54)	(−6.14)	(−5.43)
Dummy	−0.0071**	−0.0064*	0.0055	0.0055	−0.0023*	−0.0025*	0.0025**	0.0022
	(−2.06)	(−1.67)	(1.53)	(1.33)	(−1.78)	(−1.72)	(2.16)	(1.60)
Turnover		−0.0014		−0.0013		−0.0012***		−0.0011***
		(−1.31)		(−1.20)		(−2.87)		(−2.73)
Age		−0.0001		−0.0001		−0.00003		−0.00004
		(−0.90)		(−1.09)		(−0.57)		(−0.88)
Net inflow		−5.15e-06		−5.86e-06		−5.20e-06		−6.34e-06
		(−0.84)		(−0.85)		(−0.69)		(−0.75)
12b-1 expense		0.0030		0.0026		−0.0084		−0.0274
		(0.83)		(0.75)		(−0.06)		(−0.21)
Market			0.0001	0.0002			0.0088	0.0119
			(0.77)	(1.05)			(0.57)	(0.72)
SMB			−0.0001	−0.0001			−0.0146	−0.0125
			(−0.41)	(−0.20)			(−0.87)	(−0.72)
HML			−0.0010***	−0.0009***			−0.1023***	−0.0949***
			(−3.42)	(−2.88)			(−4.37)	(−3.99)
Momentum			0.0078	0.0166			0.0648***	0.0648***
			(0.33)	(0.68)			(4.12)	(3.94)
Intercept	0.0060**	0.0051	−0.0018	−0.0029	0.0017*	0.0017	−0.0018*	−0.0016
	(2.00)	(1.49)	(−0.55)	(−0.76)	(1.69)	(1.48)	(−1.69)	(−1.34)
Number of observations	3482	3175	3407	3175	7547	6909	7547	6909
R-square	4.67%	5.62%	5.75%	6.61%	2.75%	3.41%	4.11%	4.65%

Table 11
(Continued)

Panel B. Difference in returns versus difference in portfolio weight in bubble stocks for high- and low-incentive funds based on effective fee rate using 1997 stock price and number of shares adjusted for stock-splits

	Difference in quarterly returns between high- and low-incentive funds				Difference in monthly returns between high- and low-incentive funds			
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Portfolio weight in bubble stocks	0.0877**	0.1300**	0.0884**	0.1313**	0.0574***	0.0749**	0.0585***	0.0757***
	(1.98)	(2.43)	(1.96)	(2.37)	(3.00)	(2.50)	(2.89)	(2.39)
Portfolio weight in bubble stocks × dummy	−0.1313***	−0.1747***	−0.1328***	−0.1779***	−0.0884***	−0.1075***	−0.0902***	−0.1091***
	(−2.77)	(−3.11)	(−2.76)	(−3.06)	(−4.04)	(−3.35)	(−3.96)	(−3.23)
Dummy	−0.0107***	−0.0107**	0.0014	0.0009	−0.0035***	−0.0040***	0.0013	0.0007
	(−2.88)	(−2.57)	(0.43)	(0.25)	(−2.58)	(−2.61)	(1.14)	(0.59)
Turnover		−0.0014		−0.0013		−0.0012**		−0.0011**
		(−1.24)		(−1.15)		(−2.57)		(−2.44)
Age		−0.0001		−0.0001		−0.00004		−0.0001
		(−0.79)		(−0.96)		(−0.69)		(−0.98)
Net inflow		−9.85e-06		−0.00001		−0.00001		−0.00001
		(−1.08)		(−1.06)		(−1.33)		(−1.34)
12b-1 expense		0.0029		0.0025		−0.0141		−0.0350
		(0.76)		(0.68)		(−0.10)		(−0.26)
Market			0.0001	0.0001			0.0068	0.0095
			(0.45)	(0.65)			(0.43)	(0.57)
SMB			−0.0001	−0.00002			−0.0123	−0.0114
			(−0.21)	(−0.08)			(−0.73)	(−0.65)
HML			−0.0010***	−0.0009***			−0.1049***	−0.0991***
			(−3.52)	(−3.06)			(−4.39)	(−4.08)

Table 11
(Continued)

Panel B. Difference in returns versus difference in portfolio weight in bubble stocks for high- and low-incentive funds based on effective fee rate using 1997 stock price and number of shares adjusted for stock-splits

	Difference in quarterly returns between high- and low-incentive funds				Difference in monthly returns between high- and low-incentive funds			
Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Momentum			0.0017	0.0082			0.0633***	0.0635***
			(0.07)	(0.33)			(3.99)	(3.80)
Intercept	0.0089***	0.0087**	0.0016	0.0013	0.0026**	0.0030**	−0.0007	−0.0003
	(2.75)	(2.34)	(0.52)	(0.38)	(2.50)	(2.40)	(−0.72)	(−0.28)
Number of observations	3482	3175	3407	3175	7547	6909	7547	6909
R-square	0.82%	1.14%	1.89%	2.12%	0.99%	1.52%	2.35%	2.78%

This table presents the estimates of the following equation:

$$(R^H - R^L)_{i,t} = \alpha + \beta.(B^H - B^L)_{i,t} + \gamma.D + \delta.D \times (B^H - B^L)_{i,t} + \phi.(F^H - F^L)_{i,t} + \eta.X_t + \varepsilon.$$

Here, R^H is the quarterly (monthly) return of a fund in the high-incentive group; R^L is the quarterly (monthly) return of the matching fund in the low-incentive group; B^H is the portfolio weight in bubble stocks for a fund in high-incentive group; B^L is the portfolio weight in bubble stocks for the matching fund in the low-incentive group; the dummy D takes the value of 0 before 2000 and value of 1 after 2000; F represents fund characteristics; and X represents the four priced risk factors of market, size, book-to-market, and momentum.

The split between high- and low-incentive groups is done on the basis of median value of effective fee rates within each category. A fund with less than the median EFR is assigned to the low-incentive group and the matching high-incentive fund is drawn from the pool of funds with a higher than median EFR. The matching is done on four criteria: category, size, family size, and return in the previous year.

Since mutual funds report their holdings at quarterly frequency at best, their holding information is assumed to be constant over the quarter in the regressions using monthly returns.

In Panel A, the portfolio weight in bubble stocks is calculated using the nominal stock price. In Panel B on the other hand, we use the first reported price of the stock in the sample and adjust the number of shares held for any stock-splits in calculating the portfolio weight in bubble stocks. For both panels, the dependent variable in Columns (1)–(4) is the difference in quarterly return, and in Columns (5)–(8), the difference in monthly return, for each fund pair. The standard errors are adjusted for clustering at the fund-pair level.

For all specifications, 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 zero.

per quarter during the bubble period and a *gain* in performance of 2.7% per quarter after the bubble burst, for the high-incentive fund relative to the low-incentive fund's performance.

This suggests that although the high-incentive funds diverged from the herd and invested relatively less in bubble stocks than the low-incentive funds during the bubble period, they did so at the cost of hurting their performance. However, after the bubble burst, the high-incentive funds' relatively smaller holdings in bubble stocks improved their returns in comparison to the returns of low-incentive funds.[24] These results are illuminating as they show that not only did incentives in the advisory contracts influence the holdings of mutual funds but that this impact on holdings also translated to a difference in their performance.

5. Discussion

These findings show that the incentives embedded in the advisory contract negatively affect the holdings of bubble stocks during the bubble period. That is, highly incentivized funds managers moved against the general trend and did not herd with the rest of the mutual fund industry. There is another important class of incentivized money managers: the hedge funds. Recently, Griffin et al. (2005) investigated the activities of institutional traders including hedge funds. "Although hedge funds move strongly with contemporaneous returns, they trade as contrarian investors relative to lagged returns–hedge fund imbalances (although relatively small) are negatively related to lagged returns." This suggests that hedge funds do not herd. This is in line with our findings as hedge funds represent a category of very highly incentivized asset managers—maybe the mostly highly incentivized one!

A direct assessment of whether high-incentive mutual funds are actually contrarian traders is complicated by the fact that there is no available trading data on mutual funds' trading at high frequency. However, we can have an indirect estimate of the relationship between compensation and momentum for mutual funds. We therefore proceed as follows. First, we sort mutual funds in terms of incentives and construct portfolios based on the average performance for quintile portfolios of mutual funds sorted on incentives. Then, we regress the return on these portfolios on the four risk factors commonly used in the literature: Market, SMB, HML, and UMD. The coefficients on UMD factor provides us with the relation between compensation and momentum.

[24] The positive coefficient in the second row of Tables 3 and 4 implies that they increased their holdings of bubble stocks only relative to their own previous position. On an absolute scale, they were still holding less than the median fund—this fact is evident from the magnitude of the coefficients in first and second row.

The (unreported but available upon request) results show a negative relationship between momentum and compensation. The high-incentive funds have a very low or negative loading on momentum, while the low-incentive funds are the ones with a high positive loading. Moreover, the spread portfolio between the top and bottom quintile of incentives load negatively on momentum factor and this is highly statistically significant. This suggests a similarity in behavior between mutual funds and other institutional investors: an overall tendency to herd and follow momentum strategy, curbed by the type of incentives contained in the contracts. This also suggests that herding is not such a simple issue—that correlated trading can be induced by significant expectation of short-term momentum profits. Indeed that is the foundation of the rational bubble literature.

6. Conclusion

We study the relation between the incentives contained in the mutual fund advisory contracts and funds' investments in bubble stocks. We argue that reputation concerns make managers more wary of scoring at the bottom than interested in ranking top. This induces them to herd by investing in the same stocks in which other funds are investing. The incentives contained in the advisory contracts help to reduce this tendency to herd. We argue that this has important implications during a financial market bubble. The contractual incentives effectively make managers invest less in bubble stocks, thereby acting as a stabilizing force in the market.

We test this intuition on the U.S. mutual funds. We show that the higher the incentives, the lesser the funds invest in bubble stocks. Moreover, we show that a difference in performance between high-incentive and low-incentive funds is strongly related to the difference in their holdings of bubble stocks. The smaller the bubble stock holdings of high-incentive funds, the poorer they perform in comparison to low-incentive funds during the bubble period. After the bubble period, however, smaller holdings in bubble stocks lead to comparatively better performance of high-incentive funds.

Our findings provide new evidence on investor behavior and show that high-incentive contracts, far from exacerbating the excesses of a bubble, help to rein them in. Given that the herding behavior of fund managers may have contributed to the stock market bubble of the late 1990s, the structure of the advisory contract of fund managers played a crucial role. Our findings show that higher incentives provided a counterbalance to the inclination to herd. Thus, higher incentives might have created a stabilizing force and prevented some mutual funds from exacerbating the recent stock market bubble.

This gives a new dimension to the debate on compensation and is a first step in the direction of taking a more critical but neutral look at contractual incentives. It also sheds new light on the raging debate about executive compensation. It shows that there are positive externalities related to high incentives that are often ignored.

Appendix

Variable definitions

Variable	Database	Data items used	Explanation
Contract variables:			
1 Coles' incentive rate	NSAR - B	048A - 048K	Difference between the last and the first fee rates divided by the effective fee rate. It is zero for funds with linear contracts and negative for funds with concave contracts, with concavity being decreasing with increase in this variable.
2 Weighted incentive rate	NSAR - B	048A - 048K	Weighted average of the fee rates divided by the first applicable fee rate. It is equal to one for funds with linear contract and smaller than one for funds with concave contract, with concavity being decreasing with increase in this variable.
3 Effective fee rate	NSAR - B/CRSP mutual funds	048A - 048K, TNA	Effective marginal compensation rate based on the current total net assets of the fund.
Control variables:			
4 Fund size	CRSP mutual funds	TNA	Log of total net assets. For funds with multiple classes, it is the sum of TNA of all the classes.
5 Turnover	CRSP mutual funds	TURNOVER	Turnover ratio over the calendar year.
6 Fund return	CRSP mutual funds	RET	Return of the fund in a calendar year. For funds with multiple classes, it is the weighted average of returns of different classes of the fund.
7 Fund return volatility	CRSP mutual funds	RET	Standard deviation of returns of the fund in a calendar year.
8 NASDAQ R-square	CRSP mutual funds	RET	R-square of the regression of monthly excess fund return on excess return of the NASDAQ Index in a given year.

(Continued)

Variable	Database	Data items used	Explanation
9 Number of funds in family	CRSP mutual funds	ICDI	Total number of funds in a family after combining different classes.
10 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.
11 Net inflow	CRSP mutual funds	TNA, RET	Change in TNA of the fund after accounting for fund return.
12 12b-1 expense	CRSP mutual funds	X2B1	12b-1 fee.
13 Minimum required investment	NSAR - B	061	Lowest minimum initial investment required to become a shareholder of the mutual fund.
14 Performance-based fee	NSAR - B	051	A dummy variable that indicates if the mutual fund has an own-performance based fee in the contract.
15 Fee on rival performance	NSAR - B	052	A dummy variable that indicates if the mutual fund has a rival performance based fee in the contract.

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