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Buy-Side Analysts, Sell-Side Analysts, and Investment Decisions of Money Managers

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Abstract

We examine the role of financial analysts in forming institutional investors' investment decisions. In our model, a fund manager invests in a stock based on the optimal weighting of reports created by a biased sell-side analyst and an unbiased buy-side analyst. The manager puts a higher weight on the buy-side analyst's report when the quality of the buy-side analyst's information relative to that of the sell-side analyst increases, or when the sell-side analyst's degree of bias or uncertainty about the bias increases. Utilizing a unique dataset of U.S. equity funds, we find evidence supporting our model predictions on how fund managers weigh buy-side research relative to sell-side and independent research.

I. Introduction

Financial analysts gather and evaluate information from public and private sources, generate forecasts on companies' earnings and future prospects, and make recommendations that lead to the buying or selling of the companies' securities. One type of financial analyst is the sell-side analyst (SSA hereafter): SSAs work for brokerage firms and provide research for the firms' brokers and clients. Their earnings forecasts and stock recommendations are also available to the public. In an extensive literature on SSAs, it is widely accepted that their research has investment value (e.g., Elton, Gruber, and Grossman (1986), Stickel (1995), Womack (1996), Barber, Lehavy, McNichols, and Trueman (2001), and Li (2005)). More recently, there has been increasing attention from researchers, regulators, and investors on the possible bias in these analysts' forecasts and recommendations.

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Another type of financial analyst is the buy-side analyst (BSA hereafter): BSAs are employed by asset management companies, and make internal recommendations and forecasts exclusively to money managers. There is little research on BSAs thus far, and many important questions remain unanswered. For example, what roles do the BSAs play in a fund manager's decision-making process? How do fund managers utilize research produced by SSAs and BSAs? Does BSA research improve fund performance?

Our paper contributes to the literature on financial analysts and asset management by studying the role of both BSAs and SSAs in forming institutional investors' investment decisions. We first present a model that examines how a fund manager utilizes research created by a biased SSA, who works for an outside brokerage firm, and by an unbiased BSA, who is employed by the fund. The fund manager's investment decision is based on her optimal weighting of SSA and BSA research. Employing a unique dataset of U.S. equity funds, we find that on average BSA research is significantly more important in shaping fund managers' investment decisions than SSA research. The empirical evidence also supports our model predictions on how fund managers weigh BSA and SSA research.

SSAs face two opposite incentives when releasing their research to their clients and the public. On the one hand, they care about their reputation and thus have an incentive to report truthfully based on their private information. In fact, money managers evaluate SSAs based on their overall performance, and this evaluation constitutes a significant part of an analyst's reputation and compensation (e.g., Stickel (1992)). The "Chinese-wall" restriction and the threat of litigation also provide incentives to limit the bias in an SSA's research.[1] On the other hand, SSAs have an incentive to issue optimistic research, due to the conflicts of interest among their research divisions and the brokerage firms' underwriting, sales, and trading divisions. By inducing investors to buy the stocks of companies that have investment banking relationships with their brokerage firms, SSAs receive private benefits in return.[2] This problem became a public focus during the stock market boom of the 1990s, when investment banks generated substantial profits from IPOs and the trading of technology sector stocks.[3] Knowing that SSAs can be biased, how can investors improve the quality of their information? One answer is that money managers can rely on their own in-house analysts (i.e., BSAs) to conduct research. Since BSA research is utilized internally, BSAs do not face the same conflicts of interest as SSAs.

[1]Under the Securities Act of 1933 and Securities Exchange Act of 1934, the SEC endorses the separation of the research department from other departments in a brokerage firm. The Code of Ethics and Standards of Professional Conduct of the Financial Analysts Federation also recommend such separation. Section 10(b) of the 1934 Act specifies litigations related to fraudulent recommendations. Recently, there have been lawsuits filed against prominent SSAs (see, e.g., *Dow Jones News Service*, Aug. 7, 2001, and *Fortune Magazine*, May 14, 2001).

[2]Hong and Kubik (2003) find that optimistic SSAs receive favorable promotions within their brokerage firms. Recent investigations conducted by the New York Attorney General and the SEC reveal that the compensation of SSAs is linked to winning banking business for their brokerage firms (e.g., *The Wall Street Journal*, May 6, 2002).

[3]For example, Lin and McNichols (1998), Michaely and Womack (1999), and Dechow, Hutton, and Sloan (2000) all find that banking relationships affect the accuracy of SSAs' earnings forecasts and recommendations. Michaely and Womack (2005) provide a review of this literature.

In our model, the fund manager has two sources of information on a stock. She can solicit information from an SSA, who is either unbiased, in which case he will truthfully report to the fund manager based on his signal, or biased (optimistic), in which case he will add a positive bias to his signal when issuing his report. As a result, the SSA's report has investment value but the potential bias and the uncertainty about this bias warrant further research. The fund manager's second source of information is from her own BSA, who is unbiased and can improve the precision of his own signal at a cost. In equilibrium, the fund manager pays the BSA to obtain the signal with an optimal level of precision. The optimal precision level increases when the quality of the SSA's signal decreases, or when the degree of the SSA's bias or uncertainty about the bias increases, all of which result in a *lower* quality SSA report. The fund manager then weighs both reports in making the investment decision, and puts more weight on the BSA's report when the quality of the BSA's report increases relative to that of the SSA's report.

We employ a large sample of U.S. equity funds for the time period 2000 to 2002 to test our theoretical predictions. The source of our data is Thomson Financial/Nelson Information's *Directory of Fund Managers*, which contains information on funds' organizational structure, investment styles, portfolios, and performance. The dataset also contains explicit information on the investment decision-making process, in particular, how fund managers utilize research from BSAs, SSAs, and independent analysts/consultants, based on extensive annual surveys.[4] In each of the three years, fund managers place an average weight of over 70% on BSA research, an average weight of less than 25% on SSA research, and an average weight of less than 5% on independent research.

Our main empirical test is to examine the factors that determine fund managers' weighting of BSA research, including proxies for the quality of SSAs' earnings forecasts for the stocks held by a fund. First, a fund manager relies more on BSA research when the average number of SSAs covering the stocks held by the fund decreases. If we regard the SSA's signal in the model as the sufficient statistic of all the reports created by all the SSAs covering the stocks, then the SSA coverage proxies for the quality of the SSA's signal in the model. Accordingly, our empirical result supports the prediction that the optimal weight on the BSA's research decreases with the quality of the SSA's signal.

Second, a fund's reliance on BSA research increases with the average error (proxy for average bias) in the SSA's earnings forecasts for the stocks held by the fund. Third, we also observe a positive relation between the weight on BSA research and the standard deviation of SSA forecasts, which measures uncertainty about the bias of the SSAs. These results are consistent with the model prediction that buy-side research becomes more important when the degree of bias or the uncertainty in the bias of the SSA increases. Consistent with the model, we also find that a fund manager puts more weight on buy-side research when the size of the fund's assets under management is larger, when the fund changes investment-sector focus infrequently, or when the fund offers performance-based fees.

[4]The *Directory* surveys all delegated portfolio management companies that provide fee-based investment services. In each of the three years, more than 1,800 organizations worldwide are profiled in the *Directory*, and they manage assets over $20 trillion. In Section III, we discuss potential problems in our survey-based dataset.

Although our model does not provide implications of this, we also examine the impact of BSA research on fund performance. We perform cross-sectional regressions of funds' excess returns in each of the three years, defined to be the difference between their actual returns and the benchmark returns in the same year. We find a positive and significant relation between the (average) experience of the BSAs as well as the weighting of BSA research and fund performance. In addition, the positive impact of BSA research on fund performance is more pronounced for value funds than for growth funds. These results contribute to the literature on the determinants of fund performance (e.g., Chevalier and Ellison (1999)).

Our paper extends the literature on financial analysts, in particular, the recent literature focusing on the systematic errors in SSA research.[5] Our approach differs from most of the previous research in that we explore the role of both BSAs and SSAs, while previous research focuses only on the SSAs. Our paper also enhances the knowledge of the organizational structure of asset management companies, in that it is the first to provide detailed information on the investment decision process of fund managers and the role of BSAs during this process.

The remainder of the paper is organized as follows. In Section II, we describe the model of information transmission from an SSA and a BSA to a fund manager, solve for and characterize the equilibrium, and present testable hypotheses. In Section III, we first describe the dataset and then present the empirical tests and results. Finally, we conclude in Section IV. The Appendix contains all the proofs.

II. The Model of Information Transmission

We first introduce the fund manager's investment decision based on optimal weighting of information produced by both analysts. We then solve for the equilibrium and derive comparative statics on how the fund manager's decision depends on characteristics of both analysts. Finally, we present testable predictions.

A. The Fund Manager's Problem

Consider a fund manager, who has to take an action (e.g., position in buying or selling), $y \in (-\infty, \infty)$, on a stock. The payoff to the fund manager depends on the true state of the stock $\widetilde{v}$, which follows a normal distribution $N(0, \sigma_0^2)$, with mean 0 and variance σ_0^2. We assume that σ_0^2 is large ($\sigma_0^2 \rightarrow \infty$), so that $\widetilde{v}$ follows a diffuse normal distribution, and the fund manager's prior information on the stock is extremely noisy and useless. All of our results below still hold, with slightly different interpretations, if we instead assume σ_0^2 is finite. See Appendix A.2 for details. Therefore, the fund manager must rely entirely on information provided

[5]For example, Hong and Kubik (2003) relate SSAs' career concerns to the accuracy of their forecasts and recommendations. Lim (2001) links SSA forecasting bias to the characteristics of the SSAs and the companies that they cover, while Jegadeesh, Kim, Krische, and Lee (2004) analyze which types of stocks SSAs prefer to recommend favorably.

by the analysts to make her investment decisions.[6] If the true state of the world is v and the fund manager takes action y, her utility is

$$(1) \qquad U(y,b) = -\alpha(y-v)^2,$$

where $\alpha > 0$ is a constant scaling factor. From (1), the fund manager should take actions closest to the true state of the world in order to maximize utility. As a result, the higher the overall quality of information upon which her action is based, the higher the fund manager's utility. For the same level of information possessed by the fund manager, a higher α implies a greater increase in her utility.[7] A natural interpretation for α is the economy of scale in the fund's information production.

The fund manager first solicits information from an SSA, who works for an outside brokerage firm, free of costs. The SSA receives a signal about $\widetilde{v}$, based on which he issues a report to the fund manager in the form of

$$(2) \qquad \widetilde{S}_{\text{SSA}} = B + (\widetilde{v} + \widetilde{e}_{\text{SSA}}),$$

where $\widetilde{e}_{\text{SSA}} \sim N(0, \sigma^2_{\text{SSA}})$. The term $(\widetilde{v}+\widetilde{e}_{\text{SSA}})$ describes the SSA's signal, which is equal to the true state $(\widetilde{v})$ plus a noise term $(\widetilde{e}_{\text{SSA}})$ that has zero mean and variance σ^2_{SSA}. We define $p \equiv 1/\sigma^2_{\text{SSA}}$ to denote the precision of the signal. When $p \to \infty$, the SSA's signal is perfectly informative about the true state; when $p \to 0$, the signal is noisy and valueless.

The SSA's report, $\widetilde{S}_{\text{SSA}}$, has an extra term, B, indicating the expected degree of his bias (equation (2)). We assume, with probability $\theta \in (0,1)$, that the SSA is biased and adds a constant b to his private signal when issuing the report, i.e., $B = b$ with probability θ; and with probability $1-\theta$, that the SSA is unbiased and truthfully reports his signal, i.e., $B = 0$ with probability $1-\theta$. In general, the SSA can be either positively biased ($b > 0$) or negatively biased ($b < 0$), and our model is suitable for both cases. However, in line with ample existing empirical evidence as well as our own evidence, we assume $b > 0$, i.e., the SSA has an incentive to issue optimistic reports.

It is important to note that there has to be uncertainty about the bias of the SSA in the model. If the fund manager knows, with certainty, that the SSA is biased with degree b, she can then simply subtract b from the SSA's report and recover the true signal received by the SSA. Thus, it is the uncertainty about the bias of the SSA, along with the degree of the bias, that makes it difficult for the fund manager to evaluate the bias and quality of the SSA's report.

Definition 1. $\Sigma_B^2 \equiv \theta(1-\theta)b^2$ is the variance of B.

Hence, Σ_B^2 denotes the degree of uncertainty about the bias of the SSA. The following assumption, which is equivalent to imposing an upper bound on the

[6]Our model is related to the literature on information transmission from informed experts to an uninformed decision maker (Crawford and Sobel (1982)). More recently, Morgan and Stocken (2003) examine the informativeness of SSAs' recommendations, while Chen and Jiang (2006) show that an SSA's optimal decision is based on the optimal weighting of information from different sources. Our contribution to this literature is to examine the role of an unbiased BSA in information transmission.

[7]The following example illustrates the intuition of α. If the fund manager receives no report, she sets $y^* = 0$ and her expected utility is $\text{EU} = -\alpha\sigma_0^2$. If she receives a perfect signal v, she sets $y^* = v$ and the resulting $\text{EU} = 0$. The investment value of the signal, defined to be the difference in the expected utilities, is thus $\Delta\text{EU} \equiv \alpha\sigma_0^2$, which increases with α.

degree of the SSA's bias, b, ensures that the SSA's signal is valuable to the fund manager.

Assumption 1. The degree of the SSA's bias, b, is bounded by $0 < b \leq \bar{b} = \sqrt{1/(2\theta(1-\theta)p)}$.

To summarize, the three parameters, p, b, and Σ_B^2, affect the quality of the SSA's report. The SSA can be endowed with superior information on the stock (high p), yet the quality of the report is low if b and/or Σ_B^2 is high. As discussed before, this is consistent with the empirical literature documenting that sell-side research is (on average) biased but still informative.

In addition to the SSA, the fund manager can turn to the in-house BSA for additional information on the stock. For simplicity, we assume that there is no asymmetric information between the fund manager and the BSA, and that the BSA is unbiased. We also assume that the BSA's signal on $\widetilde{v}$, which is independent of the SSA's signal, has the following structure,[8]

$$\widetilde{S}_{\text{BSA}} = \widetilde{v} + \widetilde{e}_{\text{BSA}},$$

where $\widetilde{e}_{\text{BSA}} \sim N(0, \sigma^2_{\text{BSA}})$ is the noise term with mean 0 and variance σ^2_{BSA}. Similar to the definition of p above, we define $q \equiv 1/\sigma^2_{\text{BSA}}$ to denote the precision of the BSA's signal. Similar to p, a higher q indicates a higher precision or quality of the BSA's signal. Unlike the precision of the SSA's signal, which is assumed to be exogenous, the precision of the BSA's signal can be improved at a cost $C(q)$. The fund manager can pay the BSA in the amount of $C(q)$ to generate information with a precision level q. The cost function $C(\cdot)$ is increasing and convex in q, i.e., $C'(q) > 0$, and $C''(q) > 0$, so that an interior solution exists.

B. Equilibrium and the Weighting of Analysts' Reports

To solve for the optimal investment decision, the fund manager must decide on the quality of information to be produced by the BSA. The manager then optimally weighs the two reports generated by the SSA and the BSA and decides how to invest in the stock. To facilitate exposition, we solve the model backwards and first derive the fund manager's weighting scheme for a pair of given reports. We then derive the optimal information production of the BSA and comparative statics.

In the second stage of the decision problem, the fund manager chooses the optimal weights for the SSA's and BSA's reports and takes the optimal action y as

$$\text{(P0)} \qquad \max_{y} \quad E\left[-\alpha(y-\widetilde{v})^2 \middle| \widetilde{S}_{\text{SSA}} = S_{\text{SSA}}, \widetilde{S}_{\text{BSA}} = S_{\text{BSA}}\right].$$

Proposition 1. Given p and q, the fund manager's optimal action, y^*, upon observing the SSA's report (S_{SSA}) and the BSA's report (S_{BSA}), is given by

$$\text{(3)} \qquad y^* = w^* S_{\text{BSA}} + (1-w^*)(S_{\text{SSA}} - \theta b),$$

[8]Our model can be easily extended to the situation in which the BSA's and the SSA's signals are correlated. The more correlated the signals are, the smaller the marginal benefit of producing the additional signal.

where $w^* = q/(p+q)$ is the optimal weight put on the BSA's report. Moreover, w^* increases when i) the precision of the BSA's signal, q, increases, or ii) the precision of the SSA's signal, p, decreases.

Proposition 1 shows that the fund manager's best estimate of the state of the world, and hence her action, is a weighted average of the two reports. The weighting scheme is intuitive: The more informative the BSA's report is relative to the SSA's report, the more (less) weight is placed on the BSA's report (SSA's report). In the extreme cases, if the SSA's signal is perfectly informative ($p \rightarrow \infty$), all the weight is put on the SSA's report ($1 - w^* = 100\%$), and if the SSA's information is extremely noisy ($p \rightarrow 0$), all the weight is put on the BSA's report ($w^* = 100\%$).

Next, we derive the fund manager's decision as to the quality of information to be produced by the BSA in the first stage, based on the costs and benefits of information production.

Proposition 2. The optimal precision of the BSA's information, q^*, is uniquely determined by

$$\alpha\left[\frac{1}{(p+q)^2}+\frac{2p^2b^2\theta(1-\theta)}{(p+q)^3}\right]-C'(q) \quad = \quad 0. \tag{4}$$

Moreover, q^* increases when i) the scaling factor, α, increases, ii) the bias of the SSA, b, increases, iii) the uncertainty in the SSA's bias, Σ_B^2, increases, and iv) the precision of the SSA's signal, p, decreases.

Proposition 2 indicates that there exists an optimal level of precision of the BSA's information, as the interior solution to the fund manager's maximization problem. When the quality of the SSA's report declines, which can be a result of a lower p, a higher b, a higher Σ_B^2, or a combination of these parameters, the marginal benefit of producing a given level of BSA information increases. Thus, the fund manager finds it profitable to pay the BSA more to produce information at a higher precision level. When α increases, there is a larger economy of scale in the BSA's information production. Accordingly, the fund manager optimally chooses a higher level of information production.

Corollary 1. The optimal weight that the fund manager puts on the BSA's signal, w^*, increases when i) the scaling factor, α, increases, ii) the bias of the SSA, b, increases, iii) the uncertainty in the SSA's bias, Σ_B^2, increases, and iv) the precision of the SSA's signal, p, decreases.

Corollary 1 generates predictions for our empirical tests, which we discuss next.

C. Testable Hypotheses

We have demonstrated how the fund manager optimally chooses the precision of the BSA's information, and weighs the two reports in making an investment decision. In practice, as our data show, fund managers have three sources of information: SSAs, BSAs, and independent analysts/consultants. All of our model assumptions on the BSA can be applied to an unbiased independent analyst, who is not employed by a brokerage firm but can sell his research to investors for a pre-negotiated fee. From the data, we find that the average weight placed on research produced by independent analysts is only 4%, while the average, combined weights placed on research of BSAs and SSAs is 96%. Moreover, our empirical results below remain robust when we replace the weight on BSA research by the combined weights placed on BSAs and independent analysts. Therefore, our model assumption that the BSA and the SSA are the fund manager's only sources of information is reasonable.

Our model predicts a continuous, optimal weighting of the BSA's report, ranging from 0% when the SSA's report is perfectly informative or the cost of information production by the BSA is prohibitively high, to 100% when the opposite is true. In the survey-based data, fund managers are asked to estimate how they weigh research produced by BSAs, SSAs, and independent analysts (with the three weights adding up to 100%) in making their investment decisions. Thus, the continuous weighting scheme in the model directly corresponds to how fund managers utilize research sources in the data, with more details to follow in Section III.A.

For the majority of stocks held by our sample funds, multiple SSAs cover each of them. At the same time, the fund typically has a team of BSAs. Although our model assumes only one SSA and one BSA, our results can easily be extended to multiple analysts. In particular, we can interpret the SSA's signal in the model as the sufficient statistic of the information extracted from all SSAs' reports. If there is a larger number of SSAs covering the same set of stocks and performing independent research, the overall quality of SSA research tends to be higher.[9] Thus, in our empirical tests, we use the average number of SSAs covering the stocks held by a fund as a proxy for the parameter p (the precision of the SSA's signal). In the limit, if there is no SSA coverage on a stock, then $p=0$ and the fund manager must rely on the BSA alone to produce information. Our first hypothesis (H1) is that funds choose to rely more on BSA research when measures of p decrease.

Next, in our empirical tests, we require a measure for the average bias of all SSAs (parameter b) covering the stocks held by a fund. The average error in the SSAs' earnings forecasts for the stocks is such a measure. In individual stock-based empirical tests, the bias of SSA research is measured by the banking and other business relationships between an SSA's brokerage and the companies that the SSA covers (e.g., Lin and McNichols (1998), Michaely and Womack (1999), and Dechow, Hutton, and Sloan (2000)). While individual SSAs covering the same stock can have different degrees of bias, the forecasts that they make should reflect the degrees of bias, as the forecast made by a more biased SSA tends to be more optimistic relative to the actual earning (e.g., Lim (2001)). Consequently, the error of the average forecast (also known as the consensus forecast) captures the average bias of the SSAs covering the stock. We then scale this forecast error by the stock price and take the average of the scaled errors across stocks held by a

[9]However, if there is herding among SSAs, then higher coverage on a stock does not necessarily imply a higher quality of SSA research (e.g., Trueman (1994), Welch (2000)). In our empirical tests, we also include the average error and standard deviation of the SSAs' forecasts.

fund to obtain the desired bias measure for the fund. According to our model, the higher the average forecast error, the more the fund manager should rely on BSAs to produce investment-related research. This is our second hypothesis (H2).

Third, in the model the variance of the binomial distribution of the SSA's bias is Σ_B^2, which denotes the uncertainty about the SSA's bias. We show that both the weight (w^*) and optimal level of precision (q^*) increase as Σ_B^2 increases. In practice, the degrees of bias across different SSAs covering the stocks that a fund holds are uncertain. The larger the variation in the degrees of bias across SSAs, the higher the uncertainty the fund manager faces in interpreting the SSAs' reports. If the bias of an SSA's report can be proxied by the error in the forecast, we can then use the variance of the errors of the SSAs' forecasts (on the same stock) as a proxy for the uncertainty in the SSAs' biases. Since the variance of the errors of the SSAs' forecasts is the same as the variance of the forecasts themselves (across the same SSAs), we use the standard deviation of the SSAs' forecasts as a proxy for the parameter Σ_B.[10] We predict a positive relation between measures of Σ_B and the weight put on the BSA's report (hypothesis H3).

Fourth, in our model the characteristics of the SSA affect both the optimal level of precision of the BSA's information production and the weight put on the BSA's report. However, there exist factors that are unrelated to the SSA's report but influence the quality of the BSA's report. One such factor is the BSA's ability to produce high quality information, which can be measured by the experience of the BSA. Under the assumption that more experienced BSAs can produce higher quality research, the fund manager's reliance on BSA research should increase with the experience of BSAs (hypothesis H4).

Our fifth hypothesis (H5) relates to the fund's economy of scale (parameter α) in information production by the BSAs. In the model, an increase in α leads to a higher increase in the fund manager's payoff, ceteris paribus, and thus she will adjust the production of information by the BSA upward. A natural measure for α is the size of the fund, or assets under management. Thus, H5 is that funds with larger assets under management produce more information in-house and rely on this information more.

Finally, in our model the fund manager derives a higher utility when her investment action is closer to the true state of the world. This implicitly assumes that there is no agency problem between investors and the fund manager. In practice, fund managers take actions on behalf of investors, and an agency problem may exist. This can be solved by properly designed compensation contracts for the fund manager (see, e.g., Starks (1987), Das and Sundaram (2002)). We control for this potential agency problem by including a dummy variable for whether a fund offers performance-based fees in our empirical tests. With incentive-aligning compensation mechanisms, the fund manager's payoff is more sensitive to how accurate her investment decision is, which can be interpreted as a higher scaling factor, α, in the model. Accordingly, she has a stronger incentive to produce more information in-house and put more weight on this information, since informa-

[10] Alternatively, Diether, Malloy, and Scherbina (2002) interpret a higher dispersion in SSAs' earnings forecasts for a stock as a higher degree of disagreement among these SSAs, and link the dispersions of forecasts to future returns on the stocks.

tion produced by the SSA is noisy and (possibly) biased. This leads to our final hypothesis (H6).

To summarize, we test the following six hypotheses on how fund managers weigh research produced by BSAs:

H1. The weight on BSA research increases as measures of the quality of SSA signals decrease;

H2. The weight on BSA research increases as measures of the bias of SSA signals increase;

H3. The weight on BSA research increases as measures of the uncertainty about SSA bias increases;

H4. The weight on BSA research increases as measures of the quality of BSA signals increase;

H5. The weight on BSA research increases as the size of assets under management increases;

H6. The weight on BSA research increases as the degree of agency problems decreases.

III. Empirical Evidence

A. Description of Data

Our data source is Thomson Financial/Nelson Information's *Directory of Fund Managers.* A well-known information source among institutional investors (e.g., pension fund sponsors and consultants), the first edition of the Directory was published in 1988; the CD-ROM versions, which we use to build our dataset, became available in 2001. The *Directory* is based on extensive annual surveys of all the delegated portfolio management companies that provide fee-based investment services. We extract detailed information on a large sample of U.S. equity funds for 2000, 2001, and 2002. In each of the three years, more than 1,800 organizations worldwide are profiled in the *Directory*, and they manage assets of over $20 trillion.

Like other researchers who use survey-based data, we face potential problems of selection bias and accuracy in our dataset. We want to point out that the *Directory* is a regular, annual publication aimed at sophisticated institutional investors (rather than small investors). Thus, for a fund company that regularly participates in the survey and intends to survive and profit in the long run in the asset management industry, the incentive to mislead institutional investors for short-term gains is limited. In what follows, we further discuss the problems from self-reporting wherever applicable. We also perform robustness tests on funds that appear in the *Directory* more than once to control for potential selection bias problems.

The investment vehicle for our sample funds is separate accounts. Brokerage firms and financial advisors offer separate accounts to wealthy individuals, pension accounts, and other institutional investors, usually with a minimum investment of $100,000 or more and the fee depending on account size. Capital from multiple accounts within the same equity fund is invested in the same set of stocks, while each investor owns the securities in her account. This arrangement differs from a standard open-end mutual fund in which multiple investors own shares based on total investment pooled from all investors.[11] The dataset contains information on the characteristics of a fund's portfolio, investment style, benchmark, and returns. In addition, it provides information on the characteristics of fund managers and BSAs, including their experience and the fee structures. Table 1 presents summary statistics of our sample for 2000, which contains 1,237 funds; summary statistics for 2001 (1,300 funds) and 2002 (1,330 funds) are very similar, and are presented in parentheses in the table.

In each of the three years, around 75% of funds belong to fund companies that are independent investment advisors, rather than divisions of financial institutions (e.g., banks or insurance companies). In 2000, the average size of assets under management in the sample funds is $1,762 million (median $397 million), while a decline in these figures is witnessed over the next two years. The next three categories in Table 1 describe the portfolio characteristics of the funds, which are compared to those of the S&P 500 Index: i) capitalization measures whether a fund on average holds large- or mid- or small-cap stocks—around 65% of our funds have a portfolio capitalization lower than that of the Index; ii) risk is the weighted average of the betas of the individual stocks held by the fund—38% or more of the funds have a portfolio beta close to that of the Index; and iii) price-to-earnings (P/E) ratio is the weighted average of the P/E ratios of the individual stocks held by the fund—48% or more of the funds have a lower portfolio P/E ratio than that of the Index.

The category equity turnover measures how often the stocks held in a fund are traded, or how actively the portfolio is managed. Only 17% of our sample funds have a high turnover rate (equals or higher than 100% per year). Sector emphasis indicates whether a fund actively changes its sector and/or industry focus. More than 90% of the funds do not actively rotate their sectors. Investment style indicates the main investment strategy of a fund, and the four main styles are value, growth and value (or balanced), growth, and aggressive growth. In our empirical tests below, we group the first two types of funds together and re-label them value-type funds (more than 60% of funds), and call the last two types of funds growth-type funds. In terms of the experience of the fund managers, both the mean and median number of years in asset management are over 20 years, while for BSAs, the mean and median are 14 years or higher. Moreover, more than 50% of the funds offer performance-based fees in addition to the fixed management fees.

The uniqueness of the dataset is that it contains explicit information on the sources of research and how fund managers utilize research from these sources to formulate their investment strategies (the final four categories of Table 1). Based on the *Directory*, there are at least three different channels through which BSA research can benefit fund managers. First, when there are few SSAs covering the stocks in which a fund is interested, the available information is limited and the

[11]Though the dataset does not specify whether the separate account-based funds are managed like mutual funds or hedge funds, it appears that most of them resemble mutual funds: i) the fee structure is flat as a percentage of account size (no more than 2%, and varies slightly with account size), and ii) there is no hedging or short selling. The rest of the non-separate account funds in the dataset are either hedge funds or regular, open-end mutual funds. We also run the same tests including these additional funds, and all of our main results continue to hold using this larger sample.

TABLE 1

Summary Statistics

Firm Type (%)			
Independent investment advisor	Investment Bank/Broker affiliate	Bank/Trust co. affiliate	Insurance co. affiliate
76% (74%; 76%)	6% (6%; 7%)	13% (14%; 14%)	4% (5%; 4%)
Assets under Management (U.S.$ mill.)			
Mean	Median	Min	Max
1,762 (1,475; 1,093)	397 (385; 286)	0.1 (0.1; 0.1)	68,409 (51,487; 51,486)
Portfolio Capitalization			
Lower than S&P 500	Close to S&P 500		Higher than S&P 500
64% (65%; 66%)	26% (25%; 24%)		10% (10%; 10%)
Portfolio Risk (beta)			
Lower than S&P 500	Close to S&P 500		Higher than S&P 500
27% (29%; 32%)	41% (41%; 38%)		32% (31%; 30%)
Portfolio Price-to-Earnings Ratio			
Lower than S&P 500	Close to S&P 500		Higher than S&P 500
48% (50%; 50%)	18% (19%; 19%)		33% (31%; 30%)
Equity Turnover			
Low (< 50%)	Moderate (50%–100%)		High (> 100%)
45% (44%; 42%)	38% (40%; 41%)		17% (17%; 17%)
Sector Emphasis			
Active sector rotation		Non-Active sector rotation	
9% (8%; 8%)		91% (92%; 92%)	
Investment Style			
Value	Growth & Value	Growth	Aggressive Growth
36% (37%; 38%)	24% (25%; 23%)	33% (32%; 33%)	7% (6%; 6%)
Fee Structure			
Performance-based fee is offered		Performance-based fee is not offered	
53% (52%; 50%)		47% (48%; 50%)	
Experience of Fund Manager (years)			
Mean	Median	Min	Max
23 (22; 21)	22 (22; 20)	3 (3; 3)	63 (64; 49)
Average Experience of BSA (years)			
Mean	Median	Min	Max
16 (15; 15)	14 (15; 14)	1 (2; 2)	45 (48; 46)
Percentage of In-House Analysis			
Mean	Median	Min	Max
73% (74%; 75%)	80% (80%; 80%)	0% (0%; 0%)	100% (100%; 100%)
Percentage of Street Analysis			
Mean	Median	Min	Max
23% (23%; 21%)	20% (20%; 20%)	0% (0%; 0%)	100% (100%; 100%)
Percentage of Consultants/Other Analysis Used			
Mean	Median	Min	Max
4% (4%; 4%)	0% (0%; 0%)	0% (0%; 0%)	70% (100%; 70%)
Decision-Making Process			
Centralized	Multiple committee	Relative autonomy	Others
59% (58%; 55%)	26% (28%; 29%)	12% (11%; 10%)	4% (3%; 6%)

Table 1 presents summary statistics of 1,237 U.S. equity funds for 2000 (managed by separate accounts) collected from *Nelson Information's Directory of Investment Managers*. The first number in parentheses indicates the statistics for the 2001 sample (1,300 funds), and the second for the 2002 sample (1,330 funds).

fund manager must rely on the information produced by the BSAs. Therefore, BSA research fills the void left by the SSAs. Second, even if the stocks held by the fund attract many SSAs and there is a large amount of information available, the fund manager prefers that the BSAs perform additional research, because the manager does not believe SSA research is reliable. In this case, BSA research replaces or substitutes for SSA research. Third, BSA research complements SSA research, in that BSAs use all or part of SSA research as input in their own research. We present a few examples in Appendix A.5 of how funds utilize their research sources.

Although the dataset does not specify explicitly which of these channels exists in each of the funds, we believe that a combination of them is present for many funds. For example, James Investment Research offers a small-cap value fund that on average attracts only two SSAs for each of the top 10 stocks that they hold, and they rely on BSAs to produce 100% of their research. This example suggests that the filling the void channel is important for this fund. On the other hand, Barclays Global Investors offers an equity fund that attracts an average of 32 SSAs covering each of the top 10 stocks, yet Barclays relies on BSA research for 95% of all investment research with the final 5% coming from independent analysts. This suggests that the replacement channel is dominant.

In our survey-based data, different fund managers may not agree on the exact interpretations of the roles of their BSAs, and they probably have discretion over the disclosure of the weights placed on different research sources. Nevertheless, the summary statistics on the sources of research over the three years are consistent and illuminating. First, the research provided by either BSAs or SSAs carries most of the weight (on average over 96%), while the average weight on research from independent analysts is less than 5%. Second, in-house analysis dominates street analysis: in each of the three years, the average weight put on BSA research by fund managers is 73% or higher (median 80%), while the average weight on SSA research is 23% or lower. This evidence demonstrates the importance of BSAs to fund managers.

Figure 1 depicts the distribution of the weighting of BSA research for sample funds in 2000. The horizontal axis indicates the weight on BSA research, while the vertical axis denotes the frequency of funds weighting BSA research by the same percentage. The distribution spans the entire interval of 0% to 100%, has a standard deviation of 21%, and is highly skewed: less than 1% of funds rely on BSAs for 0% to 5% of all research, 5.25% of funds rely on BSAs to produce 95% to 100% of all research, and the distribution is clustered in the 65% to 90% range. The distributions for 2001 and 2002 are very similar to that of 2000, and are omitted for brevity.

Finally, the percentages of the three research sources are reported at the fund company level. BSAs, like SSAs, often specialize in evaluating securities in a few sectors. Therefore, by centralizing the use of all BSAs and making their research available to all fund managers, a fund company improves efficiency in the use of research resources. If this is the approach that a fund company adopts, then all the fund managers within the company follow the same strategy in the use of BSAs and other research sources. As shown in the last row of Table 1, 55% or more of

FIGURE 1

Distribution of Funds' Weighting of BSA Research in 2000

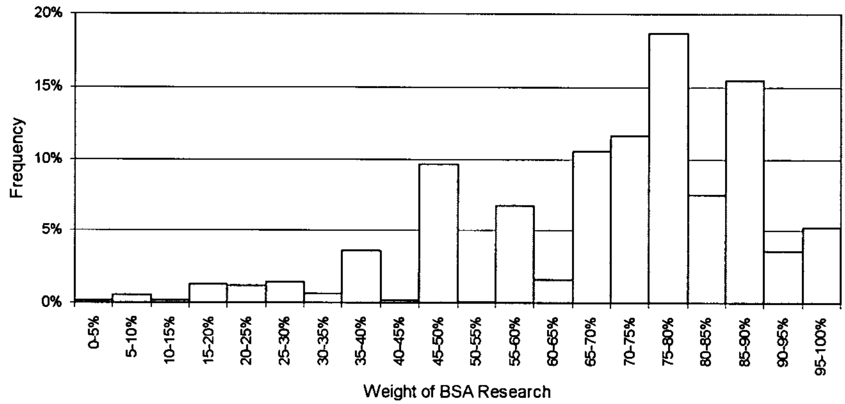

Figure 1 depicts the distribution of the weighting of BSA research for sample funds in 2000. The horizontal axis indicates the weight on BSA research, while the vertical axis denotes the frequency of funds weighting BSA research by the same percentage. The distribution spans the entire interval of 0% to 100%, has a standard deviation of 21%, and is highly skewed: less than 1% of funds rely on BSAs for 0% to 5% of all research; 5.25% of funds rely on BSAs to produce 95% to 100% of all research; and the distribution is clustered in the 65% to 90% range.

the funds in each of the three years belong to fund companies that indeed adopt this centralized approach.

The second type of decision-making process is multiple committees, in which different committees are in charge of various aspects of investment-related decisions (e.g., research and portfolio review). However, as indicated in the data, all the equity funds offered by a single company still rely on the same set of committees to make investment decisions on stocks, and hence all the funds should use BSAs in the same way. From Table 1, 26% to 29% of funds in each of the three years are in fund companies that adopt this decision-making process.

The third type of decision process is relative autonomy, that is, one fund manager's discretion over her fund's investment-related decisions can be different from another fund manager's within the same company. However, in each of the three years, only around 10% to 12% of the funds are offered by fund companies that adopt this strategy. Moreover, more than 35% of these funds belong to fund companies that offer only *one* equity fund. In that case, there is no difference between relative autonomy and a centralized decision process. Overall, in each of the three years, less than 8% of the funds belong to fund companies that adopt relative autonomy as the decision-making process *and* have multiple equity funds. In our empirical tests, we perform the same analysis excluding these funds and obtain very similar results.

In our empirical tests below, we assign the same percentages for the weighting of BSAs, SSAs, and other sources to all the equity funds within the same fund company. Given the above information on fund companies' decision-making processes, this should not bias our results. Since the majority of the fund companies in our sample adopt a centralized approach in utilizing research sources, there can be cross-fund dependence within the same fund company. Accordingly, we cluster the errors of all funds in the same fund company to account for such dependence in all our tests.

B. Empirical Tests: Weighting of BSA and SSA Research

The main goal of our empirical tests is to examine the determinants of the fund manager's weighting of research produced by BSAs. We perform ordinary least squares (OLS) regressions in each of the three years with the dependent variable being the weight (percentage) on BSA research. The explanatory variables include the characteristics of the fund's portfolio, investment style, and fund manager, as well as proxies for the quality of the information produced by the SSAs covering stocks held by the fund. In addition to examining the whole sample (first column in Tables 3, 4, and 5), we also perform the same tests on two subsamples of funds, value-type funds (second column) and growth-type funds (last column).[12] Table 2 presents results from a correlation test between these variables in all three years, while regression results in 2000, 2001, and 2002 are shown in Tables 3, 4, and 5, respectively.

Several factors significantly affect a fund manager's weighting of BSA and SSA research. First, in each of the three years, funds with low equity turnover rates rely less on BSAs than do funds with moderate rates, while there is no significant difference between funds with moderate and high rates. Funds with low turnover rates do not trade their stocks frequently and tend to adopt the buy and hold strategy, which requires less in-house research as compared to funds that manage their portfolios more actively. Therefore, reducing the amount of in-house research is cost efficient. Second, funds that actively change their sector focus (active sector rotation) put less weight on in-house analysis than those that do not, and this difference is especially pronounced for growth-type funds. If we assume BSAs often specialize in evaluating a few sectors of securities, the use of such analysts becomes much more costly when a fund frequently changes its sector focus.

Third, when funds offer performance-based fees, they put a higher weight on BSA research (significant at 1% in all three years), especially for value-type funds. As discussed before, offering performance-based fees provides fund managers a stronger incentive to improve fund performance, and corresponds to a higher scaling factor (α) in the model. Thus, the evidence supports H6. We also find that in all three years the weight on in-house analysis increases as the (natural log of) size of the fund's assets under management increases. When a fund's assets under management doubles, the weight on BSA research increases by 0.57% in 2002 and by 0.66% in 2000 and 2001, while for growth-type funds this increase is more than 0.9% in 2000 and 2001, and 0.57% in 2002. As a fund grows larger (a higher α in the model), it has more resources to employ a larger group of

[12]In Tables 3 through 5 and 6 through 8, we also run regressions with additional explanatory variables, such as the age of the fund, fees charged by the fund, average number of stocks in the portfolio, number of the fund's institutional clients, and whether the fund is quantitatively or fundamentally managed. All results stated in Sections III.B and III.C are robust to these alternative regression specifications.

TABLE 2

Correlation of Main Variables

	Weight BSA (%)	Log (assets $mill.)	Experience (manager)	Experience (BSAs)	SSA Coverage	SSA Forecast Error	SSA Forecast Std. Dev.
Panel A. Correlations in 2000							
Weight BSA (%)	1.0000						
Log (assets $mill.)	0.1323***	1.0000					
Experience (mgr)	−0.1415***	0.0144	1.0000				
Experience (BSA)	0.0120	0.0088	0.0044	1.0000			
SSA coverage	−0.1517***	0.1145***	0.0455*	0.0187	1.0000		
SSA forecast error	0.0048	0.0129	0.0010	0.0004	−0.0146	1.0000	
SSA forecast std. dev.	0.0732***	−0.0964***	−0.0089	0.0041	−0.4215***	−0.0041	1.0000
Panel B. Correlations in 2001							
Weight BSA (%)	1.0000						
Log (assets $mill.)	0.1491***	1.0000					
Experience (mgr)	−0.0946***	0.0117	1.0000				
Experience (BSA)	0.0149	0.0104	0.0185	1.0000			
SSA coverage	−0.1723***	0.0922***	0.0349*	0.0550*	1.0000		
SSA forecast error	0.0910**	−0.0357*	0.0067	0.0027	−0.1762***	1.0000	
SSA forecast std. dev.	0.1125***	−0.0341**	−0.0218	0.0032	−0.3840***	0.2073***	1.0000
Panel C. Correlations in 2002							
Weight BSA (%)	1.0000						
Log (assets $mill.)	0.1332***	1.0000					
Experience (mgr)	−0.1401***	0.0055	1.0000				
Experience (BSA)	0.0640	0.0118	0.0209	1.0000			
SSA coverage	−0.1666***	0.0694***	0.0248	0.0422	1.0000		
SSA forecast error	0.0678***	−0.0198	−0.0066	−0.0236	−0.2034***	1.0000	
SSA forecast std. dev.	0.0787***	−0.0713***	0.0150	−0.0002	−0.2891***	0.0438	1.0000

Table 2 summarizes the Pearson correlation coefficients among the main variables in 2000 (Panel A), 2001 (Panel B), and 2002 (Panel C). ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

BSAs and allocate them to different sectors of investment, and it can do so more efficiently. Therefore, our evidence supports H5.[13]

Next, we observe a positive relation between a fund's dependence on BSA research and the average experience of the BSAs, consistent with hypothesis H4, though the coefficients are not significant. We also observe a negative relation between the use of BSAs and the experience of the fund manager (significant at 10% in 2000). This can be explained by the fact that fund managers are also involved in research along with BSAs, and thus there exists a substitution effect between managers and BSAs.

Examining the trade-off between the purchase of BSA research versus the quality of SSA research provides a direct test of our model, and constitutes the central goal of our empirical work. To this end, we include three variables, average SSA coverage, average SSA earnings forecast error, and standard deviation of SSA earnings forecasts, in our tests. These variables (items 12), 13), and 14) in Tables 3 through 5) are computed based on information obtained from the IBES dataset.

We first collect the names of the top 10 stocks (in terms of dollar amount) held by each of the individual funds from the *Directory*. Since the *Directory* does not provide information on the weights of the top 10 stocks held (or information

[13]From Tables 3, 4, and 5, we also find funds that belong to companies that are independent investment advisors rely more on in-house research, compared to funds that are affiliated with other financial services companies. Large-cap funds rely less on BSA research. Finally, among the four investment styles, value funds put the highest weight on BSA research.

TABLE 3

Fund Managers' Weighting of In-House Research (2000)

Weighting of In-House Research (%)	All Funds	Value-Type Funds	Growth-Type Funds
1). The fund company is an independent investment advisor	2.41	1.41	4.16
	(1.24)	(0.67)	(1.44)
2). Portfolio capitalization (capitalization close to S&P 500 is the default type)			
2a). Portfolio cap. is less than S&P 500	0.31	−1.70	4.04
	(0.19)	(−0.88)	(1.40)
2b). Portfolio cap. is higher than S&P 500	−4.50**	−7.96**	−1.20
	(−1.93)	(−2.23)	(−0.37)
3). Portfolio risk (beta) (risk close to S&P 500 is the default type)			
3a). Portfolio beta is less than S&P 500	0.55	0.77	0.92
	(0.34)	(0.47)	(0.17)
3b). Portfolio beta is higher than S&P 500	0.80	0.47	1.27
	(0.49)	(0.19)	(0.60)
4). Portfolio price-to-earnings ratio (P/E ratio close to S&P 500 is the default type)			
4a). Portfolio P/E ratio is less than S&P 500	−0.54	−1.46	−0.71
	(−0.28)	(−0.70)	(−0.18)
4b). Portfolio P/E ratio is higher than S&P 500	−3.52	−7.48*	−1.47
	(−1.55)	(−1.77)	(−0.54)
5). Equity turnover (equity turnover moderate, or 50%–100%, is the default type)			
5a). Equity turnover is low (< 50%)	−2.57*	−3.19*	−1.41
	(−1.70)	(−1.78)	(−0.58)
5b). Equity turnover is high (> 100%)	−1.81	−2.42	−1.09
	(−0.95)	(−0.75)	(−0.48)
6). Active sector rotation	−4.39*	−0.29	−7.75**
	(−1.68)	(−0.09)	(−2.16)
7). Natural log of assets in the fund (log of $mill.)	0.95***	0.76*	1.33***
	(2.85)	(1.81)	(2.80)
8). Experience of the fund manager (number of years in fund industry)	−0.15*	−0.16	−0.19
	(−1.67)	(−1.44)	(−1.47)
9). Average experience of the buy-side analysts (number of years)	0.05	0.06	0.04
	(0.55)	(0.90)	(0.24)
10). Performance-based fee is offered	5.77***	6.36***	4.50**
	(3.94)	(3.68)	(2.10)
11). Investment style (value is the default type)			
Growth & value	−1.29	—	—
	(−0.72)	—	—
Growth	−1.68	—	—
	(−0.70)	—	—
Aggressive growth	−0.46	—	—
	(−0.14)	—	—
12). Average SSA coverage (number of SSAs)	−0.20**	−0.32***	−0.06
	(−2.19)	(−3.09)	(−0.41)
13). Average SSA earnings forecasts error (% of the stock price)	0.04	−0.35	0.99**
	(0.14)	(−1.01)	(1.98)
14). Average SSA earnings forecasts standard deviation (% of the stock price)	0.44	0.75	−2.28
	(0.31)	(0.47)	(−0.71)
15). Intercept	77.18***	83.74***	65.95***
	(15.95)	(15.53)	(8.44)
Number of observations	1,237	746	491
R^2	12.41%	14.42%	12.73%

Table 3 examines the relation between the weighting of in-house analysis and fund characteristics in 2000. The dependent variable is the weight on in-house analysis (as % of all research used by the fund). The explanatory variables on SSAs (items 12–14) are based on lagged measures obtained in 1999. The procedure is OLS. *t*-statistics are in parentheses below the coefficients. The standard errors are heteroskedasticity-robust by White's procedure and cluster controlled by classifying all the funds within the same fund company into a group (cluster). *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

TABLE 4

Fund Managers' Weighting of In-House Research (2001)

Weighting of In-House Research (%)	All Funds	Value-Type Funds	Growth-Type Funds
1). The fund company is an independent investment advisor	1.84	0.53	3.97
	(1.05)	(0.30)	(1.42)
2). Portfolio capitalization (capitalization close to S&P 500 is the default type)			
2a). Portfolio cap. is less than S&P 500	0.51	−0.84	2.40
	(0.33)	(−0.46)	(0.94)
2b). Portfolio cap. is higher than S&P 500	−2.31	−6.17**	2.28
	(−1.08)	(−2.24)	(0.80)
3). Portfolio risk (beta) (risk close to S&P 500 is the default type)			
3a). Portfolio beta is less than S&P 500	0.70	1.08	−2.21
	(0.47)	(0.69)	(−0.58)
3b). Portfolio beta is higher than S&P 500	0.74	−0.23	2.03
	(0.48)	(−0.10)	(0.99)
4). Portfolio price-to-earnings ratio (P/E ratio close to S&P 500 is the default type)			
4a). Portfolio P/E ratio is less than S&P 500	−2.23	−2.94	−1.55
	(−1.20)	(−1.38)	(−0.45)
4b). Portfolio P/E ratio is higher than S&P 500	−2.15	−1.54	−2.86
	(−1.04)	(−0.39)	(−1.15)
5). Equity turnover (equity turnover moderate or 50%–100%, is the default type)			
5a). Equity turnover is low (< 50%)	−2.91**	−2.58*	−2.91
	(−2.11)	(−1.62)	(−1.27)
5b). Equity turnover is high (> 100%)	−1.54	0.81	−3.25
	(−0.89)	(0.31)	(−1.54)
6). Active sector rotation	−4.54**	−3.16	−4.88*
	(−2.01)	(−0.99)	(−1.81)
7). Natural log of assets in the fund (log of $mill.)	0.94***	0.59	1.52***
	(2.93)	(1.52)	(3.26)
8). Experience of the fund manager (number of years in fund industry)	−0.03	−0.02	−0.07
	(−0.39)	(−0.21)	(−0.58)
9). Average experience of BSAs (number of years)	0.08	0.07	0.10
	(0.09)	(0.12)	(0.08)
10). Performance-based fee is offered	6.48***	7.60***	4.73**
	(4.91)	(5.01)	(2.28)
11). Investment style (value is the default type)			
Growth & value	−1.90	—	—
	(−1.05)	—	—
Growth	−3.20	—	—
	(−1.47)	—	—
Aggressive growth	−2.57	—	—
	(−0.81)	—	—
12). Average SSA coverage (number of SSAs)	−0.24***	−0.33***	−0.19
	(−2.65)	(−2.71)	(−1.43)
13). Average SSA earnings forecast error (% of stock price)	0.57***	0.62***	0.53
	(3.42)	(3.59)	(0.82)
14). Average SSA earnings forecast standard deviation (% of stock price)	1.35	0.71	2.23*
	(1.10)	(0.34)	(1.82)
15). Intercept	77.56***	83.22***	67.15***
	(17.97)	(15.92)	(10.39)
Number of observations	1,300	811	489
R^2	13.98%	15.52%	13.12%

Table 4 examines the relation between the weighting of in-house analysis and fund characteristics in 2001. The dependent variable is the weight on in-house analysis (as % of all research used by the fund). The explanatory variables on SSAs (items 12–14) are based on lagged measures obtained in 2000. The procedure is OLS. *t*-statistics are in parentheses below the coefficients. The standard errors are heteroskedasticity-robust by White's procedure and cluster controlled by classifying all the funds within the same fund company into a group (cluster). *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

TABLE 5

Fund Managers' Weighting of In-House Research (2002)

Use of In-House Analysis (%)	All Funds	Value-Type Funds	Growth-Type Funds
1). The fund company is an independent investment advisor	2.38	2.20	2.83
	(1.38)	(1.17)	(1.15)
2). Portfolio capitalization (capitalization close to S&P 500 is the default type)			
2a). The capitalization is less than S&P 500	1.02	0.01	2.37
	(0.66)	(0.01)	(1.00)
2b). The capitalization is higher than S&P 500	−1.49	−5.27*	2.60
	(−0.68)	(−1.64)	(0.91)
3). Portfolio risk (beta) (risk close to S&P 500 is the default type)			
3a). The risk is less than S&P 500	−0.03	0.17	−0.77
	(−0.02)	(0.11)	(−0.23)
3b). The risk is higher than S&P 500	−0.18	−0.81	0.50
	(−0.12)	(−0.32)	(0.25)
4). Portfolio price-to-earnings ratio (P/E ratio close to S&P 500 is the default type)			
4a). P/E ratio is less than S&P 500	−1.34	−1.28	−2.91
	(−0.71)	(−0.56)	(−0.92)
4b). P/E ratio is higher than S&P 500	−1.78	−2.12	−2.07
	(−0.94)	(−0.62)	(−0.91)
5). Equity turnover (equity turnover moderate, or 50%–100%, is the default type)			
5a). Equity turnover is low (< 50%)	−2.21*	−1.03	−4.44**
	(−1.65)	(−0.67)	(−1.96)
5b). Equity turnover is high (> 100%)	−1.97	−0.58	−3.25*
	(−1.28)	(−0.24)	(−1.75)
6). Active sector rotation	−3.35	−3.26	−3.34
	(−1.44)	(−0.81)	(−1.32)
7). Natural log of assets in the fund (log of $mill.)	0.82***	0.75*	0.82**
	(2.58)	(1.77)	(2.17)
8). Experience of the fund manager (number of years)	−0.20	−0.30	0.04
	(−1.16)	(−1.59)	(0.13)
9). Average experience of the BSAs (number of years)	0.14	0.08	0.21
	(1.09)	(0.72)	(0.84)
10). Performance-based fee is offered	5.63***	6.20***	4.57**
	(4.21)	(3.96)	(2.29)
11). Investment style (value is the default type)			
Growth & value	−2.98*	—	—
	(−1.74)	—	—
Growth	−3.60*	—	—
	(−1.73)	—	—
Aggressive growth	−6.24**	—	—
	(−2.01)	—	—
12). Average SSA coverage (number of SSAs)	−0.26***	−0.28***	−0.23**
	(−3.33)	(−2.69)	(−2.02)
13). Average SSA earnings forecast error (% of the stock price)	0.14	0.14	0.02
	(1.20)	(1.23)	(0.05)
14). Average SSA earnings forecast standard deviation (% of the stock price)	0.78**	1.55	0.55
	(2.48)	(1.34)	(1.20)
15). Intercept	81.59***	83.33***	74.75***
	(17.63)	(13.73)	(12.43)
Number of observations	1,330	815	515
R^2	13.01%	13.68%	11.99%

Table 5 examines the relation between the weighting of in-house analysis and fund characteristics in 2002. The dependent variable is the weight on in-house analysis (as % of all research used by the fund). The explanatory variables on SSAs (items 12–14) are based on lagged measures obtained in 2001. The procedure is OLS. *t*-statistics are in parentheses below the coefficients. The standard errors are heteroskedasticity-robust by White's procedure and cluster controlled by classifying all the funds within the same fund company into a group (cluster). *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

on other stocks held), we cannot calculate weighted averages for these variables. All together we collect information on 2,661 stocks held by our sample funds in 2000, 2,556 stocks in 2001, and 2,576 stocks in 2002. For each of the 10 stocks, we then obtain information from IBES on the number of SSAs issuing annual earnings forecasts, the consensus earnings forecasts among all SSAs covering the stock, and the actual annual earnings. We use lagged measures for the three SSA variables, consistent with existing empirical literature. For example, for the year 2000 regressions (Table 3), we collect stocks held by funds in 2000, but we compute the SSA variables based on the SSAs' earnings forecasts made for and the actual earnings of the same stocks in 1999.

First, the average SSA coverage variable, or the simple average of the number of SSAs who issue annual forecasts for the top 10 stocks held by a fund, proxies for the overall quality of information contained in SSA research (the parameter p in the model) for the fund. We find a negative and significant relation between the fund's reliance on BSA research and SSA coverage: When the average number of SSAs covering the stocks held by the fund falls by one, the percentage of all research coming from BSAs increases by 0.20% in 2000, 0.24% in 2001, and 0.26% in 2002. This finding is especially pronounced for value-type funds (significant at 1% in all three years), while it is less significant or not significant for growth-type funds.

We interpret the negative relation between SSA coverage and the weighting of BSA research as the negative relation between the quality of an SSA's signal and the BSA's information production implied by our model. An alternative explanation is based on the determinants of SSA coverage. Consistent with existing empirical research (e.g., Bhushan (1989), Barth, Kasznik, and McNichols (2001)), we find that the stocks held by value-type funds (and small-cap funds) attract significantly less SSA coverage than those held by growth-type funds (large-cap funds). Thus, much more information is available for growth and large-cap stocks, leaving less room for the BSAs to generate additional valuable information. As explained before, this alternative hypothesis is consistent with our model prediction, as low SSA coverage corresponds to low values of p in the model. Moreover, in our tests for the whole sample (first column of Tables 3–5), after we control for the characteristics of the stocks held by the fund (portfolio capitalization, risk, and P/E ratio), we still find a negative relation between SSA coverage and the reliance on BSA research. These results indicate that SSA coverage is a proxy for the overall quality of SSA research, regardless of the types of stocks held by a fund. Taken together, our results provide support for H1.

Second, to obtain the variable, average SSA earnings forecast error, for a fund, we first calculate the forecast error of the consensus earnings forecast for each of the top 10 stocks held by the fund. The consensus forecast on a stock is obtained by taking the average of all SSAs' first forecasts of the (annual) earnings on that stock. We then take the difference between the realized annual earnings and the consensus earnings forecast, and scale the difference by the stock price at the time when the forecasts are made (observations with stock prices below $1 are dropped). Using stock prices prior to the announcement of actual earnings can reduce any endogeneity effects with other firm characteristics. Finally, we take the simple average of the forecast errors on the 10 stocks to obtain the variable that measures the overall (expected) bias of SSAs covering stocks held by the fund (parameter b in the model).

In each of the three years, the average forecast errors of our sample funds are positive and significantly different from zero. These results imply an overall positive bias in the SSAs' earnings forecasts, and are consistent with existing literature (e.g., Easterwood and Nutt (1999), Lim (2001), Chan, Karceski, and Lakonishok (2003), and Jegadeesh et al. (2004)). We also find a positive relation between funds' weightings of BSA research and the average bias of the SSAs in all three years. In 2001, when the average error of SSAs' forecasts goes up by 1% (relative to stock prices), the weight on BSA research increases by 0.57% (significant at 1%). This relation is even stronger for value-type funds. In 2000, while the coefficient is not significant for the whole sample, the weight on BSA research increases by 0.99% for growth-type funds as the average error goes up by 1% (significant at 5%).

We interpret the average error in SSAs' forecasts as a proxy for their bias, which, in turn, motivates more in-house research. Alternatively, a higher (positive) average SSA error in the forecasts for a stock is due to the difficulty in evaluating the stock (by unbiased SSAs) because the stock is obscure or the firm has a large amount of risky growth options (such as intangible assets), and the information released by the firm is opaque and/or optimistic. However, we control for SSA coverage (low coverage stocks are more likely to be obscure), and a fund's portfolio risk and P/E ratio (firms whose stocks have high risk and P/E ratios tend to have a large number of growth options) in our tests, and still find a positive relation between the average SSA error and the weighting of BSA research. Therefore, the difficulty in evaluating stocks alone cannot explain the (positive) error in SSAs' forecasts, or the positive relation between the error and BSA research. Overall, our results provide support for H2.

Third, we obtain the variable standard deviation of SSA earnings forecasts by first calculating the standard deviation of all earnings forecasts made by SSAs on the same stock, scaling the standard deviation by the stock price at the time when the forecasts are made, and then taking the average of the normalized standard deviations for the 10 stocks. As stated earlier, this variable measures the uncertainty in the degrees of bias across SSAs, and is the proxy for the parameter Σ_B in the model. In each of the three years, the coefficient on this variable is positive for the entire sample. In 2002, when the standard deviation increases by 1% relative to the stock price, the weight put on BSA research increases by 0.78% (significant at 5%). In 2001, growth-type funds' dependence on BSA research increases by 2.23% when the dispersion of SSAs' forecasts increases by 1% (significant at 10%).[14]

An alternative explanation for the positive relation between the standard deviation of SSAs' forecasts and the weighting of BSA research is that the risk and uncertainty of some stocks are higher, which, in turn, lead to higher dispersion of SSAs' forecasts. The intrinsic risk and uncertainty of the stocks also lead to more reliance on in-house research. As discussed above, we control for factors that proxy for the risk and uncertainty of stocks held by the funds, such as portfolio beta (risk) and the P/E ratio, and the positive relation still holds. This implies the standard deviation of SSAs' forecasts is a proxy for the uncertainty of the bias of SSAs (covering the stocks held by a fund), in addition to the risk and uncer-

[14]We also scale the standard deviations of individual SSAs' forecasts made on a stock by the square root of the number of SSAs covering the stock. This is the standard error for the consensus (average) forecast, and is another measure of the parameter Σ_B. Using this measure yields almost identical results, and they are not reported.

tainty of the stocks. Taken together, the results on the standard deviation of SSAs' forecasts provide evidence supporting H3.

Finally, we perform an F-test on the three variables indicating characteristics of the SSAs and find that they are jointly significant at the 1% level in 2000, at the 0.1% level in 2001, and at the 0.02% level in 2002. To summarize, we find evidence supporting our model's prediction of the trade-off between the quality of SSA research and the amount of information produced by the BSAs as well as the weighting of the information produced in-house.

C. Empirical Tests: Fund Performance and Analysts

Having tested the predictions of our model, we now examine whether fund performance is affected by the weighting of BSA and SSA research, along with other fund characteristics. To measure fund performance, we use a fund's excess returns over its benchmark returns in the same year. For a large subsample of funds, we also examine excess returns, net of fees, in Section III.D below. A better variable to measure fund performance is the fund's alpha. However, in order to calculate alphas for the funds, we need a much more frequent and longer time series of fund returns, which are not available from the *Directory*.

In Panel A of Table 6, we list the seven most frequently used benchmarks of our sample funds and the returns of these benchmarks. In each of the three years, the most frequently used benchmark is the S&P 500 Index (one-third of all funds), while the second most used benchmark is the Russell 2000 Index. The poor performance of the broad indexes (S&P 500 and Russell 2000), and the dominance of value over growth indexes coincide with the overall economic and market conditions during the time period. To reduce the potential bias in our empirical results due to the self-selected benchmarks of the funds, we also assign benchmarks based on a fund's portfolio capitalization and investment styles.[15] Using our own set of benchmarks, instead of the funds' self-reported ones, we perform the same empirical tests and obtain results very similar to those reported in Tables 7 through 9.

The sample funds on average outperform their benchmarks in each of the three years (Panel B of Table 6). In 2000, the mean excess return of the sample funds (over the benchmark return) is 6.40% (significant at 1%) with a median 6.10%. However, in 2001, the sample funds performed only marginally better than their benchmarks (mean excess return is 0.82%, and median is 0.81%, both insignificant from zero). One reason for the difference in relative performance of the sample funds versus their benchmarks is the timing of the burst of the technology bubble and the subsequent economy-wide recession.[16] Another possibility is the selection bias in our survey-based dataset, in that funds are more

[15]For example, if the fund's capitalization is less than that of the S&P 500 and it is a value fund, we assign the Russell 2000 Value Index as its benchmark. For more details, see Cheng, Liu, and Qian (2004).

[16]First, the crash of the technology sector started in the second quarter of 2000 and continued for most of 2001. Funds that moved out of the sector during the first half of 2000 ended up significantly outperforming their (broadly based) benchmarks for the entire year. Second, in early 2001, the recession spread to the entire economy, and subsequently hit bottom in 2002, so that all sectors performed poorly in 2001 and 2002.

TABLE 6

Benchmarks, Benchmark Returns, and Fund Excess Returns (2000–2002)

Panel A. Top Seven Benchmarks Used by the Funds (2000–2002)

Name of Benchmark	Fraction of the Sample Funds Using the Benchmark	Benchmark Return (%)
S&P 500 Index	37% (35%; 32%)	−9.1% (−11.88%; −22.10%)
Russell 2000 Index	14% (8%; 11%)	−3.03% (2.49%; −20.48%)
Russell 1000 Value Index	5% (7%; 8%)	7.02% (−5.59%; −15.52%)
Russell 2000 Growth Index	6% (6%; 7%)	−22.43% (−9.23%; −30.26%)
Russell 1000 Growth Index	3% (4%; 5%)	−27.42% (−20.42%; −27.89%)
Russell 2000 Value Index	3% (4%; 4%)	22.81% (14.02%; −11.43%)
S&P 400 Index (mid-cap)	4% (3%; 3%)	17.49% (−0.6%; −14.53%)

Panel B. Distribution of Funds' Excess Returns

a) Summary of excess returns in 2000 (n = 1,237)

Mean	Median	Min	Max
6.40%***	6.10%***	−72.57%	70.20%

b) Summary of excess returns in 2001 (n = 1,330)

Mean	Median	Min	Max
0.82%	0.81%	−60.13%	37.83%

c) Summary of excess returns in 2002 (n = 1,330)

Mean	Median	Min	Max
1.82%***	1.40%***	−55.94%	57.05%

In Table 6, Panel A lists the top seven benchmarks used by our sample funds. The benchmarks are ranked by the percentage of the sample using them. Summary statistics for 2000 are listed first, while statistics for 2001 and 2002 are listed in parentheses with the first number indicating a 2001 statistic. Panel B summarizes the distribution of excess returns of the sample funds. A fund's excess return is calculated as the difference between its actual return in a year and its benchmark return in the same year. ***, ** indicate different from zero at the 1% and 5% levels, respectively.

likely to respond to the survey after (recent) good performance than after bad performance. This can explain the fact that in 2000, many more funds significantly outperformed their benchmarks, because they had good performance in 1999, but in 2001 and 2002 fewer funds outperformed their benchmarks, following poor performance in the previous year. Due to data limitations, we cannot gauge the degree of this selection bias.

Tables 7, 8, and 9 summarize the results from OLS regressions on (cross-sectional) fund excess returns in each of the three years. We also split the whole sample into four groups by fund investment styles (value-type funds and growth-type funds), and by whether portfolio capitalization is close to or higher than that of the S&P 500 Index (large-cap funds and small-cap funds). First, consistent with the existing literature, we find that investment styles and portfolio characteristics affect fund performance.[17] For example, in each of the three years, value funds outperform growth funds and balanced (growth and value) funds, while aggressive growth funds have the worst performance among the four investment styles (see, e.g., Ferson and Khang (2002)). Also, we do not find that the size of a fund's assets under management directly contributes to superior performance (see, e.g., Grinblatt and Titman (1989), Chen, Hong, Huang, and Kubik (2004)).

[17]First, small-cap outperform large-cap funds in 2000 and 2001. Second, funds with high portfolio risk (beta) underperform funds with moderate risk in all three years. Third, funds with high portfolio P/E ratios underperform funds with moderate P/E ratios in 2000 and 2001. We also find that funds with high equity turnover underperform funds with moderate turnover in 2000 and 2001.

TABLE 7

Fund Characteristics and Performance (2000)

Excess Return of the Fund (%)	All Funds	Value-Type Funds	Growth-Type Funds	Large-Cap Funds	Small-Cap Funds
1). Portfolio cap. (close to S&P 500 is default)					
1a). Less than S&P 500	1.86*	1.65	1.80	—	—
	(1.89)	(1.36)	(1.00)	—	—
1b). Higher than S&P 500	−1.47	−1.28	−2.60	—	—
	(−1.22)	(−0.67)	(−1.38)	—	—
2). Portfolio risk (beta) (close to S&P 500 is default)					
2a). Less than S&P 500	0.86	0.89	4.17	3.04	−0.03
	(0.64)	(0.70)	(0.80)	(1.50)	(−0.02)
2b). Higher than S&P 500	−2.85**	1.11	−5.83***	−5.04***	−1.60
	(−2.29)	(0.61)	(−3.48)	(−2.95)	(−0.90)
3). Portfolio P/E ratio (close to S&P 500 is default)					
3a). Less than S&P 500	0.81	1.31	0.80	−0.64	0.63
	(0.55)	(0.83)	(0.21)	(−0.35)	(0.28)
3b). Higher than S&P 500	−4.34***	−1.84	−3.93**	−2.05	−5.63***
	(−3.11)	(−0.79)	(−2.41)	(−1.14)	(−2.68)
4). Equity turnover (moderate, or 50%–100%, is default)					
4a). Low turnover (< 50%)	−0.48	−0.33	−0.39	−0.01	−1.09
	(−0.45)	(−0.27)	(−0.18)	(−0.00)	(−0.76)
4b). High turnover (> 100%)	−2.74*	−1.31	−2.18	0.18	−3.85*
	(−1.66)	(−0.58)	(−0.83)	(0.09)	(−1.78)
5). Active sector rotation	1.46	1.05	1.23	−0.82	2.61
	(0.75)	(0.42)	(0.42)	(−0.39)	(0.96)
6). Natural log of assets in the fund (log of $mill.)	0.14	0.31	0.02	−0.06	0.23
	(0.56)	(1.14)	(0.04)	(−0.24)	(0.60)
7). Experience of the fund manager (number of years in fund industry)	0.06	0.14**	−0.04	0.05	0.03
	(1.01)	(1.98)	(−0.39)	(0.79)	(0.46)
8). Average experience of the BSAs (number of years)	0.10	0.10	0.04	−0.01	0.17*
	(1.42)	(1.09)	(0.29)	(−0.13)	(1.70)
9). Performance-based fee is offered	−0.49	−0.65	−0.70	−0.45	−0.52
	(−0.49)	(−0.56)	(−0.40)	(−0.35)	(−0.40)
10). Investment style (value is the default type)					
Growth & value	−6.29***	—	—	−5.69***	−5.69***
	(−4.33)	—	—	(−2.94)	(−2.94)
Growth	−7.14***	—	—	−7.49**	−7.49**
	(−3.47)	—	—	(−2.51)	(−2.51)
Aggressive growth	−8.71***	—	—	−7.40*	−7.40*
	(−2.68)	—	—	(−1.79)	(−1.79)
11). The return is net-of-fee	−2.80***	−0.97	−5.38***	−1.41	−3.54***
	(−2.82)	(−0.83)	(−3.15)	(−1.20)	(−2.62)
12). Percentage of in-house analysis (%)	0.04	0.06**	0.01	−0.004	0.07*
	(1.56)	(2.14)	(0.22)	(−0.14)	(1.79)
13). Intercept	9.51**	1.12	11.69**	22.88**	7.73
	(2.46)	(0.26)	(2.03)	(2.55)	(1.40)
Number of observations	1,237	746	491	445	792
R^2	22.35%	14.23%	20.73%	24.63%	23.80%

Table 7 examines the relation between fund performance and fund characteristics including the weighting of analysts' research in 2000. We split the whole sample into four groups by investment style (value-type funds and growth-type funds) and portfolio capitalization (large-cap and small-cap). The procedure is OLS. The dependent variable is a fund's excess return, or the difference between the fund's actual return and that of its benchmark. *t*-statistics are in parentheses below the coefficients. The standard errors are heteroskedasticity-robust by White's procedure and cluster controlled by classifying all the funds within the same fund company into a group (cluster). *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Interestingly, after controlling for the characteristics of fund organization structure and portfolios, we find a positive relation between the characteristics of the BSAs and fund performance in each of the three years.[18] First, the coefficient on average experience of the BSAs is positive and significant at the 5% level in

[18]We do not include those variables on SSA characteristics in the regression. We do not view these variables as directly related to fund performance, but rather they affect the use of BSAs by the fund manager, as examined in Tables 3–5.

TABLE 8

Fund Characteristics and Performance (2001)

Excess Return of the Fund (%)	All Funds	Value-Type Funds	Growth-Type Funds	Large-Cap Funds	Small-Cap Funds
1). Portfolio cap (close to S&P 500 is default)					
1a). Less than S&P 500	1.50**	2.31**	0.36	—	—
	(2.15)	(2.48)	(0.23)	—	—
1b). Higher than S&P 500	−0.08	−0.98	−0.01	—	—
	(−0.08)	(−0.66)	(−0.01)	—	—
2). Portfolio risk (beta) (close to S&P 500 is default)					
2a). Less than S&P 500	1.49*	1.63*	1.65	2.80**	0.83
	(1.71)	(1.73)	(0.83)	(1.95)	(0.76)
2b). Higher than S&P 500	−2.45***	0.86	−3.81***	−3.06***	−1.98
	(−2.71)	(0.63)	(−3.07)	(−2.76)	(−1.55)
3). Portfolio P/E ratio (close to S&P 500 is default)					
3a). Less than S&P 500	1.34	2.01**	−1.03	1.41	−0.07
	(1.48)	(2.01)	(−0.47)	(1.27)	(−0.05)
3b). Higher than S&P 500	−2.37**	−1.93	−2.38*	−1.55	−3.43**
	(−2.40)	(−1.19)	(−1.69)	(−1.43)	(−2.46)
4). Equity turnover (moderate, or 50%–100%, is default)					
4a). Low turnover (< 50%)	1.20*	2.25**	−0.99	2.02**	0.70
	(1.68)	(2.50)	(−0.68)	(2.07)	(0.66)
4b). High turnover (> 100%)	−1.92*	1.77	−3.81**	1.97	−2.76*
	(−1.66)	(1.05)	(−2.43)	(1.29)	(−1.88)
5). Active sector rotation	−0.40	0.21	−1.35	−0.86	0.12
	(−0.32)	(0.12)	(−0.75)	(−0.57)	(0.07)
6). Natural log of assets in the fund (log of $mill.)	−0.30*	0.02	−0.64*	−0.19	−0.34
	(−1.72)	(0.10)	(−1.84)	(−0.89)	(−1.42)
7). Experience of the fund manager (number of years)	0.01	−0.01	0.03	0.01	0.02
	(0.23)	(0.06)	(0.35)	(0.29)	(0.29)
8). Average experience of the buy-side analysts (number of years)	0.13**	0.14**	0.05	0.12**	0.14*
	(2.27)	(2.22)	(0.45)	(1.97)	(1.65)
9). Performance-based fee is offered	−0.69	−1.25	−0.44	0.10	−0.89
	(−0.89)	(−1.51)	(−0.32)	(0.10)	(−0.85)
10). Investment style (value is the default type)					
Growth & value	−6.26***	—	—	−2.88**	−7.22***
	(−6.55)	—	—	(−2.38)	(−5.52)
Growth	−10.71***	—	—	−6.78***	−12.59***
	(−8.22)	—	—	(−4.86)	(−6.57)
Aggressive growth	−16.72***	—	—	−8.91***	−19.04***
	(−7.38)	—	—	(−2.73)	(−6.86)
11). Return is net-of-fee	−1.26	−0.56	−2.49*	−1.06	−1.41
	(−1.47)	(−0.58)	(−1.67)	(−1.12)	(−1.17)
12). Percentage of in-house analysis	0.08***	0.09***	0.06*	0.03	0.10***
	(3.78)	(3.74)	(1.68)	(1.45)	(3.47)
13). Intercept	4.26	−0.92	−0.09	−1.62	5.70
	(1.51)	(−0.28)	(−0.02)	(−0.35)	(1.47)
Number of observations	1,300	811	489	453	847
R^2	42.47%	23.35%	27.04%	40.05%	44.18%

Table 8 examines the relation between fund performance and fund characteristics including the weighting of analysts' research in 2001. We split the whole sample into four groups by investment style (value-type funds and growth-type funds) and portfolio capitalization (large-cap and small-cap). The procedure is OLS. The dependent variable is a fund's excess return, or the difference between the fund's actual return and that of its benchmark. *t*-statistics are in parentheses below the coefficients. The standard errors are heteroskedasticity-robust by White's procedure and cluster controlled by classifying all the funds within the same fund company into a group (cluster). *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

both 2001 and 2002, while neither the experience of the fund manager or whether the fund offers performance-based fees has a significant impact on fund performance. When the average experience of a fund's BSAs moves up from the sample mean (15 years in 2001 and 2002) by one standard deviation (7.09 years in 2001 and 7.29 years in 2002), the fund's excess return increases by 92.17 basis points in 2001 and 87.48 basis points in 2002.

TABLE 9

Fund Characteristics and Performance (2002)

Excess Return of the Fund (%)	All Funds	Value-Type Funds	Growth-Type Funds	Large-Cap Funds	Small-Cap Funds
1). Portfolio cap (close to S&P 500 is default)					
1a). Less than S&P 500	0.78	1.90**	−0.81	—	—
	(1.26)	(2.28)	(−0.87)	—	—
1b). Higher than S&P 500	−2.20***	−3.57**	−1.86**	—	—
	(−2.59)	(−2.50)	(−2.08)	—	—
2). Portfolio risk (beta) (close to S&P 500 is default)					
2a). Less than S&P 500	2.99***	2.88***	5.07***	1.55	3.71***
	(4.12)	(3.48)	(3.49)	(1.30)	(4.12)
2b). Higher than S&P 500	−2.26***	−0.56	−2.67***	−3.27***	−1.57*
	(−3.18)	(−0.48)	(−3.37)	(−3.41)	(−1.64)
3). Portfolio P/E ratio (close to S&P 500 is default)					
3a). Less than S&P 500	0.39	−0.74	2.03	0.78	−0.47
	(0.42)	(−0.70)	(1.20)	(0.63)	(−0.34)
3b). Higher than S&P 500	−1.08	−1.87	−0.08	−0.36	−1.89
	(−1.13)	(−1.09)	(−0.08)	(−0.31)	(−1.43)
4). Equity turnover (moderate, or 50%–100%, is default)					
4a). Low turnover (< 50%)	0.46	0.72	0.32	0.91	0.13
	(0.71)	(0.98)	(0.31)	(1.00)	(0.16)
4b). High turnover (> 100%)	−0.36	1.45	−0.87	0.83	−0.51
	(−0.40)	(0.81)	(−0.95)	(0.59)	(−0.46)
5). Active sector rotation	1.35	3.39*	0.48	1.21	1.86
	(1.10)	(1.71)	(0.34)	(0.59)	(1.27)
6). Natural log of assets in the fund (log of $mill.)	0.08	0.14	0.03	−0.01	0.17
	(0.70)	(0.82)	(0.23)	(−0.08)	(1.20)
7). Experience of the fund manager (number of years)	0.08	0.11	0.06	0.12	0.05
	(1.06)	(1.51)	(0.45)	(1.22)	(0.88)
8). Average experience of the buy-side analysts (number of years)	0.12**	0.09	0.13*	0.20**	0.07
	(2.12)	(1.27)	(1.74)	(2.07)	(1.13)
9). Performance-based fee is offered	−1.48***	−1.26*	−1.84**	−1.56*	−1.37**
	(−2.61)	(−1.72)	(−2.24)	(−1.93)	(−1.98)
10). Investment style (value is the default type)					
Growth & value	−1.75**	—	—	−1.60	−1.34
	(−2.13)	—	—	(−1.44)	(−1.21)
Growth	−6.87***	—	—	−4.95***	−8.18***
	(−6.59)	—	—	(−3.64)	(−5.75)
Aggressive growth	−11.10***	—	—	−4.98*	−12.95***
	(−6.82)	—	—	(−1.87)	(−6.40)
11). The return is net-of-fee	0.24	0.73	−0.38	−0.12	0.48
	(0.35)	(0.76)	(−0.47)	(−0.16)	(0.52)
12). Percentage of in-house analysis (%)	0.03*	0.05**	0.01	0.04*	0.02
	(1.81)	(2.26)	(0.13)	(1.70)	(0.98)
13). Intercept	3.14	3.15	−3.94	2.73	4.62
	(1.47)	(1.21)	(−1.34)	(0.90)	(1.61)
Number of observations	1,330	815	515	446	884
R^2	32.23%	12.45%	18.76%	23.69%	35.99%

Table 9 examines the relation between fund performance and fund characteristics including the weighting of analysts' research in 2002. We split the whole sample into four groups by investment style (value-type funds and growth-type funds) and portfolio capitalization (large-cap and small-cap). The procedure is OLS. The dependent variable is a fund's excess return, or the difference between the fund's actual return and that of its benchmark. *t*-statistics are in parentheses below the coefficients. The standard errors are heteroskedasticity-robust by White's procedure and cluster controlled by classifying all the funds within the same fund company into a group (cluster). *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Second, we observe a positive relation between a fund's weighting of in-house analysis and fund excess returns in each of the three years, although this relation is not statistically significant in 2000 and is only marginally significant (at the 10% level) in 2002. The coefficients on the weighting of BSA research implies that a 20% increase in the weight of in-house analysis (the standard deviation is around 21% in all three years) would raise the fund's annual excess return by

84 basis points or an extra profit of $14.5 million before fees in 2000; 168 basis points or $23.5 million in 2001; and 63 basis points or $6.89 million in 2002.

The impact of the weighting of BSA research on fund excess returns appears to be large. On the other hand, our model of one fund manager's investment decisions does not provide predictions on the cross-sectional differences in the payoffs of fund managers. Therefore, it is worthwhile to discuss the validity and implications of our empirical result. First, the positive impact of BSA research can be explained by the potential frictions in adjusting the use of BSAs, which is absent in our model but present in practice.[19] For example, there are adjustment costs in altering a fund company's (or a fund's) investment approach and ways of utilizing research sources. Potential imperfections in the labor markets for BSAs and fund managers also contribute to these costs, which can lead to deviations from the equilibrium use of BSA research.

Due to data limitations (e.g., BSA compensation data are not available), we cannot estimate the magnitude of adjustment costs nor explicitly test the hypothesis of whether the BSAs are underpaid relative to the investment value of their research. If the adjustment costs were indeed present and significant, then it is not surprising to see that, despite the sudden changes in the markets such as those occurred during our sample period of 2000 to 2002, funds do not quickly adjust their decision-making process and organizational structure, including the use of analyst research, to the new optimal level. This, in turn, can magnify the impact of BSA research as well as a fund's reliance on this research on the fund's performance, as we observe from our empirical tests.

We have mentioned that imperfect measures of fund performance (excess returns over self-selected benchmarks versus fund alphas) may have exaggerated the impact of BSAs on fund performance in our tests. Another possibility is that funds had successful years prior to 2000, and, in anticipation of fund inflows in 2000 and 2001, decided to use more BSAs to produce information to take advantage of the economy of scale. As discussed in the robustness tests below, we do not observe any significant correlations between the change in the weighting of BSA research (between two consecutive years) and fund performance or characteristics of SSAs in the previous year. However, due to data limitations, we cannot completely rule out reverse causality in the relation between the weighting of BSA research and fund performance. As more time-series data become available, further research can examine whether and how funds adjust their use of BSAs along with their investment styles in the long run.

Next, we examine how the impact of BSA research on fund performance differs across investment styles, portfolio characteristics, and sizes of assets under management. First, in all three years, the positive impact of in-house analysis is significantly higher for value-type than for growth-type funds (second and third columns in Tables 7–9). Second, the positive impact is higher for funds investing in small-cap than large-cap stocks in 2000 and 2001 (last two columns), but the

[19]In our model, the fund manager adjusts the precision of the information produced by the BSA, such that the marginal benefit of improving the quality of the overall information equals the marginal cost of an additional payment made to the BSAs for exerting effort. The positive and significant relation between the weighting of BSA research and fund performance suggests that, had these funds relied more on BSA research, their performance would have been even better, and that funds should continue to increase the use of BSA research until it has no significant impact on fund performance.

opposite pattern emerges in 2002. The difference in the impact of the weighting of BSA research across investment styles can be explained by the difference in the amount and quality of information available from the SSAs. As previously discussed, the stocks held by value funds (and small-cap funds) attract significantly less SSA coverage than those held by growth funds (large-cap funds). On the other hand, we do not find the average forecast error of SSAs for value-type funds to be significantly different from that for growth-type funds in any of the three years. Thus, the additional information produced by BSAs can be much more valuable for value and small-cap funds than for growth and large-cap funds.

Finally, one may think that the impact of BSAs on fund performance is driven by small funds that employ only a few BSAs, so that the marginal impact of having one additional BSA is significant. We redo the above tests on fund performance on four subsamples, sorted by the size of funds' assets under management in each of the three years. We find that the impact on fund performance of BSAs' average experience as well as the weight put on BSA research is not limited to small funds. In fact, the positive impact of the weighting of BSA research is most pronounced among the largest funds in 2001 and 2002, while the positive impact of BSA experience is indeed more significant among small- and medium-sized funds in 2000 and 2001.

To summarize, our results on the relation between the characteristics of BSAs and fund excess returns contribute to the literature on the determinants of fund performance. For example, Chevalier and Ellison (1999) find that mutual fund managers who earned their undergraduate degrees from institutions with higher SAT scores outperform their colleagues.

D. Other Robustness Tests

In this section, we perform additional robustness tests and discuss a few more empirical results. First, as discussed before, there can be potential selection biases in the data due to the nature of self-reporting by funds. One such bias is that funds have an incentive to overattribute a previous year's superior (inferior) performance to the use of BSAs (SSAs). To check for this bias, we examine the changes in funds' weightings of BSA and SSA research. Of the 341 funds that report data for 2000 and 2001 and the 843 funds that report data for 2001 and 2002, we find that only a small fraction of these funds (25 funds from 2000 to 2001, and 65 funds from 2001 to 2002) changed their weights on BSA and SSA research. Moreover, we do not find any significant correlation between the change in the weight of BSA research and funds' excess returns or the characteristics of SSAs (coverage, average forecast error, and standard deviation of forecasts) in the previous year. The lack of correlation indicates that selection bias alone cannot drive our empirical results presented in Tables 3, 4, and 5.

Second, the fair disclosure rule, or Regulation FD, became effective on Oct. 23, 2000, and thus our sample covers both pre-and post-Reg FD periods. However, there is no significant change in the use of BSAs and SSAs after the implementation of the new regulation. Third, in Tables 7 through 9, the excess returns of funds are significantly lower if the returns are net-of-fees (the coefficient on the dummy, excess return is net of fee, is negative in both years). Around 70%

of sample funds report net-of-fee returns. Among the funds that report only gross returns, 75% of them also report their fee structure. For these funds, we compute the net excess return, which is the difference between the excess return and the (management) fees charged by the funds.[20] We then perform the same empirical tests as specified in Tables 7 through 9, using the net-of-fee excess return on a smaller sample, and all of our main results continue to hold. In particular, funds' net excess returns are positively (and significantly) related to the experience of BSAs, as well as the weighting of BSA research.

IV. Summary and Conclusion

This paper is the first to examine both theoretically and empirically the role of BSAs in assisting money managers to make better investment decisions. Our results extend the literature on the investment value and potential bias of financial analysts, as well as the literature on asset management companies and their performance. We first model how a fund manager forms an investment decision by evaluating information produced by a biased SSA and an unbiased BSA. In equilibrium, the fund manager pays the BSA to produce information at an optimal precision level, and weighs the two pieces of information in making the decision. Our model predicts that the optimal weight put on the BSA's research increases when the quality of his signal improves, when the quality of the SSA's signal decreases, when the SSA's degree of bias increases, or when uncertainty about the bias of the SSA increases.

We then empirically test our model predictions and investigate the use of analyst research based on a survey-based dataset of U.S. equity funds. First, we find that, on average, funds rely more on BSA research than SSA or independent research in their investment decisions. Second, funds rely on BSA research more when the SSA coverage on the stocks held by the fund is smaller, or when the average error in the SSAs' earnings forecasts is higher, or when the standard deviation of SSAs' forecasts is higher. We also find that a fund relies more on BSA research when the size of the fund's assets is larger, the fund offers performance-based fees, or the fund does not change its sectors of focus frequently. These findings support our model's predictions of how the fund manager utilizes research from the SSA and the BSA. Finally, we demonstrate that a fund's excess returns increase when the fund's BSAs are more experienced, or when the fund relies more on BSA research relative to other sources.

Appendix

A.1. Proof of Proposition 1. The fund manager has to choose y to maximize her utility based on the SSA's report, S_{SSA}, and the BSA's report, S_{BSA},

[20]The fee percentage typically decreases when account size increases. The Spearman correlation coefficient between fee and fund size is significant at less than the 1% level. We take the average of the highest and lowest fee percentages and subtract it from the reported gross return to obtain the net-of-fee return.

$$\max_y \quad E\left[-\alpha(y-\widetilde{v})^2 \,|\widetilde{S}_{\text{SSA}} = S_{\text{SSA}}, \widetilde{S}_{\text{BSA}} = S_{\text{BSA}}\right], \quad \Longleftrightarrow$$
$$\max_y \quad \theta \times E\left[-\alpha(y-\widetilde{v})^2 \,|b+\widetilde{v}+\widetilde{e}_{\text{SSA}} = S_{\text{SSA}}, \widetilde{v}+\widetilde{e}_{\text{BSA}} = S_{\text{BSA}}\right]$$
$$+ (1-\theta) \times E\left[-\alpha(y-\widetilde{v})^2 \,|\widetilde{v}+\widetilde{e}_{\text{SSA}} = S_{\text{SSA}}, \widetilde{v}+\widetilde{e}_{\text{BSA}} = S_{\text{BSA}}\right].$$

Using the Projection Theorem, we know that

$$E\left[\widetilde{v}\,|b+\widetilde{v}+\widetilde{e}_{\text{SSA}} = S_{\text{SSA}}, \widetilde{v}+\widetilde{e}_{\text{BSA}} = S_{\text{BSA}}\right] = \frac{(S_{\text{SSA}}-b)p+qS_{\text{BSA}}}{p+q}, \quad \text{and}$$
$$E\left[\left(\widetilde{v}-\frac{(S_{\text{SSA}}-b)p+qS_{\text{BSA}}}{p+q}\right)^2 \middle| b+\widetilde{v}+\widetilde{e}_{\text{SSA}} = S_{\text{SSA}}, \widetilde{v}+\widetilde{e}_{\text{BSA}} = S_{\text{BSA}}\right] = \frac{1}{p+q}.$$

Therefore, when the SSA is biased ($B = b$), we have

$$\begin{aligned}
&E\left[(y-\widetilde{v})^2 \,|b+\widetilde{v}+\widetilde{e}_{\text{SSA}} = S_{\text{SSA}}, \widetilde{v}+\widetilde{e}_{\text{BSA}} = S_{\text{BSA}}\right] \\
&= E\left[2\left(y-\frac{(S_{\text{SSA}}-b)p+qS_{\text{BSA}}}{p+q}\right)\left(\frac{(S_{\text{SSA}}-b)p+qS_{\text{BSA}}}{p+q}-\widetilde{v}\right)\middle| \right. \\
&\qquad \left. b+\widetilde{v}+\widetilde{e}_{\text{SSA}} = S_{\text{SSA}}, \widetilde{v}+\widetilde{e}_{\text{BSA}} = S_{\text{BSA}}\right] \\
&\quad + E\left[\left(y-\frac{(S_{\text{SSA}}-b)p+qS_{\text{BSA}}}{p+q}\right)^2 \middle| b+\widetilde{v}+\widetilde{e}_{\text{SSA}} = S_{\text{SSA}}, \widetilde{v}+\widetilde{e}_{\text{BSA}} = S_{\text{BSA}}\right] \\
&\quad + E\left[\left(\frac{(S_{\text{SSA}}-b)p+qS_{\text{BSA}}}{p+q}-\widetilde{v}\right)^2 \middle| b+\widetilde{v}+\widetilde{e}_{\text{SSA}} = S_{\text{SSA}}, \widetilde{v}+\widetilde{e}_{\text{BSA}} = S_{\text{BSA}}\right] \\
&= \left(y-\frac{(S_{\text{SSA}}-b)p+qS_{\text{BSA}}}{p+q}\right)^2 + 0 + \frac{1}{p+q}.
\end{aligned}$$

Similarly, when the SSA is unbiased ($B = 0$), we have

$$E\left[(y-\widetilde{v})^2 \middle| \widetilde{v}+\widetilde{e}_{\text{SSA}} = S_{\text{SSA}}, \widetilde{v}+\widetilde{e}_{\text{BSA}} = S_{\text{BSA}}\right] = \left(y-\frac{pS_{\text{SSA}}+qS_{\text{BSA}}}{p+q}\right)^2 + \frac{1}{p+q},$$

and the fund manager's problem becomes

$$\max_y \quad -\theta\alpha\left(y-\frac{(S_{\text{SSA}}-b)p+qS_{\text{BSA}}}{p+q}\right)^2 - (1-\theta)\alpha\left(y-\frac{pS_{\text{SSA}}+qS_{\text{BSA}}}{p+q}\right)^2 - \alpha\frac{1}{p+q}.$$

Her optimal action can be derived from the first-order condition,

$$y^* = \frac{(S_{\text{SSA}}-\theta b)p+qS_{\text{BSA}}}{p+q}, \quad \text{or}$$

$$y^* = w^* S_{\text{BSA}} + (1-w^*)(S_{\text{SSA}}-\theta b), \tag{5}$$

where $w^* = q/(p+q)$ denotes the weight put on the BSA's report. Obviously, we have $\partial w^*/\partial q > 0$ while $\partial w^*/\partial p < 0$. □

A.2. Fund Manager's Problem of Weighting Reports When σ_0^2 is Finite. Similar to the proof of Proposition 1 in A.1, and following the same optimization procedure, given the pair of reports $(S_{\text{SSA}}, S_{\text{BSA}})$, the fund manager chooses action

$$y^* = \frac{p(S_{\text{SSA}}-\theta b)+qS_{\text{BSA}}}{p_0+p+q},$$

where $p_0 \equiv 1/\sigma_0^2$ denotes the precision of the signal on $\widetilde{v}$. Furthermore,

$$
\begin{aligned}
(6) \qquad y^* &= \frac{p(S_{\text{SSA}} - \theta b) + qS_{\text{BSA}}}{p_0 + p + q} \\
&= \frac{p+q}{p_0+p+q} \times \frac{p(S_{\text{SSA}} - \theta b) + qS_{\text{BSA}}}{p+q} \\
&= \frac{p+q}{p_0+p+q}[wS_{\text{BSA}} + (1-w)(S_{\text{SSA}} - \theta b)],
\end{aligned}
$$

where $w = q/(p+q)$. Hence, the difference between the last expression and (5) above is that the fund manager's decision (weights) in the present case also depends on the precision of information on $\widetilde{v}$. The more precise the information is (higher p_0 or lower σ_0^2), the less influence the two analysts' reports is on her decision. Notice the term inside the brackets of the last expression in (6) is exactly the same expression as in (5). This implies that the conditional weights of the two analysts' reports in the current case still add up to 100%.

A.3. Proof of Proposition 2. The fund manager's problem is to choose the optimal level of information produced by BSA, q, to maximize her utility, net of costs. The expected utility, conditional on the SSA's report or the BSA's report is

$$
\text{EU} = E\left[-\alpha\left(y^*\left(\widetilde{S}_s, \widetilde{S}_b\right) - \widetilde{v}\right)^2\right] = -\alpha\left[\frac{1}{p+q} + \frac{p^2b^2\theta(1-\theta)}{(p+q)^2}\right].
$$

So, the maximization problem in the first stage becomes

$$
\max_q \quad -\alpha\left[\frac{1}{p+q} + \frac{p^2b^2\theta(1-\theta)}{(p+q)^2}\right] - C(q).
$$

The first-order condition (with respect to q) is

$$
\alpha\left[\frac{1}{(p+q)^2} + \frac{2p^2b^2\theta(1-\theta)}{(p+q)^3}\right] - C'(q) = 0.
$$

The above equation has a unique solution since the first term is strictly decreasing in q, while $C'(q)$ is strictly increasing in q. To derive the comparative statics, define

$$
M(\alpha, p, q, b) \equiv \alpha\left[\frac{1}{(p+q)^2} + \frac{2p^2b^2\theta(1-\theta)}{(p+q)^3}\right] - C'(q) = 0.
$$

By the Implicit Function Theorem, we have

$$
\frac{\partial q^*}{\partial \alpha} = -\frac{\partial M/\partial \alpha}{\partial M/\partial q}.
$$

Clearly, $\partial M/\partial \alpha > 0$, and $\partial M/\partial q < 0$, therefore $\partial q^*/\partial \alpha > 0$. Similarly, we can show that $\partial q^*/\partial b > 0$. Next, $\partial M/\partial \Sigma_B^2 = 2p^2\alpha/(p+q)^3 > 0$, and $\partial M/\partial q < 0$. Therefore, we have

$$
\frac{\partial q}{\partial \Sigma_B^2} = -\frac{\partial M/\partial \Sigma_B^2}{\partial M/\partial q} > 0.
$$

Finally, to prove $\partial q^*/\partial p < 0$, we need to show $\partial M/\partial p < 0$. Note that

$$
\frac{\partial M}{\partial p} = \frac{-\alpha[2p + 2q + 2pb^2\theta(1-\theta)(p-2q)]}{(p+q)^4}.
$$

Since by Assumption 1, $b^2 \leq 1/(2\theta(1-\theta)p)$, we have

$$
\frac{\partial M}{\partial p} \leq \frac{-\alpha[2p + 2q + (p-2q)]}{(p+q)^4} = \frac{-3p\alpha}{(p+q)^4} < 0. \quad \square
$$

A.4. Proof of Corollary 1. We have already proved $\partial w^*/\partial q > 0$ and $\partial q^*/\partial b > 0$, therefore $\partial w^*/\partial b = \partial w^*/\partial q \times \partial q^*/\partial b > 0$. Similarly, we have already proved $\partial q/\partial \Sigma_B^2 > 0$, therefore $\partial w/\partial \Sigma_B^2 = \partial w/\partial q \times \partial q/\partial \Sigma_B^2 > 0$. Finally, since q is also a function of p,

$$\frac{\partial w^*}{\partial p} = \frac{p\frac{\partial q^*}{\partial p} - q}{(p+q)^2} < 0. \square$$

A.5. Examples from the Directory on the Funds' Use of Research Sources. First, Warfield Associates, Inc. offers a growth fund with total assets of \$161 million. With an investment approach of fundamental (earnings) and bottom-up (focus on companies), the fund places a weight of 80% on research produced by SSAs, 15% on research by BSAs, and 5% on independent research. Their investment decision process, described by the fund manager, is "...our primary equity research sources are the research departments of many of the major investment banking and brokerage firms ... We attend luncheons and conferences sponsored by these firms, and as much as half of the typical day is spent in the study of their research reports and related reading." They adopt the relative autonomy approach in their decision-making process.

Second, Wilbanks, Smith & Thomas Asset Management offers a balanced fund with total assets of \$678 million and an investment approach of top-down (focus on economy) and fundamental (earnings). BSA research accounts for 75% of the total weight, SSA research accounts for 20%, and independent research accounts for the remaining 5%. They adopt the multiple committees approach.

Third, John A. Levin & Co. Inc. offers a value fund with its total assets close to \$11,159 million (the minimum account size is \$5 million). Its manager, with an investment approach of fundamental (earnings) and bottom-up (focus on companies), puts an 85% weight on BSA research, a 10% weight on SSA research, and the remaining 5% on independent research. Finally, they use the centralized strategy for this value fund as well as for other funds within the company that are also value-oriented.

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