

Regulating Securities Analysts*

Mark A. Chen
University of Maryland

Robert Marquez
University of Maryland

February 25, 2005

*We thank Tim Brennan, Armando Gomes, Vojislav Maksimovic, Roni Michaely, Donald Morgan, and seminar participants at Cornell University, the University of Maryland, and the 2004 FIRS Conference in Capri, Italy for helpful comments. Part of this work was completed while Marquez was visiting the Wharton School of Business. All remaining errors are our own. Address for correspondence: Robert Marquez, Smith School of Business, University of Maryland, College Park, MD 20742. Email: rmarquez@rhsmith.umd.edu.

Regulating Securities Analysts

Abstract

We examine the effects of regulations designed to address the potential conflict of interest that arises when sell-side analyst research is not independent of investment banking. We focus on two types of regulation: (1) internal barriers between equity research and investment banking that restrict communication; and (2) mandatory disclosure of analyst compensation. We find that information barriers can increase research effort and improve report quality by limiting an investment bank's ability to distort its analyst's incentives. However, this type of regulation can also reduce information production and lower the quality of reports if an investment bank benefits directly from research activity. In contrast to imposing information barriers, requiring the disclosure of analyst pay always leads to greater information production and report quality.

1 Introduction

Retail and institutional investors have long relied on research conducted by brokerage (sell-side) analysts to help inform their investment decisions. Recently, however, securities firms and their analysts have been the objects of intense scrutiny by lawmakers and market participants for allegedly producing overly optimistic research in order to attract and retain investment banking clients. Indeed, empirical evidence indicates that analysts' stock recommendations and earnings forecasts are generally less accurate and more optimistically biased when made in the context of investment banking relationships (see, for example, Dugar and Nathan, 1995; Lin and McNichols, 1998; and Michaely and Womack, 1999). To address the widespread concern over the integrity of analyst research, various regulatory agencies and industry associations have introduced rules governing equity research and the relationships between securities firms and analysts. These regulations encompass a number of remedies, ranging from fundamental structural reforms to specific disclosure requirements.

While these reforms are widely perceived to be an important and necessary step in curbing conflicts of interest, relatively little is known about how the reforms will ultimately affect equity research activity within securities firms. Some market participants have argued that making analysts more independent of investment banking will entail burdensome costs and lead these firms to devote fewer resources to analyst research.¹ Given that equity research is a costly activity, an important question is whether regulatory efforts are likely to improve the information content of analysts' research reports and aid investors in their investment decisions.

In this paper, we investigate the effects of conflict-of-interest regulations on information production within securities firms and on the resulting quality of analysts' investment reports. We consider a simple model in which the production and dissemination of information by a securities firm (e.g., an investment bank) depends endogenously on the regulatory regime. In our model, an investment bank employs an analyst to conduct costly research on a client firm and to issue stock reports to the public. The analyst is motivated partly by career concerns, and so he has incentives

¹Regarding Rule 2711 of the National Association of Securities Dealers (NASD) on "Research Conflicts of Interest," Marc E. Lackritz, president of the Securities Industry Association, commented: "[It] will impose technical regulatory requirements at significant costs that may impair the ability of firms and their analysts to provide timely, relevant investment recommendations." (*Money*, February 7, 2002).

to increase long-term accuracy by acquiring information and reporting objectively. The investment bank, however, seeks to win future business from the client and will structure the analyst's compensation to induce optimistically-biased reporting so as to support the client's stock price. Absent any regulation, this conflict of interest undermines research effort and diminishes the value of stock reports to investors.

We focus on the two regulatory approaches to this problem that have dominated public discussion and guided recent policy changes. The first approach aims to insulate equity research from investment banking activities by erecting or significantly strengthening internal barriers that limit the flow of information between an analyst and the rest of the firm. Many of the recently-adopted structural reforms can be broadly interpreted as attempts to achieve such a separation.² We refer to such structural remedies as *information barriers*. The second regulatory approach seeks to impose *disclosure requirements* on securities firms so that investors are made better aware of the true incentives underlying an analyst's reporting behavior.³

Using an optimal contracting framework, we show that imposing information barriers can often increase the informational content and objectivity of analyst reports, thus leading to more informative stock prices. The simple intuition for this result is that restricting communication makes the analyst's information unobservable to the rest of the investment bank, thereby limiting the firm's ability to manipulate reporting behavior through monetary incentives. This reduction in distortion ensures that research effort is no longer wasted, and hence the analyst is motivated to produce more information. As a result, the quality of stock reports increases, and investors enjoy better information about the client firm.

We also show, however, that the effectiveness of structural barriers depends crucially on the nature of the analyst's research activities. If the analyst's research serves no role other than to educate public investors about the client, then barriers do generally lead to greater price informa-

²For instance, reforms instituted by the New York Stock Exchange (NYSE) and the NASD since 2002 include requirements that (1) analysts not be supervised by the investment banking department; (2) investment banking personnel be prohibited from discussing research reports with analysts prior to distribution, unless personnel from a firm's legal/compliance department are present; and (3) analysts not be allowed to attend "pitch meetings" in which investment bankers solicit underwriting business from corporate clients.

³An example of this type of regulation is the SEC's Regulation Analyst Certification (Regulation AC), adopted in April 2003. Regulation AC requires analysts to disclose in research reports whether they received any direct or indirect compensation for their report. Analysts who cannot certify that they did not receive compensation for a specific report must disclose the magnitude and source of compensation.

tiveness. But if the analyst's information production has the potential to yield other benefits to the securities firm, such as more accurate deal pricing or improved due diligence, then restricting communication can in fact lead to a *reduction* in the quality of reports. Likewise, if the securities firm is concerned with its reputation for producing useful and timely investment information, then restricting communication can be detrimental to report quality. The intuition for this result is that the inability to directly observe the analyst's information about the client forces the investment bank to adjust the analyst's incentive scheme to extract the information that would otherwise be freely available. Obtaining this information is most easily accomplished by making wages less sensitive to the quality of the analyst's information, but this flattening of the wage scheme leads to weaker incentives for information production.

We then proceed to examine the effects of disclosure regulation. For concreteness, our analysis focuses on the requirement that the securities firm publicly disclose, *ex post*, the magnitude of incentive payments made to the analyst. We find that, even though mandatory disclosure causes the investment bank to restructure the compensation contract to hide some of the analyst's information, such regulation always improves the quality of information available to investors relative to the no-regulation regime. This points to an important difference between the two types of regulation: whereas limiting communication is counterproductive precisely in settings where analyst research generates the most value, mandatory disclosure never suffers from this problem. The contrast between the two types of regulation arises from the fact that disclosure regulation works by *increasing* rather than decreasing the overall flows of information between the various parties. As a result, disclosure regulation often provides the investment bank with greater incentives to encourage information production.

Our model provides some novel empirical implications regarding the stock price impact of analyst research. First, the model implies that disclosure requirements will increase the "credibility" or price impact of optimistic stock reports. A second and related implication is that the dispersion of the price impact following an optimistic versus a pessimistic recommendation should increase as well. That is, the difference in the interim values of the firm upon observing different recommendations should be greater when regulation is effective. Finally, we present a number of cross-sectional implications, including the finding that the effect of regulatory change on equilibrium research effort

increases in the importance of the analyst's career concerns (w) and in the variability of the client's value ($V^H - V^L$). Thus, we should expect that regulation will have the most significant impact on analyst credibility for firms surrounded by large uncertainty (e.g., small, rapidly-growing firms with many intangible assets). Also, regulation should have a larger impact on credibility for analysts with powerful career concerns, such as mid-career analysts who have well-established reputations and who have large current and future earnings at stake.

A number of recent articles examine analysts' role in providing information to market participants. For instance, Womack (1996), Barber et al. (1999), and Jegadeesh et al. (2003) have all documented that analyst stock recommendations do provide useful information to investors. Several other articles examine distortions in analysts' incentives and how these distortions can lead to biased forecasts and recommendations. One possible source of bias, studied theoretically by Trueman (1994) and established empirically by Hong et al. (2000) and Welch (2000), is that analysts may "herd" in their forecasts in order to develop reputations for forecasting ability. Analysts may also issue optimistically-biased reports to compensate for the lack of an established relationship with a client firm (Ljungqvist et al., 2003) or to curry favor with a client's management in order to retain access to privileged information (Lim, 2001). Other authors have argued that analysts or their employers have incentives to profit directly from their superior information (see, e.g., Benabou and Laroque, 1992). Morgan and Stocken (2001) examine theoretically how conflicts of interest related to investment banking can lead to biased analyst recommendations and less informative stock reports. To the best of our knowledge, ours is the only study to analyze how the flow of information between equity research and investment banking gives rise to conflicts of interest and how information production and analysts' incentives arise endogenously from the profit-maximizing behavior of securities firms. Moreover, unlike previous work, our study follows an optimal contracting approach that permits a better understanding of how different regulatory environments are likely to shape analysts' incentives.⁴

Finally, our work is indirectly related to a broad literature that deals with information production in capital markets and firms' incentives to disclose information to investors (see, e.g., Diamond,

⁴This general approach has, however, been recently explored in other areas. See, for instance, John, Saunders, and Senbet (1999) for an analysis of optimal bank regulation that takes into account the endogenous choice of management compensation, and Inderst and Mueller (2003), who study how the form of the optimal managerial contract varies across different organizational structures.

1985, or, more recently, Boot and Thakor, 2001, for analyses of these issues). Our work has some relationship to studies of how regulation can promote disclosure by firms (Fishman and Hagerty, 1990; Admati and Pfleiderer, 2000), although our focus is on third-party generation of information. Also related are papers that examine how agents' long-term career concerns can provide them with incentives to produce information (see, e.g., Milbourn et al., 2001). In our model, career concerns play an important role, but they are tempered by short-term monetary compensation that also influences an analyst's incentives to produce information.

The rest of the paper is organized as follows. The next section describes the basic model. Section 3 examines equilibrium information production and report quality in the absence of regulation. In Section 4, we study the effects of regulations that impose information barriers between the analyst and the rest of the securities firm. Section 5 extends the model by allowing the analyst's research activity to yield direct benefits to the securities firm. Section 6 examines disclosure regulation. We discuss some extensions and robustness issues in Section 7. Section 8 outlines some key empirical implications and Section 9 concludes. Proofs of results are given in the Appendix.

2 The Model

We consider a setting with a profit-maximizing securities firm,⁵ an analyst, a client firm, and investors. The client firm is involved (or may potentially become involved) in an underwriting or advisory relationship with the securities firm. The analyst is employed by the securities firm to conduct research on the client firm's ongoing operations and to issue a report to the investing public. While the client's fundamental value V is initially unknown, it is common knowledge that, with equal probability, the value is either high (V^H) or low (V^L). Because the client firm wishes to be viewed favorably by investors, it will award future deals worth $\alpha > 0$ to the investment bank if the stock price rises subsequent to the analyst's report. Investors are competitive, rational, and risk-neutral, and they determine the client firm's current and intermediate-term stock price.

The analyst's research activity yields a signal $s \in \{L, H\}$ about the client firm's value. The signal is observed by the analyst and, possibly, by the securities firm. The signal has precision ϕ

⁵In what follows, we will use the phrases "securities firm" and "investment bank" interchangeably. When there is no danger of confusion, we will also sometimes refer to the investment bank as "the firm."

in the sense that $\Pr(s = H|V = V^H) = \phi = \Pr(s = L|V = V^L)$. There are two possible precision levels for the signal, ϕ^H and ϕ^L , with $\frac{1}{2} < \phi^L < \phi^H < 1$. By exerting costly effort $e \in [0, \frac{1}{2}]$, the analyst can improve the signal's expected precision. Specifically, we assume that ϕ^H occurs with probability p and ϕ^L with probability $1 - p$, where $p = \frac{1}{2} + e$. Upon learning the signal and the precision, the analyst publicly issues a stock report $R(s, \phi)$ that provides either a favorable (V^H) or unfavorable (V^L) assessment of the client firm.⁶

The analyst faces labor market or reputational concerns and incurs disutility from issuing reports that ultimately turn out to be inaccurate.⁷ We use the parameter \underline{w} to represent the extent to which the labor market penalizes the analyst for inaccuracy. The analyst's utility function is given by

$$U = w - \frac{k}{2}e^2 - \underline{w}(R(s, \phi) - V)^2 \quad (1)$$

where w is compensation received and $\frac{k}{2}e^2$ is the analyst's cost of research effort. In addition, the analyst can secure an outside level of utility \bar{U} if he declines to work for the investment bank.

The securities firm has discretion over the analyst's monetary incentives (i.e., can set w), but any incentives offered must be nonnegative due to limited liability. The securities firm can provide payments that depend on the analyst's report, the stock price reaction to the report, and any information about the client that the bank can learn (or extract) from the analyst. Note, however, that payments cannot be conditioned directly on the level of research effort since effort is not observed by the employer.

Since our objective is to focus on the effects of regulation in a setting where a conflict-of-interest problem indeed exists, we make two assumptions on the model parameters. The first assumption is that $\alpha \geq \underline{w}(V^H - V^L)^2$, or that the profits from winning the client's investment banking business are sufficiently large relative to the analyst's penalty for inaccuracy.⁸ The second assumption

⁶Discreteness in the analyst's reporting space is not crucial for our main results. See Section 6 for a discussion of the case where the analyst can select from a continuous reporting space.

⁷Recent empirical evidence suggests that the labor market does indeed reward analysts for accuracy. Hong and Kubik (2003) show, for example, that analysts who forecast earnings accurately are subsequently more likely to move to high-status brokerage firms. Stickel (1992) finds that analysts belonging to *Institutional Investor's* All-American Research Team are more likely to lose their Team membership (and generally high levels of pay) after a period of relatively inaccurate earnings forecasts.

⁸Chen and Ritter (2000) document that investment bankers often receive substantial compensation from initial public offerings (IPOs). Likewise, Yeoman (2001) shows that average underwriter compensation is sizeable for both IPOs and seasoned equity offerings. See also Chan et al. (2003), who provide evidence that the conflict-of-interest problem was exacerbated during the 1990s boom in investment banking activity.

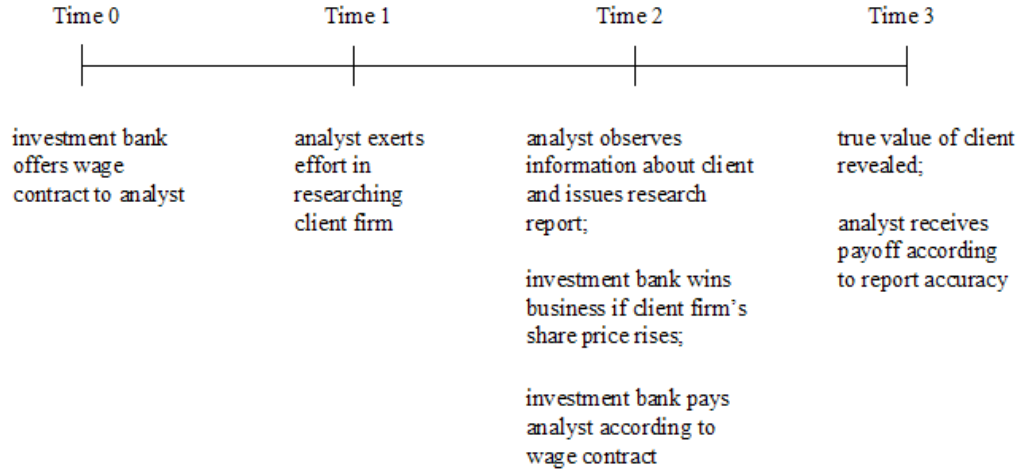


Figure 1: Timing of events.

is that $k \geq \frac{\alpha^2}{(\phi^H - \phi^L)\underline{w}(V^H - V^L)^2}$, or that the analyst's marginal cost of exerting research effort is sufficiently large relative to investment banking profits. These parametric restrictions ensure that it is prohibitively costly for the analyst to always be very well-informed and that the investment bank will sometimes find it worthwhile to influence the analyst's reporting behavior. Outside of this region, either analysts are too well-informed to be easily influenced, or the benefit of introducing a distortion in the analyst's reporting behavior is too low relative to the analyst's own career concerns. In either of these instances, the conflict-of-interest problem is greatly attenuated, and there is no substantive role for regulation.

Figure 1 summarizes the timing of the model. At time 0, the investment bank offers an incentive scheme to the analyst. At time 1, the analyst accepts or rejects the contract. If the analyst accepts, he then decides how much research effort to exert. At time 2, the research effort yields a signal about the client firm, and the analyst issues a research report on the client. The investment bank receives deal profits if and only if the client's stock price increases, and the analyst is paid according to the incentive scheme. Finally, at time 3, the true value of the client firm is revealed to all participants, and the analyst incurs disutility if his report is inaccurate.

3 Incentives for Information Production and Conflicts of Interest

In this section, we study the investment bank's profit maximizing behavior for the status quo of no regulation. Our goal is to characterize how the investment bank sets incentives for the analyst and how these incentives determine the extent of information production and the quality of reports. For simplicity, we assume that the absence of any regulatory barriers between equity research and other divisions permits the investment bank to fully observe the analyst's time-2 information about the signal realization and quality. Hence, the investment bank can offer a nonnegative wage scheme $w(s, \phi, R)$ that is contingent on the signal realization s , the signal quality ϕ , and the analyst's report R .⁹

It is worthwhile to note two aspects of feasible incentive schemes. First, although a wage scheme might plausibly depend on other information (e.g., the amount by which the client's share price rises at time 2), we can ignore such dependence because wages already depend on s and ϕ . Indeed, any wage dependence on variables beyond s , ϕ , and R would be extraneous.¹⁰ Second, if w is a wage scheme that arises in equilibrium, then dependence of w on the analyst's reporting will (except for out-of-equilibrium reporting) already be captured in the dependence of w on s and ϕ . Thus, whenever there is no ambiguity concerning the analyst's reporting behavior, we will suppress notation and simply write $w(s, \phi)$ for the wage scheme.

If investors can freely observe the information gathered by the analyst, the investment bank has no incentive to distort the analyst's report. Thus, to highlight the possible conflict-of-interest problem that may exist, we focus on the case where investors, unlike the investment bank, are not privy to the analyst's information and must rely on the stock report to learn about the client firm. Since the analyst's information is not observed by investors, the client's interim stock price will hinge on whether or not the analyst's report is favorable and on how credible investors perceive

⁹We are assuming that it is possible for the bank to commit to making payments under such a scheme. This will be true if, for example, the observability of s and ϕ ensures that contractual payments can be enforced. Alternatively, commitment will be possible if reputational considerations are sufficiently strong that the investment bank and analyst can engage in implicit contracting. (See Laffont and Tirole (1993) for relevant references and discussion). Since our model is static, the analyst's compensation is most naturally seen as a pure monetary payment. However, the compensation can be more broadly interpreted as any nonpecuniary benefit offered by the investment bank (e.g., promises of promotion, etc.).

¹⁰Apart from altering the analyst's reporting, the wage scheme can impact the analyst's behavior by influencing his choice of research effort. But the level of effort, being unobservable to investors, can only affect expected wages by altering the probability distribution of s and ϕ .

the report to be. For his own part, the analyst selects his research effort and reporting behavior to maximize expected utility. The investment bank's problem is to choose $w(s, \phi, R)$ to solve

$$\max_{w(s, \phi, R) \geq 0} \alpha \Pr(E[V|e, R(s, \phi)] > E[V]) - E[w(s, \phi, R(s, \phi))|e] \quad (2)$$

subject to

$$E[w(s, \phi, R(s, \phi))|e] - \frac{k}{2}e^2 - \underline{w}E[(R(s, \phi) - V)^2|e] \geq \bar{U} \quad (3)$$

$$e \in \arg \max_{\hat{e} \geq 0} \left(E[w(s, \phi, R(s, \phi))|\hat{e}] - \frac{k}{2}\hat{e}^2 - \underline{w}E[(R(s, \phi) - V)^2|\hat{e}] \right) \quad (4)$$

$$R(s, \phi) \in \arg \max_{\hat{R} \in \{V^L, V^H\}} \left(w(s, \phi, \hat{R}) - \underline{w}E[(\hat{R} - V)^2|e] \right) \quad \forall s \in \{H, L\}, \phi \in \{\phi^H, \phi^L\} \quad (5)$$

The first constraint is a standard individual rationality (IR) constraint that ensures the analyst's expected utility is at least \bar{U} , his opportunity cost or reservation utility. The second and third incentive compatibility (IC) constraints capture the requirement that the analyst choose his utility-maximizing effort level (at time 1) and utility-maximizing report (at time 2). We note that Equation (2) does not incorporate a role for reputation formation by the investment bank. Later, we analyze objective functions that capture the investment bank's concern for reputation. Here, we restrict ourselves to the case where the investment bank only cares about (short-term) profit maximization.

For the subsequent analysis, it is useful to let U_{SA} denote the analyst's *stand-alone utility level*, i.e., the level of utility that the analyst would receive if the wage scheme were identically zero. Working as a stand-alone, the analyst would be primarily motivated by career concerns and hence would issue reports that accorded straightforwardly with his signal.¹¹ We note, however, that our analysis is silent on whether it is feasible for analysts to work entirely in a stand alone capacity, and we restrict ourselves to studying the current state of affairs in which analyst research is primarily sponsored by securities firms.¹²

¹¹ U_{SA} can be explicitly calculated as follows. First, it is easy to show that, under a flat wage scheme, effort exerted by the analyst is $e_{SA} = \frac{1}{k}(\phi^H - \phi^L)\underline{w}(V^H - V^L)^2$. Then, substituting this effort level into the expression for the analyst's expected utility and assuming zero wages and straightforward reporting, we have that $U_{SA} = - \left[1 - \frac{\phi^H}{2} - \frac{\phi^L}{2} \right] \underline{w}(V^H - V^L)^2 + \frac{1}{2k}(\phi^H - \phi^L)^2 \underline{w}(V^H - V^L)^2$.

¹²There has been considerable recent debate as to whether completely separating equity research from firms engaged in investment banking would allow such research to "survive." While some theoretical work (e.g., Allen (1990)) suggests that complete separation would not necessarily cause the market for equity research to break down, it is unclear what would be the source of compensation for totally independent analysts. Examining the viability and

The following result describes the analyst's equilibrium reporting behavior and characterizes the optimal wage scheme and effort choice in terms of the analyst's reservation utility level.

Proposition 1 *In equilibrium, the securities firm chooses a wage scheme $w_N(s, \phi)$ that induces optimistically-biased reporting behavior $R_N(s, \phi)$ in which $R_N(s, \phi) = V^L$ if and only if $(s, \phi) = (L, \phi^H)$. Furthermore, the total wage for the low-precision states, $W_N^L \equiv w_N(H, \phi^L) + w_N(L, \phi^L)$, total wage for the high-precision states $W_N^H \equiv w_N(H, \phi^H) + w_N(L, \phi^H)$, and equilibrium level of research effort e_N are continuous functions of the reservation utility \bar{U} that satisfy the following properties:*

1. If $\bar{U} \leq U_{SA}$, then:

$$W_N^L = (2\phi^L - 1)\underline{w}(V^H - V^L)^2, W_N^H = 0, \text{ and } e_N = \frac{1}{k}(\phi^H - \phi^L)\underline{w}(V^H - V^L)^2.$$

2. If $U_{SA} \leq \bar{U} \leq (\phi^H - 1)\underline{w}(V^H - V^L)^2$, then:

$$W_N^L \text{ is strictly increasing, } W_N^H = 0, \text{ and } e_N \text{ is strictly decreasing.}$$

3. If $\bar{U} \geq (\phi^H - 1)\underline{w}(V^H - V^L)^2$, then:

$$W_N^L \text{ and } W_N^H \text{ are strictly increasing, } W_N^L - W_N^H = (2\phi^H - 1)\underline{w}(V^H - V^L)^2, \text{ and } e_N = 0.$$

Proposition 1 demonstrates that, when investors do not directly observe the information produced by the analyst's research, a conflict-of-interest problem arises: the investment bank will induce an optimistic bias in the analyst's reporting behavior. Under this biased reporting strategy, the analyst will hide unfavorable information about the client firm. In particular, the analyst will issue an unfavorable report (V^L) only if his signal is unfavorable and of high precision. In all other instances, he will issue a favorable report (V^H). The investment bank finds it optimal to distort in this manner because it is cheaper to overcome the analyst's career concerns and desire for accuracy when the analyst possesses only imprecise information about the client.

The intuition for the rest of the proposition is straightforward. First, when the analyst's reservation utility is low, the investment bank is only concerned with inducing biased reporting at the lowest cost. The wage scheme that accomplishes this is the one that minimally satisfies the incentive compatibility constraints of the analyst. Profits are thus maximized by offering a positive organization of independent research lies beyond the scope of the present paper.

payment of $(2\phi^L - 1)\underline{w}(V^H - V^L)^2$ for a favorable report in state $(s, \phi) = (L, \phi^L)$ and offering zero payments otherwise. A zero payment can be interpreted as firing the analyst whenever there is no need to manipulate his report. As the reservation utility increases, the investment bank must pay progressively higher wages in order to retain the analyst. To minimize the costs of inducing bias, the investment bank will choose to simply increase wage payments in low-precision states and maintain payments of zero in high-precision states. This wedge in the analyst's wage scheme between low-precision and high-precision states leads to weaker incentives to become well-informed, which in turn attenuates the analyst's career concerns and makes it easier for the firm to manipulate reporting. Finally, when the analyst's outside opportunities exceed a certain level, the investment bank finds it optimal to simply eliminate all research effort, which is achieved by maintaining a constant difference between wages in the high and low-precision states.

We now introduce a measure of the informational quality of the analyst's report; this measure will be necessary in order to conduct comparisons among the different scenarios we consider. We define the informativeness Φ of the stock report to be simply the negative of the variance of the client's value V . This variance is calculated by conditioning on Ω , the set of all information available to investors at time 2 upon observing the analyst's report:¹³

$$\Phi = -E[\text{var}[V|\Omega]]. \quad (6)$$

In general, report informativeness will depend on the level of research effort, the analyst's reporting strategy, and on any information available to investors at time 2. Appendix A derives explicit expressions for report informativeness under each of the scenarios considered in the paper.

Although Proposition 1 is stated for clarity in terms of research effort (i.e., information production), the relevant consideration for investors is not the level of research effort but rather the level of report informativeness. Using the definition of report informativeness, one can show the following:

¹³This measure corresponds to measures of price informativeness in the theoretical literature on market efficiency. Note that the measure is equivalent to the negative of the *ex ante* variance of the price change from time 2 to time 3. To see why this is true, let \widehat{V} denote the interim stock value that prevails at time 2 after the analyst's report. Then $\text{var}(V - \widehat{V}|\Omega) = E[(V - \widehat{V} - E[V - \widehat{V}|\Omega])^2|\Omega] = E[(V - \widehat{V})^2|\Omega]$. But $E[(V - \widehat{V})^2|\Omega] = E[(V^2 - 2V\widehat{V} + \widehat{V}^2)|\Omega] = E[(V^2 - E[V|\Omega]^2)|\Omega] = \text{var}(V|\Omega)$. Therefore, $-E[\text{var}(V - \widehat{V}|\Omega)] = -E[\text{var}(V|\Omega)]$.

Corollary 1 *The quality of the analyst's stock report is strictly lower when the investment bank is privately informed than when its information is fully observable to investors.*

This result highlights the fact that the conflict-of-interest problem and the attendant reduction in report quality stem largely from the informational advantage over public investors enjoyed by the investment bank and its analyst. The result also raises an important question: to what extent can investors rationally anticipate the conflict of interest and protect themselves against the analyst's bias?¹⁴ It is easy to see that, in this setting, investors can infer the optimistic bias in the analyst's report, but they cannot perfectly back out his actual information. This is so because not only is the investment bank inducing the analyst to be overoptimistic, it is also providing incentives for some information to be hidden—i.e., for information to be pooled across states. To the extent that the investment bank lacks the incentive and the means to credibly disclose its superior information to investors, regulatory policies aimed at governing internal and external information flows may help improve the quality of stock reports.

4 Regulations Imposing Information Barriers

The results of the previous section showed that, when investors do not directly observe the information produced by the analyst's research, a conflict of interest arises that leads to optimistically-biased reports and relatively low report quality. In this section, we examine the effects of regulations that address this problem by insulating analysts from the influence of investment banking. As discussed in the introduction, the primary consequence of recent regulations aimed at erecting or strengthening internal structural barriers is to restrict the flow of information to and from analysts within securities firms. For example, prohibiting analysts from participating in marketing or road-show activities, preventing investment bankers from supervising analysts, and physically separating equity research offices from other offices all serve to restrict communication between analysts and non-research functions within the firm.¹⁵

¹⁴In other contexts, investors appear to be capable of rationally compensating to a large degree for potential conflicts of interest. For example, studies by Kroszner and Rajan (1994) and Puri (1996) show that, prior to the passage of the Glass-Steagall Act of 1933, commercial banks involved in underwriting were not able to systematically fool investors into purchasing low-quality securities.

¹⁵Note that while the sort of regulations we are considering here restrict communication within the firm, they do not necessarily ensure that analyst compensation will be unrelated to investment banking profits. As a practical

The investment bank, being unable to directly observe the analyst’s information under such regulation, now faces a qualitatively different contracting problem from the one it faced in the previous section. In particular, the investment bank must now design the analyst’s incentives to not only determine research effort and reporting behavior, but also to *extract* the analyst’s information about the client.¹⁶ By the Revelation Principle, we can assume without loss of generality that the investment bank solves this incentive design problem by offering the analyst a mechanism in which (1) after obtaining private information about the client, the analyst announces a signal s^* and precision ϕ^* to the bank, and he is given incentives to announce truthfully;¹⁷ and (2) based upon the announcements s^* and ϕ^* , the analyst is paid $w(s^*, \phi^*)$ and obligingly issues a report $R(s^*, \phi^*)$. The problem is therefore to choose a wage scheme $w(s, \phi)$ and reporting behavior $R(s, \phi)$ to solve

$$\max_{\substack{w(s, \phi) \geq 0, \\ R: \{H, L\} \times \{\phi^H, \phi^L\} \rightarrow \{V^H, V^L\}}} \alpha \Pr(E[V|e, R(s^*, \phi^*)] > E[V]) - E[w(s^*, \phi^*)|e]$$

subject to

$$E[w(s^*, \phi^*)|e] - \frac{k}{2}e^2 - \underline{w}E[(R(s^*, \phi^*) - V)^2|e] \geq \bar{U} \quad (7)$$

$$e \in \arg \max_{\hat{e} \geq 0} \left(E[w(s^*, \phi^*)|\hat{e}] - \frac{k}{2}\hat{e}^2 - \underline{w}E[(R(s^*, \phi^*) - V)^2|\hat{e}] \right) \quad (8)$$

$$\text{The analyst finds it optimal to convey } s^* \text{ and } \phi^* \text{ truthfully.} \quad (9)$$

While the investment bank’s objective function is unchanged from the no-regulation case with private information, the overall incentive design problem changes considerably. Constraints (7) and (8) require as before that the analyst receive at least his reservation utility and that he choose research effort optimally. Constraint (9), however, now captures the incentive compatibility (i.e., “truth-telling”) requirements that the analyst always find it optimal to convey the state truthfully

matter, it may be difficult for internal remedies to remove all linkages between investment banking and analyst pay since many securities firms derive a substantial fraction of their revenues from investment banking operations. For example, in the midst of the New York Attorney General’s efforts to craft a settlement with Merrill Lynch & Co. in 2003, the president of NASD Regulation, Inc. expressed concern over “how, operationally, analyst compensation would be severed completely from investment-banking revenue, [on which all employee pay] is based” (Cohen and Kelly (2003)).

¹⁶Extracting this information is necessary in order to profitably induce an optimistic bias in the analyst’s reporting. See Proposition 2 and its proof in the Appendix.

¹⁷This announcement is to be interpreted as an *internal* announcement to the brokerage. Indeed, the brokerage would not choose to design an incentive mechanism that revealed all information publicly to investors.

to the bank.¹⁸ Note that the exact form of the incentive compatibility constraints will depend on which reporting strategy the investment bank chooses to implement. As a first step in the characterization, we state the following result, which describes how the incentive compatibility requirements in (9) constrain the form of the optimal contract:

Lemma 1 *Suppose that $w(s, \phi)$ and $R(s, \phi)$ are a wage scheme and reporting strategy that solve the optimal design problem under restricted communication, and suppose that $R(s, \phi) = V^L$ if and only if $(s, \phi) = (L, \phi^H)$. Then $w(s, \phi)$ satisfies the following properties:*

1. $w(H, \phi^H) = w(H, \phi^L) = w(L, \phi^L)$
2. $w(H, \phi^H) - (2\phi^H - 1)\underline{w}(V^H - V^L)^2 \leq w(L, \phi^H) \leq w(H, \phi^H) - (2\phi^L - 1)\underline{w}(V^H - V^L)^2$

The lemma establishes that the wage scheme must satisfy two requirements in order to induce optimistically-biased reporting and ensure that the analyst convey his information truthfully to the investment bank. The first requirement is that payments in all states associated with a favorable stock report must be equal and positive. Intuitively, a relatively high payment must be offered in the low-signal, low-precision state in order to bias the analyst's report upward. However, an equally high payment must be offered in high-signal states to prevent the analyst from profiting by falsely announcing a low signal. The second requirement is that the payment in the state associated with the unfavorable stock report ($(s, \phi) = (L, \phi^H)$) must be strictly lower than payments in the other three states but that the difference must be neither too large nor too small if the analyst is to have proper incentives for truthful information revelation.

We can now characterize the equilibrium for the case of information barriers.

Proposition 2 *With information barriers, the securities firm chooses an incentive mechanism $(w_W(s, \phi), R_W(s, \phi))$ with optimistically-biased reporting: $R_W(s, \phi) = V^L$ if and only if $(s, \phi) = (L, \phi^H)$. Furthermore, under the mechanism the total low-precision wage W_W^L , the total high-precision wage W_W^H , and the equilibrium level of research effort e_W are continuous functions of the reservation utility \bar{U} that satisfy the following properties:*

¹⁸Because the analyst's report is observable to all parties, it is not necessary to impose additional constraints ensuring the analyst reports in accordance with an incentive mechanism's prescribed reporting strategy.

1. If $\bar{U} \leq U_{SA} + [\phi^L - \frac{1}{2}] \underline{w}(V^H - V^L)^2$, then:

$$W_W^L = (4\phi^L - 2)\underline{w}(V^H - V^L)^2, W_W^H = \frac{1}{2}W_W^L, \text{ and } e_W = \frac{1}{k}(\phi^H - \phi^L)\underline{w}(V^H - V^L)^2.$$

2. If $U_{SA} + [\phi^L - \frac{1}{2}] \underline{w}(V^H - V^L)^2 \leq \bar{U} \leq (2\phi^H - \frac{3}{2}) \underline{w}(V^H - V^L)^2$, then:

$$W_W^L \text{ and } W_W^H \text{ are strictly increasing, and } e_W \text{ is strictly decreasing.}$$

3. If $\bar{U} \geq (2\phi^H - \frac{3}{2}) \underline{w}(V^H - V^L)^2$, then:

$$W_W^L \text{ and } W_W^H \text{ are strictly increasing, } W_W^L - W_W^H = (2\phi^H - 1)\underline{w}(V^H - V^L)^2, \text{ and } e_W = 0.$$

Moreover, if e_N is the equilibrium level of research effort the analyst would choose under no regulation, then $e_W \geq e_N$, with the inequality strict for $\bar{U} \in (U_{SA}, (2\phi^H - \frac{3}{2}) \underline{w}(V^H - V^L)^2)$.

Proposition 2 shows that, as in the case with no regulation, stock reports in the restricted communication regime exhibit an optimistic bias, and research effort is a decreasing and continuous function of the analyst's reservation utility level. Figure 2 presents a comparison of equilibrium levels of research effort under the two regimes. As depicted in the figure, research effort is always higher – and often strictly higher – with information barriers than with no regulation. The intuition for this is that the separation imposed by information barriers prevents the investment bank from observing the analyst's information, thereby introducing a tension into the incentive design problem. On the one hand, the investment bank desires to reward low-precision states more heavily than high-precision states so that the analyst's effort will be low, thus making it easier to manipulate reporting behavior. On the other hand, the investment bank must elicit the analyst's information about the underlying state. In order to ensure the analyst does not lie about the state, the wage scheme cannot penalize high-precision states too heavily relative to low-precision states.¹⁹ Thus, restricting communication makes it costlier for the investment bank to manipulate the analyst's reporting and research effort, leading to higher research effort and greater information production.

We can immediately extend the comparison of effort levels in Proposition 2 to a comparison of report qualities.

¹⁹ An implication of this is that, relative to the no-regulation case analyzed previously, the option to simply “fire” the analyst (i.e., pay a zero wage) will typically not be part of the optimal contract, as it would not induce the analyst to truthfully convey his information to the investment bank.

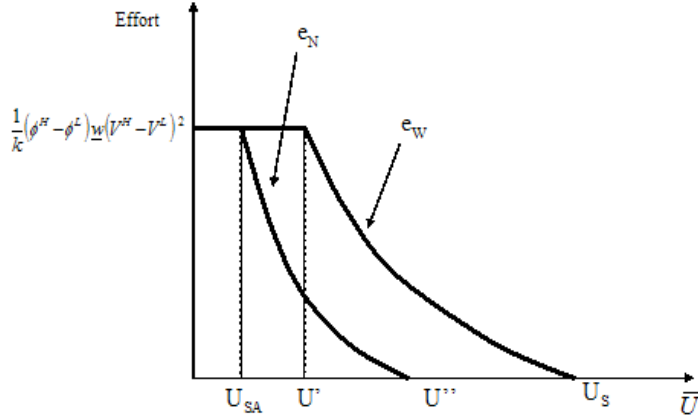


Figure 2: Equilibrium effort provision with and without information barriers. Without regulation, effort e_N is strictly decreasing for values of the reservation utility above U_{SA} and zero for reservation utilities above $U^{**} = (\phi^H - 1)\underline{w}(V^H - V^L)^2$. With information barriers, effort e_W is always higher, and it is strictly higher for reservation utilities between U_{SA} and $U_S = (2\phi^H - \frac{3}{2})\underline{w}(V^H - V^L)^2$.

Corollary 2 *If $\bar{U} \in (U_{SA}, (2\phi^H - \frac{3}{2})\underline{w}(V^H - V^L)^2)$, then report quality under restricted communication is strictly higher than under no regulation. Otherwise, quality is the same across the two regimes.*

Thus, although information barriers do not eliminate bias, in many cases they do help to increase the average precision of the analyst's underlying information, and this leads to a higher level of report informativeness. Note also that the probability of bias is lower under restricted communication than under no regulation because the analyst's research effort in the former regime is greater, making it less likely that he will observe a signal (specifically, an unfavorable signal with low precision) that leads him to issue a falsely optimistic report.²⁰ However, it bears emphasizing that the results in this section assume that the analyst's research activity serves no purpose to the securities firm other than to influence the client's share price. In the next section, we will consider

²⁰ As noted earlier, some market observers have argued that completely separating equity research from investment banking (for example, via a spinoff of the research division) would be more effective than internal reforms in curbing conflicts of interest. However, there are at least three arguments against total separation. First, analysts may still be subject to conflicts of interest if it is not possible to prevent external contracting. Second, in view of the high costs of analyst research, complete separation could curtail funding and seriously threaten the quality and viability of analyst activity. As one observer put it, "The big fear is that if you spin off research divisions, they are going to wither on the vine." (Valdmanis (2002)). Finally, complete separation could lead to a loss of other direct benefits associated with in-house research activity (see, e.g., Chen (2003)). We analyze the implications of such benefits in the context of our model in Section 4.

the more realistic case where the information gathered by the analyst can benefit the securities firm directly, such as by enhancing the firm's reputation for providing timely and accurate investment information or by enabling the firm to develop specialized expertise in working with certain types of client companies.

5 Direct Benefits from Information Production

We consider here two stylized scenarios involving direct informational benefits to the securities firm. In the first scenario, benefits can materialize only if the securities firm wins the client's investment banking business. In the second scenario, benefits can occur independently of winning the client's business.

5.1 Benefits contingent on winning the client's business

There are a number of reasons why the securities firm might derive certain benefits from the analyst's research if (and only if) it wins the client's business. For instance, the information gathered by the analyst could complement the due diligence that occurs after winning an investment banking deal, thus making the deal pricing more accurate and reducing the chance of a failed merger or initial public offering. Alternatively, the information produced by the analyst could alleviate informational asymmetries in negotiations between the client and the securities firm, enabling the latter to secure larger underwriting or advisory fees.

We model such possibilities by allowing the magnitude of investment banking profits to increase in the level of research effort. Specifically, we assume that investment banking profits are now a strictly increasing function of the analyst's research effort. Expected profits are now given by

$$\alpha_1(e) \Pr(E[V|e, R(s, \phi)] > E[V]) - E[w(s, \phi, R(s, \phi))|e] \quad (10)$$

where $\alpha_1(e) > 0$, $\alpha_1'(e) > 0$, and $\alpha_1''(e)$ exists and is continuous for all $e \in [0, \frac{1}{2}]$. Note that this objective function is the same as the objective function studied previously, except that the fixed investment banking profits α have been replaced by the variable profits $\alpha_1(e)$. To continue to focus on the interesting and relevant case where the investment bank sometimes finds it worthwhile

to induce biased reporting, we impose parameter restrictions analogous to the ones made in the basic model setup: $\alpha_1(e) \geq \underline{w}(V^H - V^L)^2$ and $k \geq \frac{(\alpha_1(e))^2}{(\phi^H - \phi^L)\underline{w}(V^H - V^L)^2}$ for all $e \in [0, \frac{1}{2}]$. Letting $\Gamma(e) = \frac{2k\alpha_1(e) - 2k(2\phi^L - 1)\underline{w}(V^H - V^L)^2}{3k - (2\phi^H - 2\phi^L)\underline{w}(V^H - V^L)^2}$, we thus have the following result, where e_{SA} denotes the stand-alone level of research effort:

Proposition 3 *If $\alpha'_1(e_{SA}) > \Gamma(e_{SA})$, then report informativeness is at least as high under no regulation as under information barriers, and it is strictly higher if in addition $\bar{U} > U_{SA}$. If $\alpha'_1(e_{SA}) \leq \Gamma(e_{SA})$, then informativeness is lower in the absence of regulation.*

The main implication of Proposition 3 is that, if the investment bank can benefit directly from the analyst's research, then erecting internal information barriers need not increase the quality of reports; indeed, it can easily decrease report quality. Furthermore, barriers can also reduce the direct benefits accruing to the investment bank. This is true even though the barriers themselves do not prevent the investment bank from enjoying the direct benefits once the analyst has conducted his research. Rather, the barriers reduce the amount of research effort that is exerted in the first place, making it less likely that the investment bank will be able to reap large rewards from the research.

The intuition for this result is straightforward. Consider the case where the marginal benefit associated with effort is relatively high. In this case, the investment bank's direct gain from raising research effort above e_{SA} outweighs the expected loss in deal profits from allowing the analyst to obtain better information.²¹ Hence, the investment bank now wishes to encourage information production above the stand-alone level. Absent any regulations, the investment bank has wide latitude in designing the wage scheme, and it can induce a high level of research effort by offering a wage premium in high-precision states versus low-precision states. If barriers are present, however, then the wage scheme must be designed not only to induce effort provision, but also to extract information about the client from the analyst. The need to ensure that the analyst does not convey this information falsely prevents the investment bank from rewarding high-precision states too heavily relative to low-precision states. In essence, internal barriers restrict the flow of information

²¹A local condition turns out to be sufficient for examining the effectiveness of this kind of regulation because $\alpha'_1(e_{SA})$ completely determines whether equilibrium research effort will be an increasing or a decreasing function of \bar{U} , and information barriers are counterproductive exactly when they place a binding constraint on equilibrium research effort. See the proof of Proposition 3 for details.

between the investment banking function and the analyst, thereby placing a constraint on the amount of information production that can be induced via the incentive scheme. This constraint becomes an important limiting factor precisely when the benefits to information production are high.

5.2 General benefits from information production

In addition to yielding contingent benefits, the analyst's research activity could also create benefits that accrue independently of whether the investment bank wins the client's business. For example, researching the client firm might allow the analyst to improve his general knowledge about the industry, making it easier to research and attract other clients in the future. Precise information about the client could also help the investment bank to develop a reputation for accurate deal pricing, thus paving the way for deal flow from other potential clients. More generally, the bank itself may be concerned with developing a reputation for providing clients and customers with high-quality information, and this concern may curb the tendency to distort the analyst's reporting behavior.²² In addition, the production of timely investment information could increase profits from trading, asset management, market-making, and retail brokerage operations. We capture these benefits in the model by assuming, for simplicity, that they can be represented as an additional term in the investment bank's objective function. Thus, the bank's expected profits are equal to

$$\alpha \Pr(E[V|e, R(s, \phi)] > E[V]) - E[w(s, \phi, R(s, \phi))|e] + \alpha_2(e) \quad (11)$$

where we again take informational benefits to be increasing in research effort: $\alpha_2(e) > 0$, $\alpha_2'(e) > 0$, and $\alpha_2''(e)$ exists and is continuous for all $e \in [0, \frac{1}{2}]$. Note that this is again the same objective function used in the baseline model, except for the addition of the term $\alpha_2(e)$. Maintaining our earlier parameter assumptions on α , we can state the following proposition:

Proposition 4 *If $\alpha_2'(e_{SA}) > \frac{\alpha - (2\phi^L - 1)w(V^H - V^L)^2}{2}$, then report informativeness is higher under no regulation than under information barriers, and it is strictly higher if in addition $\bar{U} > U_{SA}$. If $\alpha_2'(e_{SA}) \leq \frac{\alpha - (2\phi^L - 1)w(V^H - V^L)^2}{2}$, then informativeness is lower in the absence of regulation.*

²²For a model in which reputational concerns can lead investment banks to act as credible producers of information, see Chemmanur and Fulghieri (1994).

The basic intuition for this result is similar to that for Proposition 3. When the marginal direct benefit of information production is high, profits are maximized by encouraging high research effort. In the absence of regulation, there is no informational barrier between the investment bank and the analyst, and so the employer observes the analyst’s information directly. The wage scheme can therefore be freely designed to take full advantage of high research effort by rewarding high-precision states more heavily than low-precision states. In contrast, with information barriers, the analyst’s information is unobservable to the investment bank. Because the wage scheme must now perform the added function of eliciting the analyst’s information, strong incentives can no longer be provided for information generation. Although the investment bank still benefits fully (e.g., in the form of an enhanced reputation) from any research that might be conducted by the analyst, it is now more difficult for the investment bank to induce research activity.

In sum, when the analyst’s research activity yields direct benefits to the securities firm, then analyst effort and the informativeness of stock reports can be greater when no regulations are present than when communication is restricted. This follows from the fact that information barriers aimed at insulating analysts may dampen incentives for research effort precisely in situations where information production is most beneficial to the investment bank and to investors.

6 Disclosure Regulation

We turn now to an analysis of regulation that focuses on imposing disclosure requirements rather than on erecting barriers within the firm. As discussed in the introduction, one prominent form of disclosure regulation is the requirement that securities firms publicly reveal ex post incentive payments to analysts.²³ For concreteness, we assume that the securities firm must disclose these wage payments at the same time that the analyst issues his stock report. Thus Ω , the set of all information observed by investors at time 2, now includes the disclosed wage payment $w(s, \phi)$ as

²³Mandatory disclosure of the *ex ante* wage scheme has no effect in our model since investors already anticipate the optimal scheme. Recently, other forms of disclosure regulation have been adopted in practice. For example, NASD Rule 2711 includes a provision that requires analyst research reports to display the total percentages of the employing firm’s stock recommendations that are buys, holds, or sells. This kind of regulation would also have little effect in our model since investors again anticipate the likelihood of a negative report. See Barber, et al. (2003) for an empirical study of the impact of this type of regulation.

well as the analyst's report $R(s, \phi)$.²⁴ It is apparent that observing both the wage and the report can sometimes provide investors with more information than observing the report alone. For instance, even if the analyst were to follow an uninformative strategy of always issuing a favorable report, disclosure of the wage payment would reveal all pertinent information to investors if contractual payments differed across all states.

Whether or not disclosure regulation will actually succeed at improving report quality, however, is less clear. Indeed, because the investment bank sets incentives endogenously, it may choose to react to mandatory wage disclosure in ways that ultimately reduce price informativeness. For example, in response to disclosure requirements, the investment bank will likely want to limit investors' information by using a flattened wage scheme to pool information across some states, making it easier to induce credible bias. To shed light on the likely impact of disclosure regulation, we first compare its effectiveness to that of information barriers in the baseline case where the analyst's research does not directly benefit the investment bank.

Proposition 5 *Suppose the analyst's research yields no direct benefits to the securities firm. Then there exists a level of utility $U_D > U_{SA}$ such that, for all $\bar{U} \leq U_D$, report informativeness is strictly greater under disclosure regulation than under information barriers.*

The result states that, even when restricting communication would successfully improve upon no regulation, disclosure regulation will strictly dominate information barriers whenever the analyst's reservation utility, \bar{U} , is in the neighborhood of what he could obtain working in a stand-alone capacity.²⁵

Although Proposition 5 pertains to the base case where research does not yield intrinsic benefits to the securities firm, the discussion in Section 4 suggested that such benefits are likely to arise in many instances, such as when the firm is concerned about pricing deals accurately, cultivating a reputation for dispensing timely investment advice, or developing research expertise at an industry level. Hence, it is important to assess the effectiveness of disclosure regulation in more general

²⁴The main qualitative results of this section would continue to hold if complete disclosure could not be perfectly enforced, so that investors observe the wage payment only with some positive probability.

²⁵If competition among analysts in the labor market is keen, then the gap between the analyst's reservation utility and his stand-alone utility is likely to be small. Similarly, when analysts face significant costs of switching employers, or when investment banks are limited in number and have relatively inelastic labor demand (e.g., they only need to hire one analyst to cover a particular stock or sector), we should expect the reservation utility of the analyst to be close to U_{SA} .

settings where informational benefits are potentially important. The following proposition compares mandatory disclosure to the status quo of no regulation and shows that disclosure always increases report quality, regardless of how large are the intrinsic benefits from research.

Proposition 6 *Under mandatory disclosure, observability of the wage provides additional information to investors. Moreover, research effort with disclosure regulation is at least as high as without regulation. Hence, price informativeness is always strictly higher with mandatory disclosure than without.*

The intuition underlying this result is as follows. Even when investors can observe the analyst's wage payments, the investment bank can (and will) derive positive expected profits from inducing an optimistic reporting bias. However, since an optimistically-biased report is only credible if investors cannot discern the true state, the investment bank will optimally pool its payments to the analyst in some states (e.g., in states $(s, \phi) = (L, \phi^L)$ and $(s, \phi) = (H, \phi^H)$) to prevent investors from using the wage disclosure to uncover the false optimism. Although the disclosure of the wage payment does not perfectly reveal the analyst's information, it does provide investors with an additional piece of useful information at time 2. Furthermore, because the wage scheme has been flattened *across precision levels*, the analyst's incentives for research effort are (weakly) greater than under the status quo of no regulation.

We conclude from Propositions 5 and 6 that, from the viewpoint of investors, disclosure regulation exhibits important advantages over information barriers.²⁶ First, even when research serves no purpose other than to educate investors, as long as the analyst does not capture excessive surplus from working for the securities firm versus working in a stand-alone capacity, disclosure results in a greater increase in price informativeness.

Second, we know from Section 4 (Propositions 3 and 4) that one significant drawback to regulation that restricts communication is a possible reduction in report informativeness when the analyst's research is directly valuable to the securities firm. Mandatory disclosure, in contrast, never

²⁶These results depend, of course, on the assumption that market participants understand and utilize the additional information. Empirical evidence suggests that investors do indeed understand and make use of information about agents' incentive contracts. See, for instance, Lemmon, Schallheim, and Zender (2000) for evidence of this in the context of compensation provided to mutual fund managers. Even if one takes the view that investors are generally naive and do not rationally anticipate analyst overoptimism, disclosure regulation would seem to be a particularly effective approach since it highlights the conflict-of-interest problem and provide investors with verifiable information about analyst behavior.

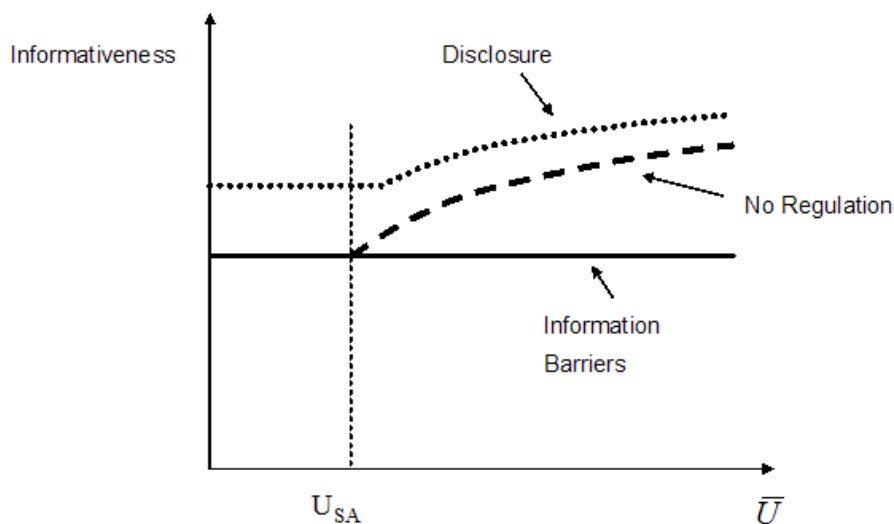


Figure 3: Equilibrium levels of informativeness when direct informational benefits are high. The figure depicts informativeness levels versus the analyst's reservation utility for each of the three regulatory regimes (disclosure, information barriers, and no regulation).

reduces price informativeness relative to the status quo, regardless of the analyst's outside option for employment and regardless of whether his research yields intrinsic benefits. Hence, disclosure works best relative to internal barriers precisely when an analyst's information is most beneficial to the securities firm. The relative informativeness of the analyst's report in the three regimes is depicted in Figure 3. From a policy perspective, if accurately measuring the benefits of analyst research activity is infeasible, then disclosure regulation may be preferable since it minimizes the chance of worsening rather than improving the situation for investors.

Third, disclosure regulation very often results in greater research effort and more *production* of information than does regulation that restricts communication. This is particularly true when the direct benefits from analyst research are significant. In other words, \bar{U} , disclosure may not only be preferred by investment banks, but it also may result in greater societal benefits, especially if analyst employers use research for specific, value-creating purposes (e.g., the accurate pricing of securities offerings) that ultimately enhance the informational and allocational role of financial markets.

7 Extensions

We have derived explicit results on the effects of conflict-of-interest regulations using a relatively simple modelling framework. In this section, we discuss the robustness of our results with respect to five issues: (1) a larger reporting space for the analyst; (2) greater generality in the payoffs accruing to investment banking activities; (3) dependence of the analyst’s reservation utility on the regulatory environment; (4) multiplicity of securities; and (5) the presence of “naïve” investors who do not incorporate all available information in forming an estimate of market values.

7.1 Continuous Reporting Space

As a practical matter, stock recommendations of sell-side analysts are almost always limited to a small number of predetermined categories (e.g., “buy,” “sell,” or “hold”), and a discrete reporting space is likely appropriate for modeling such recommendations.²⁷ However, some elements of an analyst’s research, such as earnings forecasts, price targets, or descriptive analyses, can potentially give investors information that is much more finely grained.

This additional richness can be modelled by assuming that the analyst issues a report specifying a target stock price $R \in [V^L, V^H]$ and that, as before, the analyst suffers a penalty proportional to the squared difference between his reported R and the realized firm value V . Two new considerations arise with this type of generalization. First, because the analyst will have more flexibility in minimizing his inaccuracy penalty, an optimal incentive scheme that implements biased reporting will generally need to satisfy a larger number of incentive compatibility constraints than in the discrete reporting case. Second, the stringency of the incentive constraints will depend endogenously on the equilibrium level of research effort chosen by the analyst. These two complications notwithstanding, it can be shown that the investment bank will still choose to induce optimistically-biased reporting by pooling together reports across three states under the non-disclosure regimes, and across two states under disclosure regulation. In addition, research effort under continuous reporting can be shown to exhibit the same qualitative relationship with the analyst’s reservation utility as under

²⁷There may also be theoretical reasons to believe that analysts, if allowed to choose, will prefer to issue discrete recommendations. For example, Morgan and Stocken (2003) present a model of stock recommendations in which categorical ranking systems arise endogenously even though analysts have the ability to make finer distinctions in their stock reports.

discrete reporting. Therefore, the qualitative results for the continuous reporting case are virtually identical to those for the discrete reporting case.²⁸

7.2 More General Payoffs from Investment Banking

Rather than taking the securities firm’s investment banking profits to be a fixed α that is received if the client’s stock price increases, we could instead allow profits to vary in size. One natural extension is to assume that the magnitude of the payoff is contingent on the client firm’s (time 2) share price. This generalization would capture the fact that investment banks serving as merger advisors or underwriters are often compensated on the basis of how “successful” a particular deal turns out to be, and ultimate success in many cases (e.g., for seasoned equity offerings or acquisitions using stock) depends on how much—and not just whether—the client’s stock price rises.²⁹

Allowing α to increase with the interim stock price is in fact formally equivalent to assuming that the analyst’s research yields direct informational benefits to the securities firm. To see why this is true, simply note that a greater level of research effort, all else equal, enhances the analyst’s credibility and magnifies the positive stock price impact of a favorable report. In other words, assuming that α is increasing in the stock price is tantamount to assuming, as was done in Section 4.1, that α is increasing in effort. Consequently, all of the qualitative results of that section carry over to the case of a price-dependent benefit to the bank.

7.3 Changes in the Analyst’s Outside Opportunities

Our model has assumed that the analyst’s outside opportunities are exogenously determined and invariant to changes in the regulatory environment. However, it is possible that conflict-of-interest regulations could reduce the value of analysts’ outside opportunities. Information barriers or disclosure requirements, by limiting securities firms’ ability to profit from in-house research, could reduce analyst pay levels throughout the industry and lower the payoffs that analysts can obtain

²⁸The sole exception is that the appropriate versions of Proposition 2 and Corollary 1 must be modified slightly. Specifically, when reporting is continuous, values of ϕ^H and ϕ^L exist for which information barriers are counterproductive even in the absence of direct informational benefits. This result provides a further argument in favor of using disclosure rules rather than information barriers. Detailed proof of this result, as well as proof of the other results in the continuous reporting case, is available upon request.

²⁹McLaughlin (1992) documents the structure of fee contracts in tender offers and shows that such contracts can influence tender offer outcomes. For evidence on underwriter spreads in seasoned equity offerings, see for instance Bhagat and Frost (1986), Hansen and Torregrosa (1992), Altinkilic and Hansen (2000), and Yeoman (2001).

outside of their current employment relationships. In addition, the regulations could be particularly burdensome to some securities firms, such as smaller investment banks that have limited financial resources or specialized firms that are unable to subsidize research with investment banking profits. Such firms could be driven to eliminate their equity research programs entirely, lessening the overall level of demand for analyst labor.

The main qualitative results of our analysis would be unaffected if indeed the analyst's reservation utility were to decrease with regulation. To see why, fix a level of reservation utility \bar{U} and consider, for instance, the case with no direct informational benefits. For this case, we showed that imposing either information barriers or mandatory disclosure increases research effort above the status quo level. Also, we showed that the equilibrium effort schedule is decreasing in the analyst's reservation utility. Thus, if regulation were to lower the reservation utility below \bar{U} , the accompanying increase in research effort would be even larger. Similar reasoning shows that the other implications of the basic model would also continue to hold in the more general setup: information barriers would still be counterproductive in the presence of sizable informational benefits, whereas disclosure regulation would still unambiguously improve informativeness relative to the status quo.

7.4 Multiple Securities

While we have analyzed the incentives faced by an analyst who reports on one stock, in practice analysts often follow and report on a group of stocks. As a consequence, an analyst's career concerns may depend not only on his accuracy with respect to a particular security, but also on how he performs vis-a-vis his entire portfolio. Here, we discuss how our basic results would be affected by moving to a framework with multiple securities.

Suppose that the analyst covers $N > 1$ stocks and that his research effort and inaccuracy penalty with respect to one stock in the portfolio do not have direct implications for his effort and penalty on other stocks. Provided that market participants know which companies in the portfolio are potential investment banking clients, then all of the analysis in the basic model will apply separately for each of the prospective customers. In other words, the same qualitative results obtain immediately if the problem is separable across the components of the analyst's portfolio.

More generally, our previous analysis suggests that the main results would likely continue to

hold whenever information barriers place an upper bound on the equilibrium level of research effort. Recall from the basic model that barriers are less effective than mandatory disclosure whenever they preclude the securities firm from reaping the direct informational benefits of research. In these cases, barriers are counterproductive because they place informational constraints on the optimal incentive scheme, and these constraints limit the bank's ability to provide strong effort incentives to the analyst. We would expect similar constraints to bind in the multiple securities case whenever the direct informational benefits from researching potential clients are sufficiently large.

An issue that merits further study is how our results might be affected if the analyst's cost of effort and concern for accuracy exhibited strong complementarities across different stocks. For example, a high level of effort exerted in researching a telecommunications stock might increase the analyst's industry expertise, thus facilitating his research on another telecommunications stock. Likewise, due to industry-wide shocks, being inaccurate with respect to two pharmaceutical companies may not be significantly worse for the analyst's career prospects than missing the mark on one such company. Large complementarities could change the nature of the optimal incentive scheme and alter the design of regulation. To the extent that wage disclosures provide investors with extra information about prospective investment banking clients, we would still expect mandatory disclosure to be superior to the status quo of no regulation. However, a detailed analysis of this complex issue lies beyond the scope of the present paper.

7.5 Naïve Investors

Finally, it is of interest to consider whether our results depend on the extent to which investors are rational. Throughout the analysis, we have maintained the assumption that investors exhibit full rationality and that interim prices therefore correctly reflect analysts' incentives to issue false reports. A contrasting view, however, is that investors—particularly small retail investors—are ignorant about analysts' conflicts of interest and do not properly see beyond the public facade of an analyst's report. Such a view has been commonly voiced by the popular press and by proponents of legislation intended to protect small investors from analysts' conflicts of interest (see, for instance, Morgenson (2003), Shelby (2003)).

Investor naïvete could be introduced into our model by assuming that some positive fraction

of investors mistakenly believe (at least in the short term) that an analyst’s public research report always accords with his information.³⁰ The precise impact of these naïve investors on interim (time 2) prices would undoubtedly depend on the specifics of the modeled price formation process. Nevertheless, we can begin to draw some qualitative conclusions for the interesting case where informational benefits to the investment bank are substantial. Recall from Section 4.2 that, under full investor rationality, structural barriers turn out to be counterproductive whenever the securities firm’s marginal benefit from research activity, α'_2 , is sufficiently large. It is straightforward to show a corresponding result for the naïve investor case: there exists a cutoff level, independent of the proportion of irrational investors, such that structural barriers strictly reduce informativeness whenever the investment bank’s marginal benefit from research activity exceeds the cutoff level. Intuitively, this result holds because the investment bank’s informational and reputational benefits come solely from the amount of the activity being performed (i.e., the level of e). Therefore, the investment bank will find it most profitable to implement the same level of research effort and report informativeness whether or not some investors are naïve.

8 Empirical Implications

Our analysis provides a number of interesting and potentially testable empirical implications regarding the stock price impact of analyst research (e.g., earnings forecasts or stock recommendations). These implications follow directly from the fact that the different regulatory regimes lead to different levels of research effort, and the equilibrium level of research effort in turn determines how investors use the analyst’s report to update their priors about the client company. For instance, one implication of the model is that disclosure requirements will increase the “credibility,” or price impact, of optimistic stock reports. (Structural barriers have a similar effect, but only when they are not counterproductive—i.e., only when they provide no intrinsic benefit to the securities firm.) This implication comes from the fact that, as research effort intensifies, the frequency of favorable reports decreases, and investors more readily increase their expectations of the client upon seeing a favorable report. A second and related implication is that the dispersion of the price impact

³⁰Of course, to conduct such a formal analysis, it would also be necessary to impose conditions ensuring existence of an equilibrium interim price.

following an optimistic versus a pessimistic recommendation should increase as well. That is, the difference in the interim values for the firm upon observing different recommendations should be greater when regulation is effective.

The model also delivers cross-sectional implications about the relative effectiveness of regulation. The analysis shows that the effect of regulatory change on equilibrium research effort increases in the variability of the client firm's value ($V^H - V^L$). Thus, we should expect that regulation would have the most significant impact on analyst credibility for firms with highly uncertain prospects. Such uncertainty might be present for small, young, rapidly-growing firms within such industries as biotechnology or computer software. Likewise, we would expect regulation to play a larger role for industries and firms with relatively few tangible assets. Finally, regulation should have a larger impact on credibility for analysts facing powerful career concerns (i.e., high \underline{w}), such as mid-career analysts with established reputations who have large future earnings at stake.

9 Conclusion

The analysis presented here has shown that the conflict of interest that undermines the integrity of analyst research is primarily a problem of information transmission between securities firms and investors. The problem is therefore best addressed by solutions designed to increase the amount of information available to all parties. This perspective emerges from a modelling framework in which a securities firm (i.e., investment bank) can respond to changes in the regulatory regime by adjusting the type of compensation contract used to influence an analyst's research effort and reporting behavior. Thus, our approach recognizes the endogenous nature of costly information production within securities firms and enables us to investigate how regulatory changes are likely to affect the quality of analysts' forecasts and recommendations via the amount of underlying information that is produced.

We conclude by noting that our attempt to understand the role of analysts' monetary incentives in the generation and transmission of information has led us to take a simplified view towards a number of potentially important issues. An example is the extent to which competition, either among investment banks for analyst services or among analysts for employment opportunities, affects the relevant outside option for an analyst. Clearly, a better grasp of the forces that determine

analysts' outside opportunities would be useful for quantifying the impact of regulation. Moreover, we have limited our analysis to two specific types of regulation on the premise that they represent the most widely discussed and implemented regulatory approaches. The broader issue of optimal regulatory design is left for future research.

Appendix

A Reporting Strategies and Informativeness Levels

A.1 Optimistically-Biased Reporting (Φ_B)

Under the optimistically-biased reporting strategy considered in the text, $R(s, \phi) = V^L$ if $s = L$ and $\phi = \phi^H$; otherwise, $R(s, \phi) = V^H$. This implies that investors can distinguish between the two possibilities $(s, \phi) = (L, \phi^H)$ or $(s, \phi) \in \{(H, \phi^H), (H, \phi^L), (L, \phi^L)\}$. Calculating the variance by conditioning, we have that $-\Phi_B(p) = \Pr(R = V^H) * \text{var}(V|R = V^H) + \Pr(R = V^L) * \text{var}(V|R = V^L)$. Now,

$$\begin{aligned} E(V|R = V^H) &= \Pr_{\phi=\phi^H}^{(s=H)}|R = V^H E(V|_{\phi=\phi^H}^{s=H}) \\ &+ \Pr_{\phi=\phi^L}^{(s=H)}|R = V^H E(V|_{\phi=\phi^L}^{s=H}) + \Pr_{\phi=\phi^L}^{(s=L)}|R = V^H E(V|_{\phi=\phi^L}^{s=L}) \\ &= \frac{1}{1 - \frac{1}{2}p} \left[\left(\frac{1}{2}p\phi^H + \frac{1}{2}(1-p) \right) V^H + \left(\frac{1}{2}p(1-\phi^H) + \frac{1}{2}(1-p) \right) V^L \right] \end{aligned}$$

Some algebraic manipulations reveal that $\text{var}(V|R = V^H) = E[(V - E(V|R = V^H))^2|R = V^H] = \frac{1}{(1-\frac{1}{2}p)^2} \left[\left(\frac{1}{4} - \frac{1}{4}p^2(\phi^H)^2 \right) - \frac{p}{2} \left(\frac{1}{2} - \frac{1}{2}p\phi^H \right) \right] * (V^H - V^L)^2$. Also, since an unfavorable report is issued only when $s = L$ and $\phi = \phi^H$, $E(V|R = V^L) = \phi^H V^L + (1 - \phi^H)V^H$, and therefore $\text{var}(V|R = V^L) = E[(V - E(V|R = V^L))^2|R = V^L] = \phi^H(1 - \phi^H)(V^H - V^L)^2$. Finally, since $\Pr(R = V^H) = \frac{1}{2}p + \frac{1}{2}(1-p) + \frac{1}{2}(1-p) = 1 - \frac{1}{2}p$ under the distorted strategy and since $\Pr(R = V^L) = \frac{1}{2}p$, it follows that

$$\Phi_B(p) = \frac{\frac{1}{2} - \frac{p}{2} + p\phi^H - p(\phi^H)^2}{p-2} * (V^H - V^L)^2. \quad (12)$$

A.2 Optimistically-Biased Reporting with Wage Disclosure (Φ_{BW})

Here, investors learn the ex post wage paid as well as the information they learn in A.1. As shown in the proof of Proposition 6, the investment bank pools information by setting $w(H, \phi^H) = w(L, \phi^L)$. Therefore, investors can distinguish among the following three possibilities: $(s, \phi) =$

(H, ϕ^L) , $(s, \phi) = (L, \phi^H)$, or $(s, \phi) \in \{(H, \phi^H), (L, \phi^L)\}$. We can calculate that

$$\begin{aligned}
-\Phi_{BW}(p) &= E[\text{var}[V|s, \phi, w(s, \phi)]] \\
&= \Pr(\begin{smallmatrix} s=H, \\ \phi=\phi^L \end{smallmatrix})\text{var}(V|_{\phi=\phi^L}^{s=H}) + \Pr(\begin{smallmatrix} s=H, \\ \phi=\phi^H \end{smallmatrix} \text{ or } \begin{smallmatrix} s=L, \\ \phi=\phi^L \end{smallmatrix})\text{var}(V|_{\phi=\phi^H}^{s=H} \text{ or } \begin{smallmatrix} s=L, \\ \phi=\phi^L \end{smallmatrix}) \\
&\quad + \Pr(\begin{smallmatrix} s=L, \\ \phi=\phi^H \end{smallmatrix})\text{var}(V|_{\phi=\phi^H}^{s=L})
\end{aligned}$$

Now, it is straightforward to calculate that $\Pr(\begin{smallmatrix} s=H, \\ \phi=\phi^L \end{smallmatrix}) = \frac{1}{2}(1-p)$. Similarly, $\Pr(\begin{smallmatrix} s=H, \\ \phi=\phi^H \end{smallmatrix} \text{ or } \begin{smallmatrix} s=L, \\ \phi=\phi^L \end{smallmatrix}) = \frac{1}{2}$ and $\Pr(\begin{smallmatrix} s=L, \\ \phi=\phi^H \end{smallmatrix}) = \frac{1}{2}p$. Also, we have $\text{var}(V|_{\phi=\phi^L}^{s=H}) = E[(V - E(V|_{\phi=\phi^L}^{s=H}))^2|_{\phi=\phi^L}^{s=H}] = \phi^L(1 - \phi^L)(V^H - V^L)^2$, and likewise $\text{var}(V|_{\phi=\phi^H}^{s=L}) = \phi^H(1 - \phi^H)(V^H - V^L)^2$. Finally, we have

$$\begin{aligned}
\text{var}(V|_{\phi=\phi^H}^{s=H} \text{ or } \begin{smallmatrix} s=L, \\ \phi=\phi^L \end{smallmatrix}) &= \Pr(V = V^H|_{\phi=\phi^H}^{s=H} \text{ or } \begin{smallmatrix} s=L, \\ \phi=\phi^L \end{smallmatrix}) * (V^H - E[V|_{\phi=\phi^H}^{s=H} \text{ or } \begin{smallmatrix} s=L, \\ \phi=\phi^L \end{smallmatrix}]])^2 \\
&\quad + \Pr(V = V^L|_{\phi=\phi^H}^{s=H} \text{ or } \begin{smallmatrix} s=L, \\ \phi=\phi^L \end{smallmatrix}) * (V^L - E[V|_{\phi=\phi^H}^{s=H} \text{ or } \begin{smallmatrix} s=L, \\ \phi=\phi^L \end{smallmatrix}]])^2 \\
&= [p\phi^H + (1-p)(1 - \phi^L)][p(1 - \phi^H) + (1-p)\phi^L](V^H - V^L)^2.
\end{aligned}$$

Combining the above expressions, we obtain that

$$\Phi_{BW}(p) = -\frac{1}{2} \left[\begin{aligned} &(2 - 3p + p^2)\phi^L(1 - \phi^L) + (p + p^2)\phi^H(1 - \phi^H) \\ &\quad + (p - p^2)(1 - \phi^H - \phi^L + 2\phi^H\phi^L) \end{aligned} \right] * (V^H - V^L)^2 \quad (13)$$

A.3 Symmetric Information (Φ_F)

For completeness, we also analyze the case where all information is observable by investors. In this case, investors can distinguish among all four states. Therefore, we have that $-\Phi_F(p) = \frac{1}{2}p\text{var}(V|_{\phi=\phi^H}^{s=H}) + \frac{1}{2}(1-p)\text{var}(V|_{\phi=\phi^L}^{s=H}) + \frac{1}{2}p\text{var}(V|_{\phi=\phi^H}^{s=L}) + \frac{1}{2}(1-p)\text{var}(V|_{\phi=\phi^L}^{s=L})$. Now, noting that $E(V|_{\phi=\phi^H}^{s=H}) = \phi^H V^H + (1 - \phi^H)V^L$, we calculate that $\text{var}(V|_{\phi=\phi^H}^{s=H}) = E[(V - E(V|_{\phi=\phi^H}^{s=H}))^2|_{\phi=\phi^H}^{s=H}] = \phi^H(1 - \phi^H)(V^H - V^L)^2$. The other three conditional variance terms can be calculated in similar fashion. After simplifying, we have

$$\Phi_F(p) = -[p\phi^H(1 - \phi^H) + (1-p)(\phi^L(1 - \phi^L))] * (V^H - V^L)^2. \quad (14)$$

B Proofs

The following lemma establishes a simple but useful preliminary result: for a given reporting strategy, if two contracts provide the analyst with the same total payments in both high and low precision states, then the analyst's incentives for effort will be the same under the two contracts.

Lemma 2 *Suppose that $w(s, \phi)$ and $\widehat{w}(s, \phi)$ are two contracts that induce the same reporting strategy and that satisfy the following conditions:*

1. $\widehat{w}(H, \phi^H) + \widehat{w}(L, \phi^H) = w(H, \phi^H) + w(L, \phi^H)$; and
2. $\widehat{w}(H, \phi^L) + \widehat{w}(L, \phi^L) = w(H, \phi^L) + w(L, \phi^L)$.

Then $w(s, \phi)$ and $\widehat{w}(s, \phi)$ induce the same level of research effort from the analyst.

Proof of Lemma 2: Observe that $\Pr_{\phi=\phi^H}^{(s=H, \cdot)} = \Pr_{\phi=\phi^H}^{(s=L, \cdot)} = \frac{1}{2}p$ and $\Pr_{\phi=\phi^L}^{(s=H, \cdot)} = \Pr_{\phi=\phi^L}^{(s=L, \cdot)} = \frac{1}{2}(1-p)$. Therefore, the expected wage payment received by the analyst under $w(s, \phi)$ is given by $\frac{1}{2}p(w(H, \phi^H) + w(L, \phi^H)) + \frac{1}{2}(1-p)(w(H, \phi^L) + w(L, \phi^L))$. Similarly, the expected wage payment received by the analyst under $\widehat{w}(s, \phi)$ is $\frac{1}{2}p(\widehat{w}(H, \phi^H) + \widehat{w}(L, \phi^H)) + \frac{1}{2}(1-p)(\widehat{w}(H, \phi^L) + \widehat{w}(L, \phi^L))$. For a given level of effort, these two expected wages are equal if the conditions in the lemma are satisfied. Therefore, the analyst's marginal incentives to exert research effort are the same under the two contracts. ■

Proof of Proposition 1: We will characterize the optimal contract and equilibrium effort level assuming that the investment bank induces the optimistically-biased reporting strategy $R_N(s, \phi)$ described in the proposition (the proof will be completed by verifying that other reporting strategies lead to lower profits for the firm.) We first calculate the analyst's expected utility under the biased reporting strategy. Observe that $\Pr(R_N(s, \phi) \text{ is incorrect} |_{\phi=\phi^H}^{s=H, \cdot}) = \Pr(R_N(s, \phi) \text{ is incorrect} |_{\phi=\phi^H}^{s=L, \cdot}) = 1 - \phi^H$. Also, $\Pr(R_N(s, \phi) \text{ is incorrect} |_{\phi=\phi^L}^{s=H, \cdot}) = 1 - \phi^L$. Finally, $\Pr(R_N(s, \phi) \text{ is incorrect} |_{\phi=\phi^L}^{s=L, \cdot}) = \phi^L$. Taking the weighted sum of these conditional probabilities, we have that the total probability of being incorrect is $p(\frac{1}{2} - \phi^H) + \frac{1}{2}$. Therefore, the analyst's expected utility under wage contract $w(s, \phi)$ is given by $\frac{1}{2}pW^H + \frac{1}{2}(1-p)W^L - [p(\frac{1}{2} - \phi^H) + \frac{1}{2}]\underline{w}(V^H - V^L)^2 - \frac{k}{2}e^2$ where $W^H \equiv w(H, \phi^H) + w(L, \phi^H)$ and $W^L \equiv w(H, \phi^L) + w(L, \phi^L)$. Maximization with respect to effort implies

that

$$e = \frac{1}{2k}W^H - \frac{1}{2k}W^L - \frac{1}{k}\left(\frac{1}{2} - \phi^H\right)\underline{w}(V^H - V^L)^2, \quad (15)$$

which is nonnegative provided that $W^L - W^H \leq (2\phi^H - 1)\underline{w}(V^H - V^L)^2$ (this inequality will be satisfied if the wage scheme is profit-maximizing). Therefore, the wage contract $w(s, \phi)$ solves the investment bank's profit maximization problem only if $W^H \geq 0$ and $W^L \geq 0$ solve the following problem:

$$\begin{aligned} \max_{W^H, W^L} \Pi &= \alpha(1 - \frac{1}{2}p) - \frac{1}{2}pW^H - \frac{1}{2}(1 - p)W^L \\ \text{s.t.} \quad p &= \frac{1}{2} + \frac{1}{2k}W^H - \frac{1}{2k}W^L - \frac{1}{k}\left(\frac{1}{2} - \phi^H\right)\underline{w}(V^H - V^L)^2 \end{aligned} \quad (16)$$

$$\frac{1}{2}pW^H + \frac{1}{2}(1 - p)W^L - \frac{k}{2}\left(p - \frac{1}{2}\right)^2 - \left[p\left(\frac{1}{2} - \phi^H\right) + \frac{1}{2}\right]\underline{w}(V^H - V^L)^2 \geq \bar{U} \quad (17)$$

$$W^L \geq (2\phi^L - 1)\underline{w}(V^H - V^L)^2 \quad (18)$$

Equation (16) can be used to eliminate p from the optimization problem. Then, letting \mathcal{L} denote the Lagrangian and letting λ and μ denote the Lagrange multipliers for the IR constraint (17) and the IC constraint (18), respectively, we have the first-order conditions

$$\begin{aligned} \frac{\partial \mathcal{L}}{\partial W^H} &= -\frac{\alpha}{4k} - \frac{1}{4} + \frac{(\frac{1}{2} - \phi^H)}{2k}\underline{w}(V^H - V^L)^2 - \frac{W^H}{2k} + \frac{W^L}{2k} \\ &\quad - \lambda \left[-\frac{1}{4} - \frac{W^H}{4k} + \frac{W^L}{4k} + \frac{(\frac{1}{2} - \phi^H)}{2k}\underline{w}(V^H - V^L)^2 \right] \leq 0 \end{aligned} \quad (19)$$

$$\begin{aligned} \frac{\partial \mathcal{L}}{\partial W^L} &= \frac{\alpha}{4k} - \frac{1}{4} - \frac{(\frac{1}{2} - \phi^H)}{2k}\underline{w}(V^H - V^L)^2 + \frac{W^H}{2k} - \frac{W^L}{2k} \\ &\quad - \lambda \left[-\frac{1}{4} + \frac{W^H}{4k} - \frac{W^L}{4k} - \frac{(\frac{1}{2} - \phi^H)}{2k}\underline{w}(V^H - V^L)^2 \right] - \mu(-1) \leq 0. \end{aligned} \quad (20)$$

Since W^L must be strictly positive in equilibrium to satisfy the IC constraint, the Kuhn-Tucker conditions imply that $\frac{\partial \mathcal{L}}{\partial W^L} = 0$. We then have the following four possibilities:

Case 1: $W^H > 0$ and the IC constraint is slack.

In this case, the Kuhn-Tucker conditions imply that $\frac{\partial \mathcal{L}}{\partial W^H} = 0$, and so $\lambda = 1 - 2\mu$. Then, since complementary slackness implies that $\mu = 0$, we have $\lambda = 1$. Therefore, the first-order conditions

imply that $W^L = W^H + \alpha$, and the IR constraint binds.

Case 2: $W^H > 0$ and the IC constraint binds.

This case cannot hold, as we now show. Suppose to the contrary that this case did hold and that the IR constraint were satisfied by an expected utility of

$$U^* = \frac{1}{2}pW^H + \frac{1}{2}(1-p)W^L - \frac{k}{2}\left(p - \frac{1}{2}\right)^2 - \left[p\left(\frac{1}{2} - \phi^H\right) + \frac{1}{2}\right]\underline{w}(V^H - V^L)^2.$$

Substituting (16) into this equation eliminates p , yielding an implicit function in W^H and W^L . Holding the analyst's expected utility constant and implicitly differentiating this function, we obtain that

$$\frac{\partial W^H}{\partial W^L} = \frac{-k + W^H - W^L - (1 - 2\phi^H)\underline{w}(V^H - V^L)^2}{k + W^H - W^L - (1 - 2\phi^H)\underline{w}(V^H - V^L)^2}, \quad (21)$$

which is negative. Then we can compute the total derivative of the investment bank's profits with respect to W_L and use (21) to obtain that

$$\begin{aligned} \frac{d\Pi}{dW^L} &= -\frac{1}{2} + \left(1 - \frac{\partial W^H}{\partial W^L}\right) \left[\frac{1}{4} + \frac{W^H}{2k} - \frac{W^L}{2k} + \frac{\alpha}{4k} - \frac{(\frac{1}{2} - \phi^H)}{2k}\underline{w}(V^H - V^L)^2\right] \\ &= \frac{W^H - W^L + \alpha}{2k + 2W^H - 2W^L + (4\phi^H - 2)\underline{w}(V^H - V^L)^2}. \end{aligned} \quad (22)$$

This last expression is positive by our parameter assumption on α and by the fact that $W^L = (2\phi^L - 1)\underline{w}(V^H - V^L)^2$. In other words, the firm could increase profits by raising W^L and lowering W^H slightly in such a way that the IR constraint continues to be satisfied by the same level of analyst utility, a contradiction.

Case 3: $W^H = 0$ and the IC constraint is slack.

By complementary slackness, $\mu = 0$. If $\lambda = 0$, then the second f.o.c. implies that $W^L = \frac{\alpha}{2} - \frac{k}{2} - (\frac{1}{2} - \phi^H)\underline{w}(V^H - V^L)^2 < 0$, contradicting the nonnegativity constraint. Therefore $\lambda > 0$, and the individual rationality constraint binds.

Case 4: $W^H = 0$ and the IC constraint binds.

In this case, $W^L = (2\phi^L - 1)\underline{w}(V^H - V^L)^2$.

Based on the above candidate solutions, we proceed to characterize the optimal choices of W^H and W^L as functions of \bar{U} . First, note that the analyst's equilibrium expected utility is increasing

separately in W^H and W^L . Now note that, for Case 4, $W^H = 0$ and $W^L = (2\phi^L - 1)\underline{w}(V^H - V^L)^2$. It is easy to check that this gives the analyst his stand-alone utility, U_{SA} , provided that the firm sets $w(L, \phi^L) = W^L$ and $w(S, \phi^L) = 0$. Thus, for $\bar{U} < U_{SA}$ the IR constraint must be slack, and $W^H = 0$ (By Case 2, $W^H > 0$ would imply a contradiction). For intermediate values of \bar{U} greater than U_{SA} but less than $(\phi^H - 1)\underline{w}(V^H - V^L)^2$, the IR constraint binds, and $W^L - W^H < (2\phi^H - 1)\underline{w}(V^H - V^L) < \alpha$. Case 3 is then the only possibility. Next, when \bar{U} equals $(\phi^H - 1)\underline{w}(V^H - V^L)^2$, according to Case 3 $W^H = 0$, $W^L = (2\phi^H - 1)\underline{w}(V^H - V^L)^2$, and hence Equation (15) implies effort is zero. Finally, consider values of \bar{U} above $(\phi^H - 1)\underline{w}(V^H - V^L)^2$. We argue that the firm can do no better than by setting $W^L - W^H = (2\phi^H - 1)\underline{w}(V^H - V^L)^2$. First, the probability of receiving a high-precision signal is $\frac{1}{2}$ so long as the analyst exerts zero effort, and so the investment bank cannot gain by setting $W^L - W^H > (2\phi^H - 1)\underline{w}(V^H - V^L)^2$ while maintaining the same level of analyst utility. Second, if the firm were to set $W^L - W^H < (2\phi^H - 1)\underline{w}(V^H - V^L)^2$, then maintaining the same level of analyst utility would require $W^H > 0$. But then the argument used in Case 2 above implies that the firm could strictly increase expected profits by increasing W^L and decreasing W^H . Taken together, the preceding arguments characterize the optimal choice of W^H and W^L as in the proposition. Given this optimal wage scheme, Equation (15) then characterizes equilibrium effort as a function of \bar{U} in accordance with the proposition.

To complete the proof, we verify that the investment bank indeed maximizes profits by inducing the biased reporting strategy considered above. First, inducing favorable reporting in all states would make the analyst's report completely uninformative, resulting in zero investment banking profits. Second, inducing straightforward reporting would not be profit-maximizing since it would only yield profits α with probability $1/2$. Third, any strategy inducing a downward bias in a given state would be suboptimal as both the analyst and the investment bank would be better off with the wage payment in that state assigned instead to the favorable report. Thus, the only remaining alternative would be to induce a reporting strategy in which the analyst issues an unfavorable report if and only if he receives an unfavorable signal with *low* precision. Let $\widehat{R}(s, \phi)$ denote this alternate reporting strategy. Using arguments similar to those used in analyzing $R(s, \phi)$ above, it can be shown that the optimal contract $(\widehat{W}^H, \widehat{W}^L)$ associated with $\widehat{R}(s, \phi)$ has the following characteristics: (1) for $\bar{U} \leq U_{SA}$, $\widehat{W}^L = 0$ and $\widehat{W}^H = (2\phi^H - 1)\underline{w}(V^H - V^L)^2$; (2) for $\bar{U} > U_{SA}$,

$\widehat{W}^L = 0$ and \widehat{W}^H is strictly increasing. Let Π denote maximized profits under $R(s, \phi)$, and let $\widehat{\Pi}$ denote maximized profits under $\widehat{R}(s, \phi)$. We proceed to argue that $\Pi > \widehat{\Pi}$ for all values of \bar{U} . First, direct computations show that, for $\bar{U} \leq U_{SA}$, $\Pi - \widehat{\Pi} = \frac{1}{2}(\phi^H - \phi^L)\underline{w}(V^H - V^L)^2 + \frac{1}{k}(\phi^H - \phi^L)^2\underline{w}(V^H - V^L)^2 - \frac{\alpha}{k}(\phi^H - \phi^L)\underline{w}(V^H - V^L)^2 > 0$. Second, consider intermediate levels of $\bar{U} > U_{SA}$ for which equilibrium effort is positive under $R(s, \phi)$. Calculating $\frac{\partial \Pi}{\partial \bar{W}^L}$ and $\frac{\partial \widehat{W}^L}{\partial \bar{U}}$ and using the Chain Rule, we have that

$$\frac{\partial \Pi}{\partial \bar{U}} \Big|_{W^H=0} = \frac{-k + (2\phi^H - 1)\underline{w}(V^H - V^L)^2 + \alpha - 2W^L}{k - (2\phi^H - 1)\underline{w}(V^H - V^L)^2 + W^L}. \quad (23)$$

Likewise, we can calculate that

$$\frac{\partial \widehat{\Pi}}{\partial \bar{U}} \Big|_{\widehat{W}^L=0} = \frac{-k + (2\phi^L - 1)\underline{w}(V^H - V^L)^2 + \alpha - 2\widehat{W}^H}{k - (2\phi^L - 1)\underline{w}(V^H - V^L)^2 + \widehat{W}^H}. \quad (24)$$

Since effort under $R(s, \phi)$ is positive, we have that $W^L < (2\phi^H - 1)\underline{w}(V^H - V^L)^2 < \widehat{W}^H$. Therefore, simple calculations show that $\frac{\partial \Pi}{\partial \bar{U}} \Big|_{W^H=0} > \frac{\partial \widehat{\Pi}}{\partial \bar{U}} \Big|_{\widehat{W}^L=0}$. Thus we have that $\Pi > \widehat{\Pi}$. Third, consider high levels of $\bar{U} > U_{SA}$ such that effort under $R(s, \phi)$ is zero and such that $\widehat{W}^H - \widehat{W}^L = \alpha$. Direct computations show that, for these cases,

$$\Pi - \widehat{\Pi} = -\frac{\alpha^2}{8k} + \left[\frac{\phi^H}{2} - \frac{\phi^L}{2} + \frac{\alpha}{2k}\phi^L - \frac{\alpha}{4k} \right] \underline{w}(V^H - V^L)^2 - \frac{1}{2k}(\phi^L - \frac{1}{2})^2 \underline{w}^2(V^H - V^L)^4 \quad (25)$$

which is positive from our parameter assumptions on k . Furthermore, for these cases we have $\frac{\partial \Pi}{\partial \bar{U}} \Big|_{W^H=0} > -1$ from (23) and $\frac{\partial \widehat{\Pi}}{\partial \bar{U}} \Big|_{\widehat{W}^L=0} < -1$ from (24). Thus we have established that $\Pi > \widehat{\Pi}$ for all levels of reservation utility. ■

Proof of Corollary 1: From Appendix A, we have expressions for report informativeness in the symmetric information case ($\Phi_F(p)$) and in the biased reporting case ($\Phi_B(p)$). Using these expressions, we can calculate that $\Phi_F(1) = \Phi_B(1) = -(\phi^H - (\phi^H)^2)(V^H - V^L)^2$. Moreover, direct computations show that $\Phi'_B(1) > \Phi'_F(1)$ and that $\Phi''_B(p) > \Phi''_F(p)$ for all $p \in (\frac{1}{2}, 1)$. Therefore, $\Phi_F(p) > \Phi_B(p)$ for all $p \in [\frac{1}{2}, 1]$. Finally, $\Phi_F(p)$ and $\Phi_B(p)$ are strictly increasing, and we know from Proposition 1 that equilibrium effort under private information and no regulation, e_N , is always weakly lower than under symmetric information, $e_{SA} = \frac{1}{k}(\phi^H - \phi^L)\underline{w}(V^H - V^L)^2$. ■

Proof of Lemma 1: Since $w(s, \phi)$ and $R(s, \phi)$ solve the optimization problem, the analyst must find it optimal to declare the signal and precision truthfully and issue the report dictated by $R(s, \phi)$. In other words, for each $s^* \in \{H, L\}$ and $\phi^* \in \{\phi^H, \phi^L\}$, the following truthtelling constraints must be satisfied:

$$\begin{aligned} w(s^*, \phi^*) - \Pr\left(R(s^*, \phi^*) \text{ is wrong} \Big|_{\phi=\phi^*}^{s=s^*}\right) \underline{w}(V^H - V^L)^2 \\ \geq w(s^*, \widehat{\phi}) - \Pr\left(R(s^*, \widehat{\phi}) \text{ is wrong} \Big|_{\phi=\phi^*}^{s=s^*}\right) \underline{w}(V^H - V^L)^2 \end{aligned} \quad (26)$$

$$\begin{aligned} w(s^*, \phi^*) - \Pr\left(R(s^*, \phi^*) \text{ is wrong} \Big|_{\phi=\phi^*}^{s=s^*}\right) \underline{w}(V^H - V^L)^2 \\ \geq w(\widehat{s}, \phi^*) - \Pr\left(R(\widehat{s}, \phi^*) \text{ is wrong} \Big|_{\phi=\phi^*}^{s=s^*}\right) \underline{w}(V^H - V^L)^2 \end{aligned} \quad (27)$$

$$\begin{aligned} w(s^*, \phi^*) - \Pr\left(R(s^*, \phi^*) \text{ is wrong} \Big|_{\phi=\phi^*}^{s=s^*}\right) \underline{w}(V^H - V^L)^2 \\ \geq w(\widehat{s}, \widehat{\phi}) - \Pr\left(R(\widehat{s}, \widehat{\phi}) \text{ is wrong} \Big|_{\phi=\phi^*}^{s=s^*}\right) \underline{w}(V^H - V^L)^2 \end{aligned} \quad (28)$$

where $\widehat{s} \neq s^*$ and $\widehat{\phi} \neq \phi^*$. It is straightforward to verify that these constraints are satisfied if and only if $w(H, \phi^H) = w(H, \phi^L) = w(L, \phi^L)$ and $w(H, \phi^H) - (2\phi^H - 1)\underline{w}(V^H - V^L)^2 \leq w(L, \phi^H) \leq w(H, \phi^H) - (2\phi^L - 1)\underline{w}(V^H - V^L)^2$. ■

Proof of Proposition 2: We begin by verifying that the investment bank can only maximize profits if it induces the optimistically biased strategy $R_W(s, \phi)$. First, a downward-biased reporting strategy, the strategy of always issuing a favorable report, and the strategy of inducing straightforward reporting are all unprofitable for the same reasons as in the proof of Proposition 1. Second, consider the overoptimistic reporting strategy in which an unfavorable report is issued if and only if the signal is unfavorable with low precision. It can be shown that inducing this strategy is infeasible because two or more of the analyst's truthtelling constraints contained in Condition (9) are logically incompatible. Thus, profits are maximized by $R(s, \phi)$.

Using Lemma 1 and an argument similar to that in the proof of Proposition 1, we have that a wage scheme $w(s, \phi)$ solves the investment bank's problem if and only if $W^H \equiv w(H, \phi^H) +$

$w(L, \phi^H) \geq 0$ and $W^L \equiv w(H, \phi^L) + w(L, \phi^L) \geq 0$ solve:

$$\begin{aligned} \max_{W^H, W^L} \Pi &= \alpha(1 - \frac{1}{2}p) - \frac{1}{2}pW^H - \frac{1}{2}(1-p)W^L \\ \text{subject to} \quad p &= \frac{1}{2} + \frac{1}{2k}W^H - \frac{1}{2k}W^L - \frac{1}{k}(\frac{1}{2} - \phi^H)\underline{w}(V^H - V^L)^2 \end{aligned} \quad (29)$$

$$\frac{1}{2}pW^H + \frac{1}{2}(1-p)W^L - \frac{k}{2}(p - \frac{1}{2})^2 - [p(\frac{1}{2} - \phi^H) + \frac{1}{2}]\underline{w}(V^H - V^L)^2 \geq \bar{U} \quad (30)$$

$$W^H \geq W^L - (2\phi^H - 1)\underline{w}(V^H - V^L)^2 \quad (31)$$

$$W^H \leq W^L - (2\phi^L - 1)\underline{w}(V^H - V^L)^2 \quad (32)$$

$$W^H \geq W^L/2 \quad (33)$$

We use Equation (29) to eliminate p from the above problem. Then, letting λ , μ_1 , μ_2 , and μ_3 denote the Lagrange multipliers for Constraints (30), (31), (32), and (33), respectively, we can derive the necessary first-order conditions for optimization as was done in the proof of Proposition 2. The standard Kuhn-Tucker conditions, combined with the facts that $W^H > 0$ and $W^L \geq W^H + (2\phi^L - 1)\underline{w}(V^H - V^L)^2$, lead to the following three possibilities:

Case 1: The IR constraint is slack.

The first-order conditions imply that $\frac{\lambda}{2} + \frac{\mu_3}{2} = \frac{1}{2}$. Since the IR constraint (30) is slack, $\lambda = 0$, implying that $\mu_3 = 1$ and that the associated constraint binds. Therefore, the f.o.c. for W^L implies that $\frac{\alpha}{4k} - \frac{3}{4} + \frac{(\phi^H - \frac{1}{2})}{2k}\underline{w}(V^H - V^L)^2 + \frac{W^H}{2k} = \frac{W^L}{2k} + \mu_1 - \mu_2$. If the constraint for μ_2 is slack, then $W^L < W^H$, a contradiction. Therefore, $W^L = (4\phi^L - 2)\underline{w}(V^H - V^L)^2$ and $W^H = \frac{1}{2}W^L$.

Case 2: The IR constraint binds and $W^H > W^L/2$.

Since $\mu_3 = 0$, $\lambda = 1$ and the first-order conditions imply that $W^L = W^H + \alpha - 4k\mu_1 + 4k\mu_2$. If the constraint (31) is slack, then $W^L \geq W^H + \alpha$, a contradiction. Therefore, $W^H = W^L - (2\phi^H - 1)\underline{w}(V^H - V^L)^2$.

Case 3: The IR constraint binds and $W^H = W^L/2$.

In this case, W^L is determined by the binding IR constraint.

Combining the results from the above three cases and using arguments similar to those used in the proof of Proposition 1, it is straightforward to characterize the equilibrium wage scheme and research effort as functions of the analyst's reservation utility \bar{U} . Finally, observe that we have established that $e_W = e_N = \frac{1}{k}(\phi^H - \phi^L)\underline{w}(V^H - V^L)^2$ for $\bar{U} \leq U_{SA}$ and $e_W = e_N = 0$ for

$\bar{U} \geq (2\phi^H - \frac{3}{2})\underline{w}(V^H - V^L)^2$. Hence, to complete the proof we only need to show that $e_W > e_N$ for the remaining values of \bar{U} . This can be done as follows. Let U_N denote the analyst's expected utility in the no-regulation case. Substitute (16) into the expression for U_N and differentiate to obtain that $\frac{\partial U_N}{\partial W_L} = \frac{k+(1-2\phi^H)\underline{w}(V^H-V^L)^2+W^L}{4k}$. Also, calculate from (16) that $\frac{\partial e}{\partial W_L} = -\frac{1}{2k}$. Therefore, $\frac{\partial e}{\partial U_N} = \frac{\partial e}{\partial W_L} \frac{\partial W_L}{\partial U_N} = -\frac{2}{k+(1-2\phi^H)\underline{w}(V^H-V^L)^2+W^L}$. In similar fashion, if U_W denotes expected utility in the information barriers case, then we can calculate that $\frac{\partial e}{\partial U_W} = -\frac{2}{3k+(1-2\phi^H)\underline{w}(V^H-V^L)^2+W^L}$. Thus, whenever $U_W = U_N$, $\frac{\partial e}{\partial U_N} < \frac{\partial e}{\partial U_W}$. In other words, effort under information barriers decreases less rapidly than effort under no regulation. But the IR constraint binds in both regimes whenever $\bar{U} \in (U_{SA}, (2\phi^H - \frac{3}{2})\underline{w}(V^H - V^L)^2)$, so we automatically have that $U_W = U_N$ over this range. ■

Proof of Corollary 2: The investment bank induces the same optimistically-biased reporting strategy under information barriers as under no regulation. Since report quality under this reporting strategy, $\Phi_B(p)$, is strictly increasing in p (see the expression derived in Section A.1 of Appendix A), report quality is strictly increasing in research effort. From Proposition 2, if $\bar{U} \in (U_{SA}, (2\phi^H - \frac{3}{2})\underline{w}(V^H - V^L)^2)$, then research effort is strictly higher under information barriers regulation than under no regulation. For other values of \bar{U} , effort is equal in the two regulatory regimes. ■

Proof of Proposition 3: Consider first the no-regulation case. Observe that the only effect of the intrinsic research benefits is to alter the investment bank's profit function. Furthermore, it can be shown that the investment bank will still choose to induce an optimistic bias exactly when the analyst receives a favorable signal with low precision. Hence, the optimization problem is the same as in the proof of Proposition 1, with the exception that firm profits are now given by $\Pi = \alpha_1(e)(1 - \frac{1}{2}p) - \frac{1}{2}pW^H - \frac{1}{2}(1 - p)W^L$. To clarify the role played by the marginal benefit of inducing higher effort, we proceed to explicitly consider the first-order conditions of the optimization problem. Letting λ denote the Lagrange multiplier for the IR constraint (17) and letting μ denote the Lagrange multiplier for the incentive compatibility constraint (18), we have the first-order

conditions

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial W^H} &= -\frac{\alpha_1(e)}{4k} - \frac{1}{4} + \frac{(\frac{1}{2} - \phi^H)}{2k} \underline{w}(V^H - V^L)^2 - \frac{W^H}{2k} + \frac{W^L}{2k} \\
&+ \left[\frac{3\alpha'_1(e)}{8k} - \frac{W^H \alpha'_1(e)}{8k^2} + \frac{W^L \alpha'_1(e)}{8k^2} + \frac{\alpha'_1(e)(\frac{1}{2} - \phi^H)}{4k^2} \underline{w}(V^H - V^L)^2 \right] \\
&- \lambda \left[-\frac{1}{4} - \frac{W^H}{4k} + \frac{W^L}{4k} + \frac{(\frac{1}{2} - \phi^H)}{2k} \underline{w}(V^H - V^L)^2 \right] \leq 0
\end{aligned} \tag{34}$$

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial W^L} &= \frac{\alpha_1(e)}{4k} - \frac{1}{4} - \frac{(\frac{1}{2} - \phi^H)}{2k} \underline{w}(V^H - V^L)^2 + \frac{W^H}{2k} - \frac{W^L}{2k} \\
&+ \left[-\frac{3\alpha'_1(e)}{8k} + \frac{W^H \alpha'_1(e)}{8k^2} - \frac{W^L \alpha'_1(e)}{8k^2} - \frac{\alpha'_1(e)(\frac{1}{2} - \phi^H)}{4k^2} \underline{w}(V^H - V^L)^2 \right] \\
&- \lambda \left[-\frac{1}{4} + \frac{W^H}{4k} - \frac{W^L}{4k} - \frac{(\frac{1}{2} - \phi^H)}{2k} \underline{w}(V^H - V^L)^2 \right] - \mu(-1) = 0.
\end{aligned} \tag{35}$$

Arguments similar to those used in the proof of Proposition 1 give rise to four distinct candidate solutions, depending on whether $W^H > 0$ and whether the IC constraint binds. To analyze these cases, we calculate, as in the proof of Proposition 1, the total derivative of firm profits with respect to W^L for a fixed level of the analyst's expected utility:

$$\frac{d\Pi}{dW^L} = \frac{W^H - W^L + \alpha_1(e) + \alpha'_1(e) \left(-\frac{3}{2} + \frac{W^H}{2k} - \frac{W^L}{2k} - \frac{(\frac{1}{2} - \phi^H) \underline{w}(V^H - V^L)^2}{k} \right)}{2k + 2W^H - 2W^L + (4\phi^H - 2) \underline{w}(V^H - V^L)^2}. \tag{36}$$

Using the fact that $W^L - W^H \leq (2\phi^H - 1) \underline{w}(V^H - V^L)^2$ over the range of interest, it follows from inspection of Equation (36) that if $\alpha'_1(e_{SA}) < \frac{2k\alpha_1(e_{SA}) - 2k(2\phi^L - 1) \underline{w}(V^H - V^L)^2}{3k - (2\phi^H - 2\phi^L) \underline{w}(V^H - V^L)^2}$, then the sign of $\frac{d\Pi}{dW^L}$ is positive when the IC constraint binds and $\bar{U} = U_{SA}$. Therefore, $W^L - W^H$ will always lie above $(2\phi^L - 1) \underline{w}(V^H - V^L)^2$ as \bar{U} increases. Hence, it cannot be the case that $W^H > 0$ and the IC constraint binds, and equilibrium effort will always be below e_{SA} for $\bar{U} > U_{SA}$. Likewise, if $\alpha'_1(e_{SA}) = \frac{2k\alpha_1(e_{SA}) - 2k(2\phi^L - 1) \underline{w}(V^H - V^L)^2}{3k - (2\phi^H - 2\phi^L) \underline{w}(V^H - V^L)^2}$, then equilibrium effort will be e_{SA} for all $\bar{U} > U_{SA}$. However, if $\alpha'_1(e_{SA}) > \frac{2k\alpha_1(e_{SA}) - 2k(2\phi^L - 1) \underline{w}(V^H - V^L)^2}{3k - (2\phi^H - 2\phi^L) \underline{w}(V^H - V^L)^2}$ then the IC constraint must bind. This implies that effort is strictly increasing in \bar{U} for all $\bar{U} \geq U_{SA}$.

Next, consider equilibrium under an information barrier policy. The optimization in this situation is the same as in the proof of Proposition 2, except that $\Pi = \alpha_1(e)(1-\frac{1}{2}p) - \frac{1}{2}pW^H - \frac{1}{2}(1-p)W^L$. Arguments similar to those used in the proof of Proposition 2 identify four distinct cases, depending on whether or not the IR constraint binds and whether or not $W^H > W^L/2$. To analyze these cases, one can calculate $d\Pi/dW^L$, the total derivative of profits for increases in W^L and decreases in W^H that together leave the analyst as well off as before. Then, one can show that if $\alpha'_1(e_{SA}) \leq \frac{2k\alpha_1(e_{SA}) - 2k(2\phi^L - 1)\underline{w}(V^H - V^L)^2}{3k - (2\phi^H - 2\phi^L)\underline{w}(V^H - V^L)^2}$, then it is only possible to have a binding IR constraint and $W^H > W^L/2$ if the constraint for μ_1 binds. This case is qualitatively similar to the case with no direct benefits in that W^L increases steadily and effort decreases steadily as \bar{U} increases. If instead $\alpha'_1(e_{SA}) > \frac{2k\alpha_1(e_{SA}) - 2k(2\phi^L - 1)\underline{w}(V^H - V^L)^2}{3k - (2\phi^H - 2\phi^L)\underline{w}(V^H - V^L)^2}$, then the only possibilities involve a binding constraint associated with μ_2 . Therefore, the level of effort must be constant and equal to the stand-alone effort level, e_{SA} .

To summarize, if $\alpha'_1(e_{SA}) \leq \frac{2k\alpha_1(e_{SA}) - 2k(2\phi^L - 1)\underline{w}(V^H - V^L)^2}{3k - (2\phi^H - 2\phi^L)\underline{w}(V^H - V^L)^2}$, then optimal effort levels under no regulation and under information barriers bear the same qualitative relationship as in the absence of intrinsic benefits. However, consider the case with $\alpha'_1(e_{SA}) > \frac{2k\alpha_1(e_{SA}) - 2k(2\phi^L - 1)\underline{w}(V^H - V^L)^2}{3k - (2\phi^H - 2\phi^L)\underline{w}(V^H - V^L)^2}$. In the absence of regulation, effort is strictly increasing in \bar{U} (for $\bar{U} > U_{SA}$), but under information barriers effort is constant for all \bar{U} . The proof is completed by noting that both the no-regulation as well as the information barriers regimes entail the same biased reporting strategy and that $\Phi_B(p)$ is strictly increasing in effort (see A.1 in Appendix A). ■

Proof of Proposition 4: The proof of this proposition is similar to the proof of Proposition 3. ■

We now proceed to prove Proposition 6; the proof of Proposition 5 follows similarly.

Proof of Proposition 6: As argued in the proof of Proposition 1 for no regulation, under disclosure regulation the firm's desire to obtain investment banking business implies that it will induce the biased reporting strategy $R(s, \phi)$ in which an unfavorable report is issued if and only if the state is $(s, \phi) = (L, \phi^H)$. To maximize profits, the firm will choose an optimal wage scheme $w(s, \phi)$ that "pools" information across states. Specifically, the firm will set $w(L, \phi^L) = w(H, \phi^H)$, thereby preventing investors from using the wage disclosure to learn perfectly whether upward distortion has occurred. Under this wage scheme, the interim stock price increases whenever $(s, \phi) \in \{(L, \phi^L), (H, \phi^H), (H, \phi^L)\}$, and so the investment bank still obtains profits in three out of four

states.

To simplify the characterization, we assume without loss of generality that $w(L, \phi^L) = w(H, \phi^H) = (2\phi^L - 1)\underline{w}(V^H - V^L)^2$. To see why this simplification is valid, suppose that $w(L, \phi^L) = w(H, \phi^H) = (2\phi^L - 1)\underline{w}(V^H - V^L)^2 + \delta$ where $\delta > 0$. Consider a wage scheme $\widehat{w}(s, \phi)$ with $\widehat{w}(L, \phi^L) = \widehat{w}(H, \phi^H) = (2\phi^L - 1)\underline{w}(V^H - V^L)^2$, $\widehat{w}(L, \phi^H) = w(L, \phi^H) + \delta$, and $\widehat{w}(H, \phi^L) = w(H, \phi^L) + \delta$. By Lemma 2, $w(s, \phi)$ and $\widehat{w}(s, \phi)$ induce the same level of effort from the analyst. Also, the expected wages under $w(s, \phi)$ and $\widehat{w}(s, \phi)$ are equal. Hence, $w(s, \phi)$ and $\widehat{w}(s, \phi)$ lead to the same economic outcomes for the bank and the analyst.

To characterize the optimal scheme $w(s, \phi)$, we first note that profits are maximized only if $w^H \equiv w(L, \phi^H) \geq 0$ and $w^L \equiv w(H, \phi^L) \geq 0$ solve the following optimization program:

$$\begin{aligned} \max_{w^H, w^L} \Pi &= \alpha(1 - \frac{1}{2}p) - \frac{1}{2}pw^H - \frac{1}{2}(1 - p)w^L - (\phi^L - \frac{1}{2})\underline{w}(V^H - V^L)^2 \\ &\text{subject to} \\ p &= \frac{1}{2} + \max[0, \frac{1}{2k}w^H - \frac{1}{2k}w^L - \frac{1}{k}(\frac{1}{2} - \phi^H)\underline{w}(V^H - V^L)^2] \end{aligned} \quad (37)$$

$$\begin{aligned} \frac{1}{2}pw^H &+ \frac{1}{2}(1 - p)w^L - \frac{k}{2}(p - \frac{1}{2})^2 - [p(\frac{1}{2} - \phi^H) + \frac{1}{2}]\underline{w}(V^H - V^L)^2 \\ &\geq \bar{U} - (\phi^L - \frac{1}{2})\underline{w}(V^H - V^L)^2 \end{aligned} \quad (38)$$

Assuming that $w^L - w^H \leq (2\phi^H - 1)\underline{w}(V^H - V^L)^2$ (it can be shown that this is optimal for the investment bank), we can derive, as in the proof of Proposition 2, the first-order conditions necessary for optimization. Straightforward application of the Kuhn-Tucker conditions implies that if the Individual Rationality constraint is slack, then we must have $w^H = w^L = 0$. On the other hand, if the Individual Rationality constraint binds, then the investment bank will find it optimal to choose $w^H = 0$ and to set w^L in accordance with the binding constraint.

Applying Lemma 1 and directly comparing the wage scheme implied by Cases 1 and 2 to the wage scheme characterized in Proposition 2 (the no-regulation case), we see that, for a given reservation utility \bar{U} , effort is always higher under wage disclosure. The final step of the proof is to show that, for any given level of effort e , informativeness under the optimistically-biased reporting strategy is higher with wage disclosure ($\Phi_{BW}(p)$) than with no wage disclosure ($\Phi_B(p)$). This fact follows directly from the expressions for $\Phi_{BW}(p)$ and $\Phi_B(p)$ derived in Appendix A. ■

References

- Admati, A. and P. Pfleiderer, 2000, "Forcing Firms to Talk: Financial Disclosure Regulation and Externalities," *Review of Financial Studies* 13: 479-519.
- Allen, F., 1990, "The Market for Information and the Origin of Financial Intermediation," *Journal of Financial Intermediation* 1:3-30.
- Altinkilic, O. and R. Hansen, 2000, "Are There Economies of Scale in Underwriting Fees? Evidence of Rising External Financing Costs," *Review of Financial Studies*, 13:191-218.
- Barber, B., R. Lehavy, M. McNichols, and B. Trueman, 2001, "Can Investors Profit from the Prophets? Consensus Analyst Recommendations and Stock Returns," *Journal of Finance* 56:773-806.
- Barber, B., R. Lehavy, M. McNichols, and B. Trueman, 2003, "Buys, Holds, and Sells: The Distribution of Investment Banks' Stock Ratings and the Implications for the Profitability of Analysts' Recommendations," mimeo, University of Michigan Business School.
- Benabou, R. and G. Laroque, 1992, "Using Privileged Information to Manipulate Markets: Insiders, Gurus, and Credibility," *Quarterly Journal of Economics* 107:921-958.
- Bhagat, S. and P. Frost, 1986, Issuing Costs to Existing Shareholders in Competitive and Negotiated Underwritten Public Utility Offerings," *Journal of Financial Economics* 15:233-259.
- Boot, A. and A. Thakor, 2001, "The Many Faces of Information Disclosure," *Review of Financial Studies*, 14: 1021-1057.
- Chan, L., J. Karceski, and J. Lakonishok, 2003, "Analysts' Conflict of Interest and Biases in Earnings Forecasts," mimeo, University of Florida.
- Chemmanur, T. and P. Fulghieri, 1994, "Investment Bank Reputation, Information Production, and Financial Intermediation," *Journal of Finance* 49: 57-79.

- Chen, H. and J. Ritter, 2000, "The Seven Percent Solution," *Journal of Finance* 55: 1105-1131.
- Chen, Z., 2003, "Buy-Side and Sell-Side: The Industrial Organization of Information Production in the Securities Industry," mimeo, The Wharton School, University of Pennsylvania.
- Cohen, L. and K. Kelly, 2003, "Loose Leash—NYSE Turmoil Poses Question: Can Wall Street Regulate Itself?," *The Wall Street Journal*, December 31, p. A1.
- Diamond, D., 1985, "Optimal Release of Information by Firms," *Journal of Finance* 40: 1071-1094.
- Dugar, A. and S. Nathan, 1995, "The Effect of Investment Banking Relationships on Financial Analyst's Earnings Forecasts and Investment Recommendations," *Contemporary Accounting Research* 12(1): 131-160.
- Fishman, M. and K. Hagerty, 1990, "The Optimal Amount of Discretion to Allow in Disclosure," *Quarterly Journal of Economics* 105: 427-444.
- Hansen, R. and P. Torregrosa, 1992, "Underwriter Compensation and Corporate Monitoring," *Journal of Finance* 47:1537-1555.
- Hong, H., J. Kubik, and A. Solomon, 2000, "Security analysts' career concerns and herding of earnings forecasts," *RAND Journal of Economics* 31: 121-144.
- Hong, H. and J. Kubik, 2003, "Analyzing the Analysts: Career Concerns and Biased Earnings Forecasts," *Journal of Finance* 58: 313-351.
- Inderst, R. and H. Mueller, 2003, "Internal Versus External Financing: An Optimal Contracting Approach," *Journal of Finance* 58:1033-1062.
- Jegadeesh, N., J. Kim, S. Krische, and C. Lee, 2003, "Analyzing the Analysts: When do Recommendations Add Value?," forthcoming, *Journal of Finance*.
- John, K., A. Saunders, and L. Senbet, 2000, "A Theory of Bank Regulation and Management Compensation," *Review of Financial Studies* 13: 95-125.

- Kroszner, R. and R. Rajan, 1994, "Is the Glass-Steagall Act Justified? A Study of the U.S. Experience with Universal Banking Before 1933," *American Economic Review* 84: 810-832.
- Laffont, J.-J. and J. Tirole, 1993, *A Theory of Incentives in Procurement and Regulation*, Cambridge, MA: MIT Press.
- Lemmon, M., S. Schallheim and J. Zender, 2000, "Do Incentives Matter? Managerial Contracts for Dual-Purpose Funds," *Journal of Political Economy* 108: 273-299.
- Lim, T., 2001, "Rationality and Analysts' Forecast Bias," *Journal of Finance* 56:369-385.
- Lin, H.-W. and M.F. McNichols, 1997, "Underwriting Relationships, Analysts' Earnings Forecasts, and Investment Recommendations," *Journal of Accounting and Economics* 25: 101-127
- Ljungqvist, A., F. Marston, and W. Wilhelm, 2003, "Competing for Securities Underwriting Mandates: Banking Relationships and Analyst Recommendations," mimeo, New York University.
- Michaely, R. and K. Womack, 1999, "Conflict of Interest and the Credibility of Underwriter Analyst Recommendations," *Review of Financial Studies* 12: 653-686.
- Milbourn, T., A. Thakor, and R. Shockley, 2001, "Managerial Career Concerns and Investments in Information," *RAND Journal of Economics* 32: 334-351.
- Morgan, J. and P. Stocken, 2003, "An Analysis of Stock Recommendations," *RAND Journal of Economics* 34: 183-203.
- Morgenson, G., 2003, "In Wall Street Hierarchy, Short Shrift to Little Guy," *The Wall Street Journal*, April 29, p. C.1.
- National Association of Securities Dealers, "Proposed Rule Regarding Research Analyst Conflicts of Interest," File No. SR-NASD-2002-21, February 8, 2002.
- New York Stock Exchange, "Disclosure and Reporting Requirements," Information Memo 02-24, May 20, 2002.

Puri, M., 1996, "Commercial Banks in Investment Banking: Conflict of Interest or Certification Role?", *Journal of Financial Economics* 40: 373-401.

Securities and Exchange Commission, "Commission Approves Rules to Address Analyst Conflicts," press release, May 8, 2002.

Securities and Exchange Commission, "Final Rule: Regulation Analyst Certification," Release Nos. 33-8193; 34-47384, April 14, 2003.

Shelby, Sen. Richard, Opening Statement, *Congressional Hearings on the Impact of the Global Settlement*, May 7, 2003.

Stickel, S., 1992, "Reputation and Performance Among Security Analysts," *Journal of Finance* 47:1811-1836.

Trueman, B., 1994, "Analyst Forecasts and Herding Behavior," *Review of Financial Studies* 7: 97-124.

Valdmanis, T., 2002, "Reform Could be Bitter Pill for Street; Fixing System's Checks, Balances Could be Costly," *USA Today*, October 23, p. B.01.

"Wall St. Faces Tough Rules," *Money*, February 7, 2002.

Welch, I., 2000, "Herding among security analysts," *Journal of Financial Economics* 58: 369-396.

Womack, K., 1996, "Do Brokerage Analysts' Recommendations Have Investment Value?", *Journal of Finance* 51:137-167.

Yeoman, J., 2001, "The Optimal Spread and Offering Price for Underwritten Securities," *Journal of Financial Economics* 62: 169-198.