Incentives for Accuracy in Analyst Research

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Abstract

This paper proposes a model to analyze the dynamic relations between incentive contracts and analysts' effort in providing accurate research when both ethical and reputational concerns matter. First, we show that reputation picks up ability and thus serves as a sorting device: when analysts have a relatively low reputation for providing research quality (below a threshold level) banks find it more profitable to offer a mix of monetary and non monetary (ethic based) incentives and rely on the analyst's work ethic in ordre to provide research quality. Alternatively, when analysts have a high reputation, full financial (performance based) incentives contracts offer a substantial reward for their contribution to the firm's profits. Second, we find that the design of compensation contracts, in the presence of reputational concerns and work ethic, may lead to incentive problems: full financial incentives contracts may exacerbate conflicts of interest by giving analysts extrinsic rewards on reporting, thereby inducing them to prefer high short term benefits to the detriment of long term research and coverage effort. On the contrary, a mix of monetary and non monetary rewards based on the analyst's work ethic may allow them to resist pressures from conflicts of interest and induces a high research effort thus enhancing long-run reputation.

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Keywords: Motivation, Reputation, Reporting, Investment analysts.

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1 Introduction

We propose a theoretical model to analyze the impact of incentives arising from compensation contracts on the dynamic reporting behavior of security analysts, in the presence of reputational and ethical concerns. The recent scandals in Wall Street research that followed the bursting of the dot-com bubble has led to an examination of the perverse role of analysts incentives in providing biased research. Therefore, the issue of how the nature of incentives affects analysts' research and coverage effort is important and relevant.

In this paper, we focus on the trade-off between short run revenues and long run research quality (and hence reputation) in a context where incentives may be financial (based on performance) and non financial (based on a standard for accuracy). A large number of studies have documented conflicts of interest for analysts and their impact on the quality of securities research.[1] For instance, analysts may seek to win lucrative underwriting business by issuing optimistic research about current or potential clients. In turn, providing biased research undermines analysts reputation with investors. From this perspective, analysts might sacrifice their reputation for providing valuable information to investors when confronted with sufficiently valuable short-term payoff.[2]

The design of compensation contract offered to analysts then requires a specific attention to analyze the sources of conflict of interest in analyst research. In particular, both long term reputational concerns as well as short term incentives matter. A growing literature in agency theory points out that there may be hidden costs of pure monetary incentives, especially when individuals are intrinsically motivated to do a good job (see e.g. Benabou and Tirole, 2003; Lindeberg, 2001; Deci and Ryan, 1985; Frey et al., 1997; Kreps, 1997). We borrow from this literature the idea that incentives may be designed over monetary as well as non monetary dimensions, in particular by taking work ethic into consideration (see e.g. Noe and Rebello, 1994; Carlin and Gervais, 2009). In general, ethic and intrinsic motivation to exert an effort is private information and can not be contracted upon. As such, the firm must design compensation contracts allowing the screening of agents and motivating

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[1] See Mehran and Stultz (2007) for a review of conflicts of interest in general. Dugar and Nathan (1995), Lin and McNichols (1998), Dechow et al. (2000), Michaely and Womack (1999), and Chan et al. (2007) document conflicts of interest arising from investment-banking activity. Irvine (2001, 2004), Cowen et al. (2006), Hong and Kubik (2003) and Agrawal and Chen (2008) discuss conflicts of interest created by the incentives to generate trade commissions. The remaining agency conflict is caused by the desire of analysts to stay on friendly terms with management (see Lim (2001), Das et al. (1998), and Francis and Philbrick (1993).

[2] See Jakson (2005) for theoretical discussion of analysts' trade-offs and reputation, Fang and Yasuda (2009a) and Ljungqvist et al. (2006) for empirical analysis.

them in accordance with their ethical preferences. Following Heinle and Hoffman (2007), we therefore consider that analysts may experience ethical distress whenever their action choices deviate from a standard or norm as specified in the employment contract. The analyst's activity is a complex set of tasks: data collection, company visits, writing forecasts that will contribute to the firm's attractiveness, etc. To account for these elements, we decompose the analyst's activity into two sequential efforts: first, a research and coverage effort, and second, a reporting effort.[3] In addition, we consider that the analyst's effort to achieve high quality reporting will be tied to non monetary (ethical distress) or monetary incentives. The incentive structure on the report's quality can be interpreted as follows. If, the analyst is likely to invest in research quality, then financial incentives over accuracy are useless. Otherwise, the employer may offer performance-based incentives for the overall reporting effort (i.e. the production of forecasts and their accuracy). In that case, the analyst's compensation is tied to both the generation of forecasts and recommendations, and the quality of the research provided to the investors. Therefore, we build on the premise that a conflict of interest arises due to substantial monetary awards on reporting; if there is a large amount of money at stake -due to incentives-, which manifests itself as business-generated revenues, the temptation to forgo the research quality is high. Finally, the trade-off faced by firms in designing compensation contracts that incorporate monetary and non monetary (ethic based) incentives over the report's quality is analyzed in a dynamic setting with long term reputation building concerns.

Our focus on how incentive contracts affect the analyst's reporting effort by taking reputation and work ethic into account generates several predictions. First, we show that reputation picks up ability and thus serves as a sorting device: when analysts have a relatively low reputation for providing research quality (below a threshold level), banks find it more profitable to offer a mix of monetary and non monetary (ethic based) incentives, and to rely on the analyst's work ethic to provide research quality. Alternatively, when analysts have a high reputation for providing research quality, then banks will offer full financial incentives contracts. These results are consistent with empirical evidence on the relation between pay and performance (see e.g. Stickel, 1992, and Michaely and Womack, 1999). We contribute to this literature by showing that analysts use their forecasts as a tool to develop their reputation as long as the compensation contract values the reputation sufficiently. As

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[3]The research and coverage effort relates to the information gathering process (including earnings and other information from SEC filings, industry and macroeconomic conditions and conference calls and other management communications). The reporting effort relates to the outputs from analyst research (including earnings forecasts, target price forecasts, stock recommendations and reports describing firms' prospects).

mentioned, banks offer the performance based contract to attract talented analysts and reward their contribution to the firm's profits (i.e. analysts with an established reputation are better incentivized than other analysts). Alternatively, if analysts are less accurate, then their compensation is lower. The incentives of analysts therefore capture skills.

Second, we find that the design of compensation contracts, in the presence of reputational concerns and work ethic, may lead to incentive problems. In particular, full financial incentives contracts appear to exacerbate conflicts of interest by giving analysts extrinsic rewards on research quality, thereby inducing a lower research and coverage effort. Further financial incentives induce analysts to prefer high short term benefits to the detriment of long term reputation. On the contrary, a mix of monetary and non monetary rewards based on the analyst's work ethic induces a high research effort thereby enhancing a long-run reputation. Overall, while full financial incentives contracts tend to be harmful for both long-run reputation and research quality, mixed incentives contracts may play a mitigating role in analyst conflicts translating into a high research-reputation equilibrium. By focusing on compensation structures that provide adequate incentives to analysts in order to avoid exploiting conflicts of interest we contribute to the literature on career concerns and incentives (see e.g. Hong and Kubik, 2003; Jackson, 2005; Ljungqvist et al., 2007, Fang and Yasuda, 2009b). In particular, we endogenously derive the incentive structure of the analyst by modeling the interaction between the investment bank and the analyst, when both reputational and ethical concerns matter. We show that implicit incentives arising from the presence of ethical concerns play a crucial role in inducing analysts to resist pressure from conflicts of interest. Our theory indicates that without ethical considerations at stake, the attraction of lucrative compensation and then the temptation to liquidate reputation for profits are stronger for reputable analysts.

The remainder of the paper is organized as follows. Section 2 presents the model. Section 3 presents the equilibrium behaviors of agents. Section 4 analyzes the stationary equilibrium and discusses the main results of the paper. Section 5 concludes.

2   The Model

2.1   General Set-Up

The economy is populated by overlapping generations of individuals who live for two periods. The size of the population is constant. We index by $t + 1$ the generation

born in t. Each generation consists of two classes of agents: employers (investment bankers, brokers or any institution employing financial analysts) and financial analysts. There is a continuum of mass 1 of financial analysts and a continuum of mass 1 of employers. Analysts are randomly matched one-to-one with employers for the duration of their lifetime.[4] We model the relationship between the employer and the analyst as a principal-agent relationship with moral hazard due to imperfect observability of the analyst's effort.[5]

For simplicity (and without loss of generality), we assume that analysts do not consume in the first period, receive a wage only in the second period and do not save or leave bequests (they consume their entire earnings).

The analyst activity is a complex set of tasks that include research and coverage (data collection, calls, company visits, meetings, and contact with the company's managers etc.), reporting (writing forecasts and recommendations) and contributing to the firm's attractiveness both with existing and potential clients. In this paper, we consider two sequential activities. In the first period, the analyst provides a research and coverage effort, and in the second period he exerts a reporting effort.[6] Incentives in the second period are designed over two dimensions: producing a report and meeting a standard for quality or accuracy. Producing the report is subject to usual financial incentives, but meeting the standard for quality or accuracy is subject either to non-financial, (intrinsic) incentives, or to explicit financial (performance-based, extrinsic) incentives. The analyst's task in the second period hence consists of a principal task -the reporting effort- and a secondary task -meeting a quality standard. The "secondary" dimension of the reporting effort can be interpreted as follows. The employer may offer performance-based incentives for the overall reporting effort (i.e. the production of the report and its quality). Yet, if the employer believes that the analyst will invest in research quality and provide reports likely to meet the accuracy standards, then financial incentives over quality are useless. The distinction between principal and secondary activities stems from the differences in the nature of incentives and is tied to the design of compensation contracts. This is formalized as follows.

The contractual relationship between the employer and the analyst is subject to imperfect observability of the analyst's effort. Hence, the employer has to

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[4]This corresponds to high mobility costs. Relaxing this assumption and letting analysts change for a different employer would not alter the basic results of our paper.

[5]For the rest of this paper we will use "she" to refer to the principal (the bank) and "he" to refer to the agent (the analyst).

[6]Such a sequentiality is observed in practice.

design a contract that helps solving the moral hazard problem. In practice, there is a large set of rewarding tools and the analysts' compensation package is quite complex.[7] According to the 2003 analyst settlement, banks must tie an analyst's compensation to his reporting activity rather than to the amount of investment-banking revenues generated. These two components of an analyst's compensation may create conflicting incentives. At the individual level, banks face a trade-off between short-term profit arising from increased trading volume and long-term reputation. Analysts also face a trade-off between a loss in long-term reputation and a gain in short-term benefits, such as underwriting-related revenues. The relation between reputation and research quality implies that banks and other firms employing financial analysts may propose different compensation contracts.[8] In this paper, we focus on two sets of compensation tools: purely monetary incentives (performance-based compensation) and non-monetary incentives (based on an accuracy standard for analysts' reports).

Precisely, all contracts offer financial incentives for the (second period) reporting effort.[9] Yet, one class of contracts offers further financial incentives on the report quality or accuracy while another class of contracts relies on non financial incentives to provide research accuracy. In the first type of compensation contract, the monetary wage is conditional upon performance over both reporting and report accuracy. In the second type of contract, the monetary wage is conditional upon performance over the reporting task only and non financial incentives are designed over the quality or accuracy of the report.[10] The basic structure of the model (types of contracts available and sequence of events) are defined with precision as follows.

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[7]Groysberg, Healy and Maber (2008) report that analysts' compensation is generally based on three types of indicators: *'input metrics'* (experience, being homegrown or externally hired, and the type of firms assigned to analysts for coverage - trading volume for instance), *'process metrics'* (client calls, meetings, interactions and company visits as well as the number of stock initiations meant to generate new business opportunities), and *'output metrics'* (client feedbacks, investment banking business generated for the bank, commissions earned for stocks covered, and performance of analysts' stock recommendations).

[8]The analyst's effort also depends on the analyst's concerns for productivity (or human capital) and reputation. We will therefore also consider that the analyst's research effort in the first period has an impact both on his reputation and productivity in the second period.

[9]Note that our results would not be altered if we consider that analysts receive a fixed reservation wage at the end of the first period.

[10]Concerning the different rewarding tools documented by Groysberg, Healy and Maber (2008), we focus here on a limited number of determinants (or 'metrics'): the analyst's human capital ('input metrics'), the research and coverage effort ('process metrics' - imperfectly observable by the bank), and the analyst's performance in providing high quality forecasts and recommendations ('output metrics' - imperfectly observable).

Sequence of Events:

    Period t

- A new generation of financial analysts and employers is born. Each type of agent lives for two periods.

- Financial analysts and employers are matched one-to-one randomly.

- The analyst uses his unit time endowment to exert an effort of research and coverage, θ_t

    Period $t+1$

- The employer offers a contract Ω_{t+1}^i to the analyst, $i = M, F$ (see definition 1),

- The analyst accepts or rejects the contract

- The analyst exerts a reporting effort which is imperfectly observable by the employer.

- At the end of period $t+1$ output is observed by both parties and payments are realized (conditional upon verifiable output).

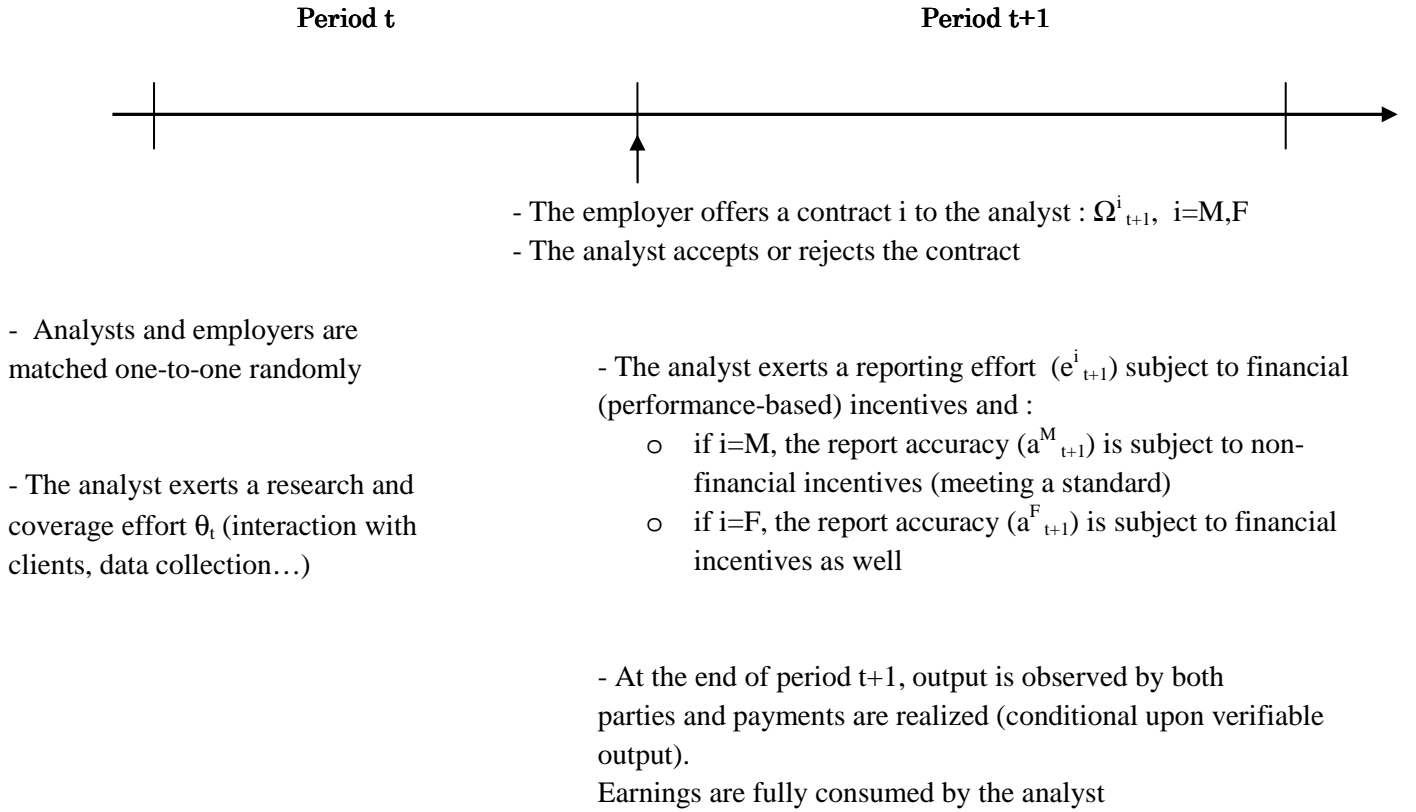The timing of events is summarized in Figure 1.

Definition 1. Incentives Contracts

We denote by Ω^i_{t+1}, $i = M, F$, the contract offered by the employer in the beginning of period $t+1$. This contract is either a 'mixed incentives' contract (M-contract) or a 'financial incentives' contract (F-contract):

1. *A 'mixed incentives' contract $\Omega^M_{t+1} = (w^M_{t+1}, e^M_{t+1}, a^M_{t+1})$ is such that the analyst receives a monetary wage w^M_{t+1} (financial performance-based incentives) for his reporting effort, e^M_{t+1} and has to meet a standard for accuracy a^M_{t+1} (non-financial, non-performance based incentives). In the M-contract, the agent's output is evaluated only with respect to the reporting effort.*

2. *A 'full financial incentives' contract $\Omega^F_{t+1} = (w^F_{t+1}, e^F_{t+1}, a^F_{t+1})$ is such that a monetary wage w^F_{t+1} compensates the analyst for both the reporting effort, e^F_{t+1} and the report accuracy or quality, a^F_{t+1}. In the F-contract, the agent's output is evaluated with respect to both the reporting effort and the report accuracy.*

The equilibrium values of w, e and a characterizing each type of contracts are computed in Section 3.

Figure 1. Timing of the Contractual Relationship between Banks and Analysts

Period t   Period t+1

- The employer offers a contract i to the analyst : Ω^i_{t+1}, i=M,F
- The analyst accepts or rejects the contract

- Analysts and employers are matched one-to-one randomly

- The analyst exerts a reporting effort (e^i_{t+1}) subject to financial (performance-based) incentives and :
    o if i=M, the report accuracy (a^M_{t+1}) is subject to non-financial incentives (meeting a standard)
    o if i=F, the report accuracy (a^F_{t+1}) is subject to financial incentives as well

- The analyst exerts a research and coverage effort θ_t (interaction with clients, data collection…)

- At the end of period t+1, output is observed by both parties and payments are realized (conditional upon verifiable output).
Earnings are fully consumed by the analyst

Note:

A contract offer may be of two types (see definition 1):
− an 'incentives mix' contract $\Omega^M_{t+1}=(w^M_{t+1}, e^M_{t+1}, a^M_{t+1})$, where w^M_{t+1} is the wage paid to compensate the analyst for his reporting effort e^M_{t+1} and a^M_{t+1} is a standard set by the employer for the accuracy of the report.
− a 'financial incentives' contract $\Omega^F_{t+1}=(w^F_{t+1}, e^F_{t+1}, a^F_{t+1})$, where w^F_{t+1} is the wage paid to compensate the analyst for his reporting effort e^F_{t+1} and standard quality a^F_{t+1} .

2.2 Analysts' Intertemporal Utility and Productivity

In each period, a generation of analysts is born and lives for two periods. The analyst's intertemporal utility is defined over leisure time and consumption.[11] In the first period of life, the analyst uses his unit time endowment to exert a research and coverage effort denoted by θ_t. The effort cost in the first period is simply a time cost. In the second period, the analyst's consumption level is denoted by c_{t+1}. The analyst receives a wage only in period $t+1$ and do not consume in the first period.[12]

The *intertemporal utility function* of an analyst member of generation $t+1$ (born in t) is then given by:

$$u_{t+1} = \log(1 - \theta_t) \ + \ \log c_{t+1} \tag{1}$$

with $1 - \theta_t$ the first period leisure time and c_{t+1} the second period consumption.

The analyst's productivity in $t+1$, ρ_{t+1} depends on two arguments: the research and coverage effort in period t, θ_t and the previous period productivity level, ρ_t:

$$\rho_{t+1} = \rho(\theta_t, \rho_t) \tag{2}$$

where $\rho(.,.)$ is increasing in both arguments, differentiable and concave.

Budget constraint:
The analyst receives a wage only in period $t+1$ and do not consume in the first period. The budget constraint therefore writes $c_{t+1} \leq \omega_{t+1}$ where ω_{t+1} is the expected wage (net of effort costs) in period $t+1$. Since entire earnings are consumed in the second period (there are no savings or bequests), substituting for c_{t+1} in the intertemporal utility leads to the following utility function:

$$u_{t+1} = \log(1 - \theta_t) \ + \ \log(\omega_{t+1}) \tag{3}$$

2.3 Analysts' Reputation

The role of personal reputation in determining forecasts accuracy and the relationship between pay and performance have been documented by Fang and Yasuda

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[11]This is a basic assumption in overlapping generations models.

[12]Equivalently we can consider the analyst receives a fixed wage in period t and normalizes it to his reservation wage.

(2009). The authors show that analysts working at top-tier banks receive higher compensation packages and are more accurate than analysts working at lower-status banks. In this paper, we rely on these elements to model the analyst's reputation and analyze how it affects the bank's choice of compensation contract and the analyst's reporting effort.

At the beginning of period $t + 1$ the bank offers a compensation contract to the analyst. This means the bank needs some information available regarding the analysts' types. Indeed, analysts can be categorized according to information available on them at that time. Information on an analyst's type depends on the history of his observed productivity levels.[13] At the beginning of time $t + 1$, the productivity level of an analyst includes information about his research and coverage effort and past productivity for periods previous to $t + 1$. In the simple model presented here, we assume therefore and without loss of generality, that if an analyst produced high quality research in period t, he is placed in the high-productive type in period $t + 1$. That is, it is thought more likely that the analyst provides informative research. Let ρ_{t+1} be the publicly observable productivity level of a high-productive analyst after he has exerted a research effort and before the disclosure of the report. Alternatively, an analyst who produced lower quality research is placed in the low-productive type, $(1 - \rho_{t+1})$.[14] This information allows the bank to update its beliefs about an analyst's research quality using Bayes' rule, wherever possible.

Let us denote by π_{t+1} the probability, as perceived by banks, that the analyst provides high quality research given the analyst's public research quality (or productivity) history. The reputation of analysts which provide high quality research is updated according to:

$$\pi(\rho_{t+1}) = \frac{\rho_{t+1}}{\rho_{t+1} + (1 - \rho_{t+1})\eta} \qquad (4)$$

The numerator is the proportion of high-productivity analysts who provide high quality research, and the denominator is the total proportion of analysts who issue informative research. Equation (4) follows from the fact that high-productivity analysts always provide informative reports, while low-productivity analysts provide informative reports with probability η in any given period.

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[13] The academic literature that analyzes the accuracy of analysts' earnings forecasts as a function of experience and past accuracy includes Stickel (1992), Clement (1999) and Jackson (2005).

[14] For a formal presentation of this result see Aron (1987).

2.4 Output and Incentives in the Second Period

At the beginning of the second period the firm offers a compensation contract to the analyst who may accept or reject it. Two types of contracts are available: an incentive mix contract (on reporting) or a pure financial incentive contract (on both the reporting effort and the report quality). The objective of the firm is to design the contract in a way acceptable by the analyst (i.e. participation is ensured) and inducing the analyst to exert the maximal effort level (i.e. it is incentive compatible).

The analyst's effort in the second period consists of a principal task - reporting - and a requirement over the quality or accuracy of the report. The incentives structure of the model corresponds to a variant of the linear multi-tasks agency framework first developed by Holmström and Milgrom (1987, 1991).[15]

Incentives Structure of both Types of Contracts

With a linear multi-tasks incentives scheme, the optimal contract is designed as follows: the principal determines the linear compensation (a fixed transfer plus a variable component expressed with respect to the analyst's observable output) that maximizes his/her expected profits, given that effort(s) is(are) chosen by the analyst so as to maximize his/her expected utility.

Let denote by y_{t+1}^i the analyst's observable output in the contract i, $i = M, F$. This output depends on the reporting effort e_{t+1}^i and, as described in definition 1:

· In the F-contract, output is also measured with respect to the accuracy of the report a_{t+1}^F

· In the M-contract, output depends only on the reporting effort e_{t+1}^M, and not on the standard for accuracy a_{t+1}^M.

Since effort is imperfectly observable, outputs under each contract are defined by:

$$
\begin{align}
y_{t+1}^M &= e_{t+1}^M + \varepsilon_{t+1}^M \tag{5}\\
y_{t+1}^F &= e_{t+1}^F + a_{t+1}^F + \varepsilon_{t+1}^F \tag{6}
\end{align}
$$

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[15]This model has been extensively used to analyze multi-tasks agency relationships almost exclusively under the assumption of constant absolute risk aversion: in this linear-exponential-normal (LEN) model agents have a negative exponential utility, see e.g. Itoh, 1994 or Feltham and Xie, 1994). Given the intertemporal utility function (3), our approach extends this class of models with linear compensation schemes to agents with decreasing absolute risk aversion (constant relative risk aversion).

where ε_{t+1}^{M} and ε_{t+1}^{F} are random noises capturing imperfect observability of effort such that $\varepsilon_{t+1}^{M} \rightsquigarrow N(0, (\sigma^{M})^{2})$ and $\varepsilon_{t+1}^{F} \rightsquigarrow N(0, (\sigma^{F})^{2})$.

Let denote by C_{t+1}^{i} the analyst's cost of efforts under a contract $i = M, F$. The analyst's expected wage net of effort costs, ω_{t+1}^{i}, and the risk-neutral firm's expected profits, B_{t+1}^{i}, write respectively:

$$
\begin{aligned}
\omega_{t+1}^{i} &= E(w_{t+1}^{i}) - C_{t+1}^{i} \quad \forall i = M, F & (7) \\
B_{t+1}^{i} &= \pi(\rho_{t+1}).E(y_{t+1}^{i}) - E(w_{t+1}^{i}) \quad \forall i = M, F & (8)
\end{aligned}
$$

with $\pi(\rho_{t+1})$ the analyst's reputation, $E(y_{t+1}^{i})$ the analyst's expected output and where the expected wage $E(w_{t+1}^{i})$ received by the analyst is defined as follows. Under a linear incentive scheme, the wage received by the analyst at the end of period $t + 1$ is linear in the expected observable performance measure:

$$
E(w_{t+1}^{i}) = \alpha_{t+1}^{i}.E(y_{t+1}^{i}) + \beta_{t+1}^{i} \quad \forall i = M, F \qquad (9)
$$

where α_{t+1}^{i} and β_{t+1}^{i} are respectively the variable part ('piece rate') and the fixed part of the compensation to be determined by the firm in such a way that the maximum effort levels are chosen by the analyst in equilibrium.

We now define effort costs under both types of contracts. All variables in the second period are indexed by $t+1$. Hence, for the sake of simplicity, we now therefore omit the time period indexes $t + 1$ when they are not necessary. We do this throughout the text when no confusion arises, and we reintroduce the time period indexes later on.

Mixed Incentives Contract (M-contract)

Under the M-contract, the firm sets a standard for the report's accuracy and compensates financially the analyst only for his (unobservable) reporting effort. The analyst's overall *observable output* is defined by equation (5) : $y^{M} = e^{M} + \varepsilon^{M}$, with $\varepsilon^{M} \rightsquigarrow N(0, (\sigma^{M})^{2})$, and the *wage compensation* defined in equation (9) is linear: $E(w^{M}) = \alpha^{M}.E(y^{M}) + \beta^{M} = \alpha^{M}.e^{M} + \beta^{M}$.

The *effort costs* depend on the reporting effort as well as on the standard for accuracy. The standard set by the principal establishes the quality or accuracy requirement over the reporting effort. Though no monetary sanctions or rewards are attached to meeting the standard, any deviation from it by the analyst imposes a

personal cost. This formulation allows us to capture the analyst's implicit incentives to meet the standard. The effort cost function hence writes

$$C^M(e^M, a^M) = \frac{1}{2}(e^M)^2 + \frac{\lambda}{2}(e^M - a^M)^2 \tag{10}$$

where $0 < \lambda < 1$ measures the importance of meeting the standard required by the bank. Intuitively, the higher λ, the higher the cost of not meeting the standard for the analyst. Hence, λ measures the pressure felt by the analyst when having to meet the standard and can be interpreted as an "ethical distress" (corresponding to a norm adhesion motive or work ethic).[16]

Full Financial Incentives Contract (F-contract)

Under the F-contract, the firm compensates the analyst for his reporting effort as well as for the report accuracy. The analyst's overall *observable output* is defined by equation (6): $y^F = e^F + a^F + \varepsilon^F$, with $\varepsilon^F \rightsquigarrow N(0, (\sigma^F)^2)$, and the *wage compensation* defined in equation (9) is linear: $E(w^F) = \alpha^F.E(y^F) + \beta^F = \alpha^F.(e^F + a^F) + \beta^F$.

The *effort costs* depend on the reporting effort as well as on the effort to increase the report accuracy or quality. Both tasks are interdependent in the cost function and the effort cost then writes

$$C^F(e^F, a^F) = \frac{1}{2}(e^F)^2 + \frac{1}{2}(a^F)^2 + \mu.e^F.a^F \tag{11}$$

where $-1 < \mu < 1$ measures the degree of complementarity between the two types of efforts (reporting and achieving high accuracy). Since $\frac{\partial^2 C^F(.,.)}{\partial e^F \partial a^F} = \frac{\partial^2 C^F(.,.)}{\partial a^F \partial e^F} = \mu$, the higher μ, the higher the marginal cost of increasing effort at both tasks. A higher level of μ hence corresponds to a higher (that is more costly) conflict of interest between both tasks for the analyst. When $-1 < \mu < 0$, the two efforts (reporting and achieving high accuracy) are relative complements: an increase in one effort, all else being equal, reduces the marginal cost of the other effort. This situation arises when quantity and quality are relative complement, for instance because the analyst has a very good knowledge of the businesses evaluated. On the contrary, when $0 < \mu < 1$, the two efforts are relatively substitutable: an increase in one effort, all else being equal, increases the marginal cost of the other effort. This situation may arise when quantity and quality are substitutable, for instance because the analyst has to evaluate many businesses and this is detrimental to the accuracy of the report on a stock.

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[16]We borrow from Heinle and Hoffmann (2007) such a disutility for not meeting a standard.

The contractual relationship between the firm and the analyst under both types of contracts is summarized in Appendix 6.1.

We now characterize the equilibrium variables of each contract.

3 Equilibrium

The equilibrium of this economy is solved backward: first, we determine the optimal second period contract and then present the optimal research effort in the first period.

3.1 Second Period Equilibrium

For each incentive contract, the equilibrium values of effort and wages are determined as follows: the firm determines the equilibrium wage compensation (fixed transfer and piece rate) that maximizes its expected profits, anticipating that the effort chosen by the analyst will maximize his/her expected utility. The corresponding equilibrium values are defined as follows (for detailed computations see appendix 6.2).

• Mixed incentives contract, $\Omega_{t+1}^M = (w_{t+1}^M, e_{t+1}^M, a_{t+1}^M)$:

$$
\begin{align}
e_{t+1}^M &= \pi(\rho_{t+1}) - \Psi_{t+1}^M \tag{12} \\
a_{t+1}^M &= \pi(\rho_{t+1}) \tag{13} \\
E(w_{t+1}^M) &= \frac{(\pi(\rho_{t+1}))^2}{2} - \frac{(\Psi_{t+1}^M)^2(1+\lambda)}{2} \tag{14} \\
B_{t+1}^M &= \frac{(\pi(\rho_{t+1}))^2}{2} - \pi(\rho_{t+1}).\Psi_{t+1}^M + \frac{(\Psi_{t+1}^M)^2(1+\lambda)}{2} \tag{15}
\end{align}
$$

where $\Psi_{t+1}^M = \frac{\sigma_{t+1}^M}{\sqrt{2}}$.

- Financial incentives contract, $\Omega_{t+1}^F = (w_{t+1}^F, e_{t+1}^F, a_{t+1}^F)$:

$$e_{t+1}^F = a_{t+1}^F = \frac{\pi(\rho_{t+1})}{1+\mu} - \frac{\Psi_{t+1}^F}{2} \tag{16}$$

$$E(w_{t+1}^F) = \frac{(\pi(\rho_{t+1}))^2}{1+\mu} - \frac{(\Psi_{t+1}^F)^2(1+\mu)}{4} \tag{17}$$

$$B_{t+1}^F = \frac{(\pi_{(\rho_{t+1})})^2}{1+\mu} - \pi(\rho_{t+1}).\Psi_{t+1}^F + \frac{(\Psi_{t+1}^F)^2(1+\mu)}{4} \tag{18}$$

where $\Psi_{t+1}^F = \frac{\sigma_{t+1}^F}{\sqrt{2}}$.

To analyze which type of contract will be offered, we compare the firm's expected profits. To simplify the analysis, we make the two following assumptions.

Assumption 1: Identical Variance Parameters

$$\sigma_t^F = \sigma_t^M = \sigma_t \quad \forall t \tag{19}$$

This assumption illustrates that additional effort to achieve a high report accuracy does not change the variance of the analyst's output, and therefore does not improve the performance measure of the reporting effort. This restriction allows a comparison of both types of contracts by considering that the variability of output remains the same, while the analyst's expected output and costs are different.

Assumption 2: The parameters are such that

$$\frac{\sigma_t}{2}\sqrt{\frac{1+\mu}{2}\frac{1-\mu+2\lambda}{1-\mu}} < 1 \quad \forall t \tag{20}$$

This assumption ensures that $0 < \bar{\rho}_{t+1} < 1$ (see proposition 1 below).

Comparing the firm's expected profits under the M- and F- contracts leads to the following result:

Proposition 1. *Under Assumption 1 and 2, the equilibrium contract that maximizes the firm's expected profits $B_{t+1}^i(i = M, F)$ is the mixed incentives contract (M-contract) $\Omega_{t+1}^M = (w_{t+1}^M, e_{t+1}^M, a_{t+1}^M)$ iff the analyst's productivity is below the threshold level $\bar{\rho}_{t+1}$: $\rho_{t+1} < \bar{\rho}_{t+1} = \frac{\Xi.\Psi_{t+1}.\eta_{t+1}}{1+\Xi.\Psi_{t+1}.(\eta_{t+1}-1)}$ where $\Xi = \sqrt{\frac{1+\mu}{2}\frac{1-\mu+2\lambda}{1-\mu}}$ and $\Psi_{t+1} = \frac{\sigma_{t+1}}{\sqrt{2}}$; and the financial incentives contract (F-contract) $\Omega_{t+1}^F = (w_{t+1}^F, e_{t+1}^F, a_{t+1}^F)$ otherwise.*

with $\Psi_{t+1} = \frac{\sigma_{t+1}}{\sqrt{2}}$ and where $w_{t+1}^i, e_{t+1}^i, B_{t+1}^i, a_{t+1}^i$, $i = F, M$ are defined by equations (12) to (18).

Proof: Using (15) and (18) we have:

$$B_{t+1}^M - B_{t+1}^F = \frac{(\pi(\rho_{t+1}))^2}{2} \frac{\mu - 1}{\mu + 1} + \frac{\Psi_{t+1}^2}{4}(1 - \mu + 2\lambda)$$

Given that $-1 < \mu < 1$, we then easily show that $B_{t+1}^M - B_{t+1}^F > 0$ iff $(\pi(\rho_{t+1}))^2 < \Psi_{t+1}^2 \frac{1+\mu}{2} \frac{1-\mu+2\lambda}{1-\mu}$, that is: $\pi(\rho_{t+1}) < \bar{\pi}_{t+1} = \Psi_{t+1}\sqrt{\frac{1+\mu}{2} \frac{1-\mu+2\lambda}{1-\mu}}$

Given equation (4), this condition writes: $\rho_{t+1} < \bar{\rho}_{t+1} = \frac{\Xi.\Psi_{t+1}.\eta_{t+1}}{1+\Xi.\Psi_{t+1}.(\eta_{t+1}-1)}$ where $\Xi = \sqrt{\frac{1+\mu}{2} \frac{1-\mu+2\lambda}{1-\mu}}$ and $\Psi_{t+1} = \frac{\sigma_{t+1}}{\sqrt{2}}$.

$\square$

Under the mixed incentives contract (M-contract), financial incentives are given on the reporting effort exclusively while the F-contract gives financial incentives on both reporting and accuracy. As such, proposition 1 states that when analysts have a relatively low reputation for providing research quality (below the threshold $\bar{\pi}_{t+1}$) banks find it more profitable to offer a mixed incentives contract and rely on the analyst's intrinsic motivation (work ethic) to meet the accuracy standards. Alternatively, when analysts have a reputation for providing high quality research, the F-contract offers a substantial reward for their contribution to the firm's profits.

Proposition 1 suggests that analysts' productivity and status influences the design of incentive contracts. Specifically, we find that reputation picks up analysts' ability and is associated with higher compensation. This finding is consistent with empirical evidence on the relation between pay and performance for financial analysts (see e.g. Eccles and Crane, 1988, Stickel, 1992). In this paper, incentives to provide reports and forecasts accuracy depend further on analysts' reputational concerns and productivity. Fang and Yasuda (2009a) for example, find that banks pay higher wages to attract talented analysts, and analysts with higher abilities are more likely to be hired by reputable banks and are better incentivized. In our model, the financial incentives contract enables the investment bank to bring an analyst a substantially high compensation. By doing so, it acknowledges an analyst's prestige. Consistent with evidence showing that star analysts earn substantially higher salaries than lower-status analysts, our analysts with an established reputation for producing high-quality research are better incentivized, i.e. are offered the F-contract. This result is consistent with the notion that reputation is an indicator

of ability or skill. In other words, reputation has a sorting effect in that analysts with superior ability or access to information has a high reputation for providing high quality research. Yet, the lucrative compensation tied to analysts' performance creates conflicting incentives, and the literature has examined the effectiveness of the reputation as a disciplinary device against conflicts of interest (see e.g. Ljungqvist et al., 2007, and Fang and Yasuda, 2009b). Jackson (2005) for example, shows that when analysts interact repeatedly with investors and trade off short-term incentives against the long-term gains from building a good reputation, more accurate analysts acquire higher future reputation.[17] These results echo our finding from proposition 1, namely that, because non-reputable analysts need to build a reputation for producing research quality, banks can rely on their intrinsic motivation to meet the required standard in terms of accuracy, and hence will offer a M-contract.

Given the second period's contractual variables determined previously, we compute the first period equilibrium research effort.

3.2 First Period Equilibrium

Given (3) and (2), the analyst's research effort is determined according to the following program:

$$\max_{\theta_t} \ln(1 - \theta_t) + \ln(\omega_{t+1}^i)$$
$$s.t. \quad \rho_{t+1} = \rho\left(\theta_t, \rho_t\right)$$

where ω_{t+1}^i, $i = M, F$ are given by equations (14) and (17).

This program leads to the following condition:

$$\frac{1}{1 - \theta_t} = \frac{\partial(\ln \omega_{t+1}^i)}{\partial \rho_{t+1}} \cdot \frac{\partial \rho_{t+1}}{\partial \theta_t} \tag{21}$$

where

$$\frac{\partial(\ln \omega_{t+1}^i)}{\partial \rho_{t+1}} = \frac{\partial \omega_{t+1}^i / \partial \rho_{t+1}}{\omega_{t+1}^i}$$

for $i = M, F$

---

[17]The relation between analyst reputation and earnings forecasts has been extensively studied (see, for example, Stickel (1992), Cowen, Groysberg, and Healy (2006), Hong and Kubik (2003)). These papers find a positive relation between the research quality and analyst reputation.

To obtain analytical results, we shall consider a specific functional form concerning the analyst's productivity in $t + 1$, defined by equation (2). We therefore assume that

$$\rho_{t+1} = A_t.(\theta_t)^\gamma.(\rho_t)^{1-\gamma} \tag{22}$$

where $0 < A_t \leq 1$ is an efficiency parameter and $0 < \gamma < 1$.

In turn, $\partial\rho_{t+1}/\partial\theta_t = \gamma\rho_{t+1}/\theta_t$. Condition (21) then writes: $\frac{1}{1-\theta_t} = \frac{\partial\omega_{t+1}^i/\partial\rho_{t+1}}{\omega_{t+1}^i} \cdot \frac{\gamma\rho_{t+1}}{\theta_t}$, that is:

$$\frac{\theta_t}{1-\theta_t} = \gamma\rho_{t+1}\frac{(\omega_{t+1}^i)'}{\omega_{t+1}^i} \quad i = M, F \tag{23}$$

where $(\omega_{t+1}^i)' = \partial\omega_{t+1}^i/\partial\rho_{t+1}$.

Using (7), (14) and (17), we can write:[18]

$$\omega_{t+1}^i = \Psi_{t+1}\pi(\rho_{t+1}) - \Delta^i(\Psi_{t+1})^2$$
$$\partial\omega_{t+1}^i/\partial\rho_{t+1} = \Psi_{t+1}\pi'(\rho_{t+1})$$

where $\Delta^M = 1 + \lambda$, $\Delta^F = \frac{1+\mu}{2}$, $\Psi_{t+1} = \frac{\sigma_{t+1}}{\sqrt{2}}$.

In turn, equation (23) becomes:

$$\theta_t = \frac{\gamma\rho_{t+1}\pi'(\rho_{t+1})}{\gamma\rho_{t+1}\pi'(\rho_{t+1}) + \pi(\rho_{t+1}) - \Delta^i\Psi_{t+1}} \quad i = M, F$$

where $\pi'(\rho_{t+1}) = \frac{\eta_{t+1}}{[\rho_{t+1}+(1-\rho_{t+1})\eta_{t+1}]^2}$, $\Delta^M = 1 + \lambda$, $\Delta^F = \frac{1+\mu}{2}$ and $\Psi_{t+1} = \frac{\sigma_{t+1}}{\sqrt{2}}$.

The economy's intertemporal equilibrium then is defined as follows.

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[18]Indeed we have (we omit all indexes to simplify notations): $\omega = E(w) - C$ where $E(w) = \alpha.e + \beta$. In equilibrium $\beta = C + \alpha.(\Psi - e)$, thus $E(w) = \alpha.e + C + \alpha.(\Psi - e)$. In turn: $\omega = E(w) - C = \alpha.e + \alpha.(\Psi - e) = \alpha.\Psi$, that is: $\omega^M = \alpha^M.\Psi$ and $\omega^F = \alpha^F.\Psi$. Substituting for α^F and α^M then leads to $\omega^M = \Psi.\pi(\rho) - (1 + \lambda).\Psi^2$ and $\omega^F = \Psi.\pi(\rho) - (1 + \mu).\Psi^2/2$.

Definition 2. Intertemporal Equilibrium.

An equilibrium is a set of first and second period variables that satisfies equations (1) to (23), such that under assumption 1 and 2:

1. *In the first period, the analyst chooses a level of research investment that maximizes his utility:* $\max\limits_{\theta_t} \ln(1 - \theta_t) + \ln(\omega^i_{t+1})$ *subject to the human capital accumulation equation*

$$\rho_{t+1} = A_t \cdot (\theta_t)^\gamma \cdot (\rho_t)^{1-\gamma} \tag{24}$$

   which yields:

$$\frac{\theta_t}{1 - \theta_t} = \gamma\rho_{t+1}\frac{(\omega^i_{t+1})'}{\omega^i_{t+1}} \quad i = M, F \tag{25}$$

2. *In the second period, the firm offers a M-contract* $\Omega^M_{t+1} = (w^M_{t+1}, e^M_{t+1}, a^M_{t+1})$ *iff* $\rho_{t+1} < \bar{\rho}_{t+1}$ *and a F-contract* $\Omega^F_{t+1} = (w^F_{t+1}, e^F_{t+1}, a^F_{t+1})$ *otherwise*

   with $\bar{\rho}_{t+1} = \frac{\Xi \cdot \Psi_{t+1} \cdot \eta_{t+1}}{1 + \Xi \cdot \Psi_{t+1} \cdot (\eta_{t+1} - 1)}$, $\Xi = \sqrt{\frac{1+\mu}{2}\frac{1-\mu+2\lambda}{1-\mu}}$, $\Psi_{t+1} = \frac{\sigma_{t+1}}{\sqrt{2}}$; *and where the variables of* Ω^i_{t+1}, $i = M, F$, *are defined by equations (12) to (18).*

3. *The first period research levels given the contract offer i are such that:*

$$\theta^i_t = \frac{\gamma\rho^i_{t+1}\pi'(\rho^i_{t+1})}{\gamma\rho^i_{t+1}\pi'(\rho^i_{t+1}) + \pi(\rho^i_{t+1}) - \Delta^i\Psi_{t+1}} \quad i = M, F \tag{26}$$

   and, given (22), the dynamics of human capital is governed by the following equation:

$$\rho^i_{t+1} = A_t \cdot \left[\frac{\gamma\rho^i_{t+1}\pi'(\rho^i_{t+1})}{\gamma\rho^i_{t+1}\pi'(\rho^i_{t+1}) + \pi(\rho^i_{t+1}) - \Delta^i\Psi_{t+1}}\right]^\gamma \cdot (\rho_t)^{1-\gamma} \quad i = M, F \tag{27}$$

   where $\pi'(\rho_{t+1}) = \frac{\eta_{t+1}}{[\rho_{t+1} + (1 - \rho_{t+1})\eta_{t+1}]^2}$, $\Delta^M = 1 + \lambda$, $\Delta^F = \frac{1+\mu}{2}$ *and* $\Psi_{t+1} = \frac{\sigma_{t+1}}{\sqrt{2}}$. *The dynamics of human capital accumulation is such that* ρ_{t+1} *is monotonic and strictly increasing in* ρ_t *(see the proof in appendix 6.2)*

4 Stationary Equilibrium

4.1 Existence of Equilibrium

We now analyze the model's solutions under a stationary environment. In particular, we assume that A_t, σ_t and π_t are constant and equal to A, σ and π. The threshold productivity level therefore is constant and equal to $\bar\rho = \frac{\Xi.\Psi.\eta}{1+\Xi.\Psi.(\eta-1)}$, with $\Xi = \sqrt{\frac{1+\mu}{2}\frac{1-\mu+2\lambda}{1-\mu}}$ and $\Psi = \sigma/\sqrt{2}$.

This stationary threshold value defines two possible steady-state regimes: a regime with mixed incentives below this value, and a regime with full financial incentives above.

Let θ^M (respectively θ^F) and $\rho^M \leq \bar\rho$ (respectively $\rho^F > \bar\rho$) denote the steady-state values of the research coverage efforts and reputation in the M-contract regime (respectively in the F-contract regime). We shall study the existence and uniqueness of these equilibrium values.

Note that given equations (24), (26) and (27), we have:

$$\rho^i = A^{1/\gamma}\frac{\gamma\rho^i\pi'(\rho^i)}{\gamma\rho^i\pi'(\rho^i) + \pi(\rho^i) - \Delta^i\Psi} \tag{28}$$

$$\theta^i = A^{-1/\gamma}\rho^i \tag{29}$$

We *normalize parameter A to 1*, and obtain the following stationary values of the research coverage and productivity[19]:

ρ^i is the solution of the following equation:

$$\left(\rho^i\right)^2(1-\eta)\left[1 - \Delta^i\Psi(1-\eta)\right] + \rho^i\eta(1+\gamma - 2\Delta^i\Psi(1-\eta)) - \eta(\gamma + \Delta^i\Psi\eta) = 0 \tag{30}$$

Only one of the two possible solutions is positive, that is:

$$\rho^i = \frac{2\eta(1-\eta)\Delta^i\Psi - \eta(1+\gamma) + \sqrt{D^i}}{2(1-\eta)(1-(1-\eta)\Delta^i\Psi)} \tag{31}$$

$$\theta^i = \rho^i \tag{32}$$

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[19]This normalization does not change our qualitative results, but we need it to obtain simple analytical results.

with $D^i = (2\eta(1-\eta)\Delta^i\Psi - \eta(1+\gamma))^2 + 4(1-\eta)(1-\Delta^i\Psi(1-\eta))(\gamma\eta + \Delta^i\Psi\eta^2) > 0$

The stationary values of the variables under the M-contract and F-contract then write:

$$
\begin{align}
e^M &= \pi(\rho^M) - \Psi \qquad a^M = \pi(\rho^M) \tag{33}\\
e^F &= a^F = \frac{\pi(\rho^F)}{1+\mu} - \frac{\Psi}{2} \tag{34}\\
\omega^i &= \Psi\pi(\rho^i) - \Delta^i\Psi^2 \quad i = M, F \tag{35}\\
B^M &= (\pi(\rho^M))^2 - \pi(\rho^M)\Psi + \frac{\Delta^M}{2}\Psi^2 \tag{36}\\
B^F &= \frac{(\pi(\rho^F))^2}{1+\mu} - \pi(\rho^F)\Psi + \frac{\Delta^F}{2}\Psi^2 \tag{37}\\
\pi(\rho^i) &= \frac{\rho^i}{\rho^i + (1-\rho^i)\eta} \quad i = M, F \tag{38}\\
\rho^i &= \frac{2\eta(1-\eta)\Delta^i\Psi - \eta(1+\gamma) + \sqrt{D^i}}{2(1-\eta)(1-(1-\eta)\Delta^i\Psi)} \quad i = M, F \tag{39}
\end{align}
$$

where $\Delta^M = 1 + \lambda$ $\quad \Delta^F = \frac{1+\mu}{2}$,
$D^i = (2\eta(1-\eta)\Delta^i\Psi - \eta(1+\gamma))^2 + 4(1-\eta)(1-\Delta^i\Psi(1-\eta))(\gamma\eta + \Delta^i\Psi\eta^2) > 0$
and $\Psi = \frac{\sigma}{\sqrt{2}}$.

Given that a M-contract is offered only if the analyst's productivity is below the threshold level $\bar{\rho}$, then the stationary values of productivity under both contracts only make sense if either $\rho^M \leq \bar{\rho}$ (M-contract) or if $\bar{\rho} < \rho^F$ (F-contract). These conditions impose the following restriction on the environment:

Condition 1. *Under assumption 1 and 2, there exists a unique equilibrium contract if and only if either*

$$\rho^M = \frac{2\eta(1-\eta)\Delta^M\Psi - \eta(1+\gamma) + \sqrt{D^M}}{2(1-\eta)(1-(1-\eta)\Delta^M\Psi)} \leq \bar{\rho} = \frac{\Xi.\Psi.\eta}{1 + \Xi.\Psi.(\eta-1)} \tag{40}$$

in which case the optimal contract is based on mixed incentives (M-contract), or if

$$\bar{\rho} = \frac{\Xi.\Psi.\eta}{1 + \Xi.\Psi.(\eta-1)} < \rho^F = \frac{2\eta(1-\eta)\Delta^F\Psi - \eta(1+\gamma) + \sqrt{D^F}}{2(1-\eta)(1-(1-\eta)\Delta^F\Psi)} \tag{41}$$

in which case the optimal contract is based on full financial incentives (F-contract),

where $\Xi = \sqrt{\frac{1+\mu}{2}\frac{1-\mu+2\lambda}{1-\mu}}$, $\Delta^M = 1 + \lambda$, $\Delta^F = \frac{1+\mu}{2}$, $\Psi = \frac{\sigma}{\sqrt{2}}$, $D^i = (2\eta(1-\eta)\Delta^i\Psi - \eta(1+\gamma))^2 + 4(1-\eta)(1-\Delta^i\Psi(1-\eta))(\gamma\eta + \Delta^i\Psi\eta^2) > 0$ i=M,F.

We then have the following result.

Proposition 2 *Under condition 1, the economy has a unique stationary equilibrium. The mixed financial incentives contract is offered by firms with analyst's productivity (and thus reputation) below the threshold level $\bar{\rho}$. Otherwise, the full financial incentives contract is offered.*

Proof: Immediate from condition 1. □

4.2 Comparison of Research Levels and Wages

Given the various parameters characterizing our endogenous variables, only numerical simulations allow comparing research levels and wages in each regime.

As reported in figure 2, we see that the full financial incentives contract is characterized by lower quality research services in the first period and a high expected wage in the second period (Figure 2, case a). On the contrary, the mixed financial incentives contract is characterized by a high quality research coverage in the first period and a low expected wage (tied to analysts' reporting effort) in the second period (Figure 2, case b).

Our simulations show that by offering a contract that imposes ethical distress on analysts (the M-contract), a bank ensures that analysts exert a high research effort in the first period. Under the M-contract, the lower responsiveness of effort to incentives in the second period is compensated for by a higher research and coverage effort in the first period compared to the hypothetical but out-of equilibrium research level that would have been driven by monetary incentives over both reporting and report accuracy. In turn, high research and coverage effort in the first period translates into a high reputation for the analyst. Overall, with a mixed incentives contract, a bank relies on 'work ethic' regarding reports accuracy and on reputational concerns regarding research and coverage efforts. This is the high research-reputation equilibrium associated with a M-contract.

Alternatively, under the F-contract, the higher responsiveness of effort to incentives (and the higher expected wage) in the second period induces a lower research effort

in the first period compared to the hypothetical but out-of equilibrium research level that would have been driven by non monetary incentives over accuracy. In turn, low quality research services in the first period undermine the analyst reputation for providing valuable reports and recommendations. This finding indicates that under full financial incentives contracts analysts face pressure from conflicts of interest. More precisely, the desire to win short term gains -a higher wage in the second period associated with the F-contract- leads analysts astray from research and coverage effort, which in turn inherently damages their reputation. This is the low research-reputation equilibrium associated with a full financial incentives contract.

Our results allow to examine the impact of compensation plans on an analyst's effort choice by taking reputational concerns and work ethic into consideration. The main idea is that the design of compensation contracts, in the presence of reputational concerns and work ethic, may lead to incentive problems and suboptimal action-choice among analysts. We argue that whenever a compensation contract includes further financial incentives to produce high-quality research -compared with a contract that offers a non-monetary compensation-, analysts face a trade-off between high short-term gains and long-term reputational concerns. Moreover, the outcome of this conflict of interest is that analysts liquidate their reputation. In this paper, higher expected short-term gains -or equivalently, a high second period wage under the F-contract- induce analysts to act opportunistically leading their research quality to fall which in turn, weakens their reputation. A large literature has documented the existence of conflicts of interest in analyst research and the disciplinary role of reputation.[20] Theory predicts that an analyst with an established reputation for providing high quality research is more likely to forgo opportunistic behavior in order to preserve the benefits attached to a high reputation.[21] Yet, our findings show that if a conflict of interest exists and impacts the research quality of analysts, it has the greater impact on reputable analysts.[22] As suggested in the above proposition, the attraction of lucrative compensation, and then the temptation to liquidate reputation for profits are strongest for reputable analysts. This result is at odds with the theoretical effect of personal reputation. Fang and Yasuda (2009b) for example find that while bank reputation alone fails at inducing research

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[20]A large number of studies document conflicts of interest in analyst research. Dugar and Nathan (1995), Michaely and Womack (1999), Dechow et al. (2000), and Chan et al. (2007) document conflicts of interest arising from investment banking funding. Cowen et al. (2006) and Agrawal and Chen (2008) discuss conflicting incentives due to trade commissions generation.

[21]See Benabou and Laroque (1992) and Jackson (2005) for theoretical discussions of analysts' conflicting incentives and the role of reputation.

[22]Recall that the F-contract which gives financial incentives on both the reporting effort and report accuracy is likely to be higher with the analyst's initial productivity level and hence reputation.

accuracy, personal reputation is an effective disciplinary device against conflicts of interest. What exacerbates the conflict of interest in our paper is the substantial compensation associated with the F-contract. Such contracts appear to destroy analysts incentives to provide high quality research and preserve their reputation. In contrast, we find that analysts who face ethical concerns about the quality of their research become more accurate. This finding indicates that under compensation contracts that consider analysts work ethic -the M-contract- analysts are able to resist pressures from conflict of interest or that they face fewer pressures.[23] Overall, full financial incentives contracts tend to exacerbate the conflict of interest problem in analyst research, and thus appear to be harmful for both long-run reputation and research quality. Instead, mixed incentives contracts that rely on analysts ethic may play a mitigating role in analyst conflicts translating into a high research-reputation equilibrium.
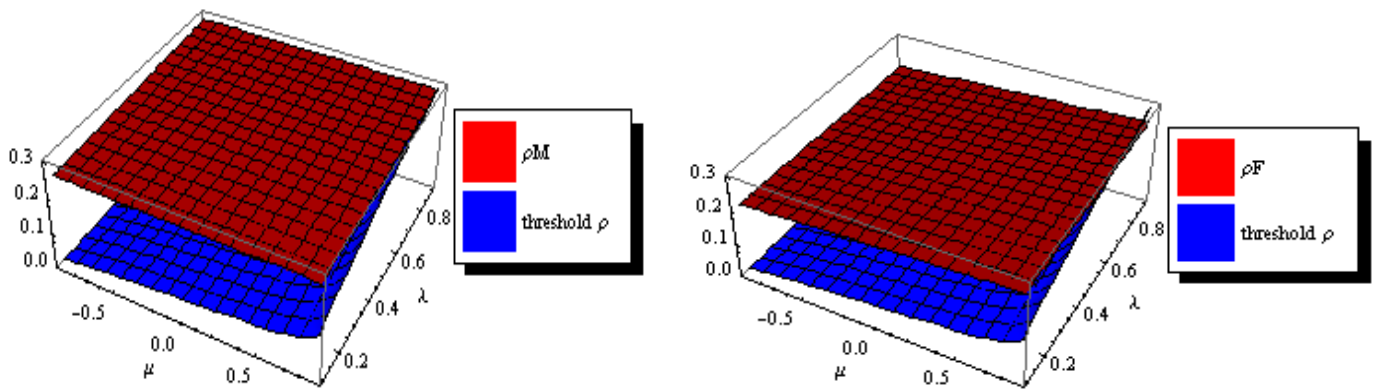
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[23]Related ideas about the ethics of agents have been discussed. For example, Friedman (1988) argues that managers feel a moral obligation to maximize shareholder wealth. Alternatively, Akerlof (1982) argues that gift exchange is an element in employee-employer relations and norms for the effort provision are the basis of employment contracts.

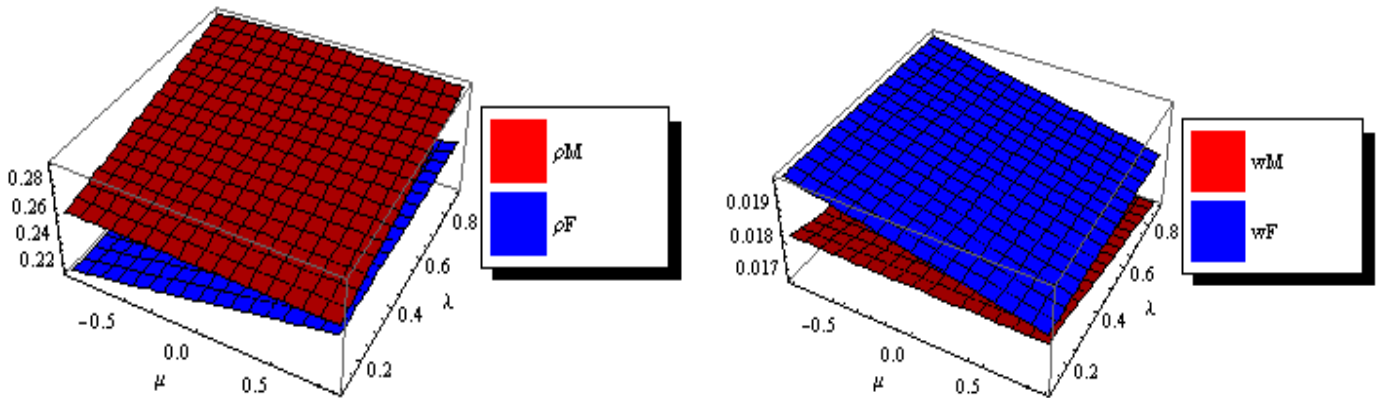# Figure 2. Simulations on Research Levels and Expected Wages

Case (a): The equilibrium contract is based on full-financial incentives (F-contract)

Parameters value: $\sigma=0.1$ $\eta=0.7$ $\gamma=0.3$

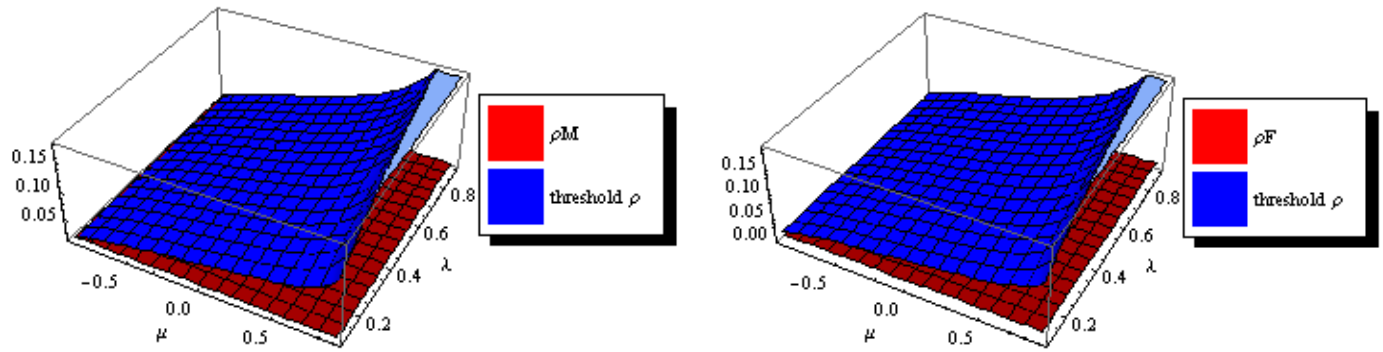The following two figures show that condition 1 is met.

The following two figures reproduce the research and wage levels.
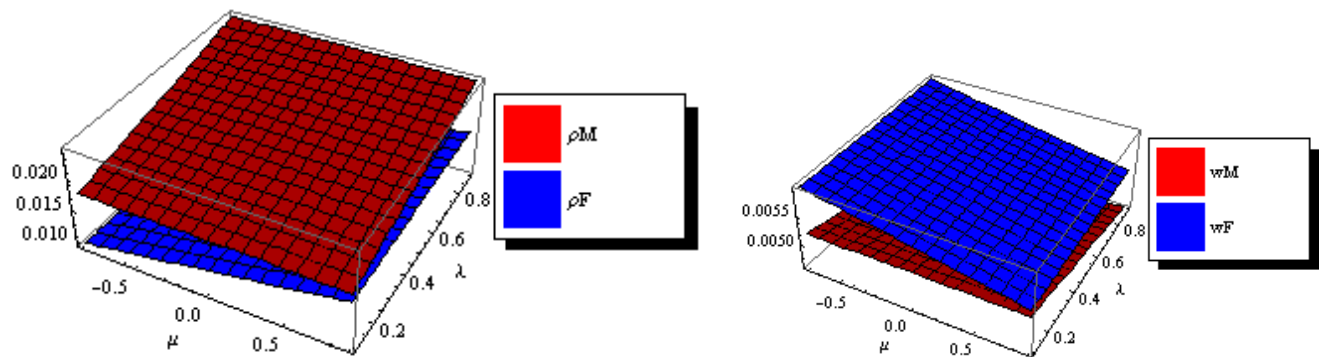
Case (b): The equilibrium contract is based on mixed incentives (M-contract)

Parameters value: $\sigma=0.1$ $\eta=0.1$ $\gamma=0.01$

The following two figures show that condition 1 is met.

The following two figures reproduce the research and wage levels.

5   Conclusion

Following the scandals in the U.S. and worldwide public concern regarding the analyst research, the SEC adopted a settlement in 2003 that required securities firms to substantially sever the links between research and investment banking, particularly with respect to the analysts' compensation. There is a consensus that conflicts of interest exist in analyst research, and recent empirical studies have investigated the role of reputation in alleviating conflicting incentives. In this paper, we model a dynamic relation between work ethic, reputational concerns and incentives in analyst research. The starting point of this paper is that while there are potential conflicts of interest, they will not be exploited unless encouraged by the incentive structure. More specifically, in our paper, the bank may offer either a mixed incentives contract (the M-contract) or a full financial incentives contract (the F-contract) depending on the analyst reputational and ethical concerns. First, we show that when analysts have a relatively low reputation for providing research quality (below the threshold $\bar{\pi}_{t+1}$) banks will offer a mixed incentives contract, and rely on analysts intrinsic motivation (work ethic) to meet accuracy standards. Alternatively, when analysts have an established reputation for providing high quality research, the F-contract enables the bank to offer a lucrative compensation. In this context, reputation appears to be an indicator of ability or skill. This finding is consistent with positive sorting as analysts with superior ability or access to information enjoy a good reputation and earn high salaries.

Second, by investigating the dynamic relation between compensation contracts and analysts' effort in providing research quality, this paper sheds some light on the role and limits of reputation in mitigating conflicts of interest. We find that full financial incentives contracts that give extrinsic rewards on the quality of research tend to exacerbate the conflict of interest. Indeed, the (expected) lucrative compensation associated with the F-contract induces analysts to reduce their first period research and coverage effort, which in turn damages their reputation for providing informative reports. On the contrary, a mix of monetary and non monetary rewards based on the analyst's work ethic induces high research effort thereby enhancing long-run reputation.

The argument presented in this paper invites to consider the relation between ethical and reputational concerns and incentives as an important driver of the quality of research. From this perspective, we argue that without ethical considerations at stake, the attraction of lucrative compensation may induce high-reputation analysts to liquidate reputation for profits and become less accurate.

6 Appendix

6.1 Optimal Contracts when $\sigma_t^M = \sigma_t^F$

Table I summarize the contractual relationship between the firm and the analyst under the M-contract and under the F-contract, when the variance parameters are identical (assumption 1) and presents the different steps to solve for the optimal contracts $\Omega_{t+1}^i = (w_{t+1}^i, e_{t+1}^i, a_{t+1}^i), i = M, F$.

To simplify notations and when no confusion arises, period $t+1$ indexes have been omitted.

Table I: Characteristics of the Contracts

(Time indexes are omitted to alleviate notations)

	Output and Preferences
Observable output	$y^M = e^M + \varepsilon^M$ and $y^F = e^F + a^F + \varepsilon^F$ where: e^i is the reporting effort , a^i is the standard for accuracy ε^i is a random (noise) term with distribution $N(0,(\sigma^i)^2)$ i=M,F
Linear compensation	$E(w^i) = \alpha^i . E(y^i) + \beta^i$, i= M,F Expected wage (conditional upon expected output)
Net compensation	$\omega^i = E(w^i) - C^i$, i= M,F where C^i is the analyst's cost of efforts
Agent's Certainty Equivalent	$CE^i = E(w^i) - C^i - r(\alpha^i)^2(\sigma^i)^2/2$, i= M,F where r is the absolute risk aversion coefficient: $r = - u''(.) / u'(.) = 1 / (w^i - C^i)$, i= M,F given a second period reservation utility null
Principal's Expected Profit	$B^i = \pi(\rho) . E(y^i) - E(w^i)$, i= M,F Where $\pi(\rho)$ is the bank reputation level : $\pi(\rho)= \rho / [\rho+(1-\rho)\eta]$ and ρ is the analyst's productivity

	Effort Cost Depending on Incentive Scheme
Mixed incentives contract	$C^M(e^M,a^M) = (e^M)^2 / 2 + \lambda . (e^M - a^M)^2 / 2$ Where $0<\lambda<1$ measures the importance of meeting the standard
Full financial incentives contract	$C^F(e^F,a^F) = (e^F)^2 / 2 + (a^F)^2 / 2 + \mu . e^F . a^F$ where $-1<\mu<1$ is the degree of complementarity between the two types of efforts

Determination of the Optimal Contract

Step 1 : Incentive Compatible Constraint : α^i such that $e^i = \text{argMax } CE^i$

Step 2 : Participation Constraint: β^i such that $CE^i =0$

Step 3 : Optimal Contract: $(e^i , a^i)= \text{argMax } B^i$

6.2 Dynamics of human capital

Proof that ρ_{t+1} is monotonic and strictly increasing in ρ_t

The dynamics of human capital is governed by equation (27):

$$\rho_{t+1}^i = A_t . \left[\frac{\gamma \rho_{t+1}^i \pi'(\rho_{t+1}^i)}{\gamma \rho_{t+1}^i \pi'(\rho_{t+1}^i) + \pi(\rho_{t+1}^i) - \Delta^i \Psi_{t+1}} \right]^\gamma . (\rho_t)^{1-\gamma} \qquad i = M, F$$

where $\Delta^M = 1 + \lambda$, $\Delta^F = \frac{1+\mu}{2}$, $\Psi_{t+1} = \frac{\sigma_{t+1}}{\sqrt{2}}$.

In turn, we can write:

$$\rho_{t+1} = A_t . (\rho_t)^{1-\gamma} . (\rho_{t+1})^\gamma \left[\frac{\gamma \pi'(\rho_{t+1}^i)}{\gamma \rho_{t+1}^i \pi'(\rho_{t+1}^i) + \pi(\rho_{t+1}^i) - \Delta^i \Psi_{t+1}} \right]^\gamma$$

$$\Leftrightarrow \rho_{t+1}^{1-\gamma} = A_t . (\rho_t)^{1-\gamma} \left[\frac{\gamma \pi'(\rho_{t+1}^i)}{\gamma \rho_{t+1}^i \pi'(\rho_{t+1}^i) + \pi(\rho_{t+1}^i) - \Delta^i \Psi_{t+1}} \right]^\gamma$$

$$\Leftrightarrow \rho_{t+1} = A_t^{\frac{1}{1-\gamma}} . (\rho_t) \left[\frac{\gamma \pi'(\rho_{t+1}^i)}{\gamma \rho_{t+1}^i \pi'(\rho_{t+1}^i) + \pi(\rho_{t+1}^i) - \Delta^i \Psi_{t+1}} \right]^{\frac{\gamma}{1-\gamma}}$$

$$\Leftrightarrow \rho_{t+1} = \rho_t \left[A_t^{\frac{1}{\gamma}} . \frac{\gamma \pi'(\rho_{t+1}^i)}{\gamma \rho_{t+1}^i \pi'(\rho_{t+1}^i) + \pi(\rho_{t+1}^i) - \Delta^i \Psi_{t+1}} \right]^{\frac{\gamma}{1-\gamma}}$$

that is:

$$\rho_{t+1} = \rho_t . [G(\rho_{t+1})]^{\frac{\gamma}{1-\gamma}}$$

with

$$G(\rho_{t+1}) = A_t^{\frac{1}{\gamma}} \frac{\gamma \pi'(\rho_{t+1}^i)}{\gamma \rho_{t+1}^i \pi'(\rho_{t+1}^i) + \pi(\rho_{t+1}^i) - \Delta^i \Psi_{t+1}}$$

We show that

$$G'(\rho_{t+1}) < 0 \quad \Leftrightarrow \quad \pi''(.) < 0$$

Hence, function $G(.)$ is strictly decreasing. Using the implicit function theorem, ρ_{t+1} therefore is monotonic and strictly increasing in ρ_t. For each ρ_t corresponds a unique ρ_{t+1}.

$\square$

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