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RESEARCH ARTICLE

Demand shocks and market manipulation

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Abstract In this paper, we analyze the conflicts of interest of an informed agent who is responsible for divulging his private information about a company and has a reward function positively dependent on its stock price. We assume that the demand for the stock is subject to shocks that may increase it. We show that the presence of this "captive demand" leads to increased incentives to misrepresent the truth and manipulate the market. As an application, we investigate the case where the shocks represent the degree of social interactions among employees of a company whose CFO is the informed agent.

Keywords Demand shock · Insider · Analyst reports · Social interactions · 401(k)

JEL Classification Numbers D82 · D84 · G11 · G12 · G24 · G33

1 Introduction

After the stock market crash of 1929, regulators began to entertain the separation of brokerage services and investment banking. The resulting regulations became known as the *Chinese Wall*. The objective was to avoid the conflicts of interest between analysts conducting research and the sales staff trying to create a market for the stocks. However, recently, the financial markets witnessed several incidents of analysts issuing buy recommendations and soon after the company filing for bankruptcy. The *Wall* turned out to be less sturdy than it seemed.

This is just an example of a general conflict that has always been present in the financial industry. These conflicts exist when informed agents are interested in the stock

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price performance but at the same time are responsible for releasing information. In this scenario, negative information might be distorted or hidden in order to prevent stock price plunges. Benabou and Laroque (1992) broadly refers to these agents as "gurus" . In this paper, we analyze these conflicts in the finance industry connecting them with the behavior of investors.[1] These issues have recently gained more relevance due to the potential implications on the 401(k) funds of companies that went bankrupt. These funds tend to be concentrated on own company stock and misleading information (by Wall Street Analysts, CFOs, or gurus in general) might exacerbate the overexposure through unwarranted optimism on the part of its holders - the employees. Consequently, they might end up losing a major part of their retirement funds, as was indeed the case on several instances, such as Enron and WorldCom.

In our model we allow for the presence of investors whose demand may suffer exogenous shocks. We start with a very general setting deriving broad results and then concentrate on one specification for the demand shock. At that point, we model this shock as a result of social interactions among investors. The main motivation behind this formulation is that these so-called social investors may represent employees of a traded company.

The objective of this paper is to better understand the connections between demand for individual stocks and the informational content of public communication devices. The novel part of this paper is not only the link between information dissemination and demand pressure but also its application to a social interactions framework. Namely, we fully substantiate the nature of the demand pressure by looking into the individual decision making process in an environment where consumption externalities are present. We are able to develop a model in which there are lies in equilibrium even when agents are rational and there exists potential costs associated to lying, and we connect the extent of these lies to microeconomic parameters. We show that, albeit rational, investors respond to lies.

In the general model, an agent has information about a company's quality and has a compensation package that can be represented as an increasing function of the company's stock price. The company stock has uncertain quality, either good or bad, and it has a certain liquidation value. We assume that the insider is able to liquidate the company.[2] The market for the stock is competitive and the strength of demand depends on the realization of a shock γ. The informed agent/trader anticipates that he may need to collect his compensation before the company's final value is realized. He also has access to precise private information that needs to be made public, not necessarily in an honest manner. However, lies might be punished. We further assume that the insider is risk-neutral and the market is comprised of risk averse investors.

As we show, demand shocks, measured by γ, govern the incentives to lie. The main intuition behind this result is that these shocks may create a strong captive demand. The higher is γ, the higher the demand will be. With a fixed supply, this will be reflected in higher equilibrium prices. So, higher γ tips the scale in favor of lies. For

[1] For realted models of information manipulation see, among others, Benabou and Laroque (1992), Morgan and Stocken (2003) and Shin (2003).

[2] This assumption is not necessary for our results. Incentives to lie would only be enhanced if the insider was not able to liquidate the company.

a large enough shock, there are always lies in the presence of bad news. For a more moderate value of the parameter, it is not optimal to always lie. We observe a region where lies occur with positive probability, but bounded away from one. Finally, when the demand shock is really weak, lying can never be profitable. So, the insider avoids costs and never lies.

We show that insiders are able to move the beliefs of investors, but not fully. The amount by which they can "fool" the investors depends on the strength of the demand shock. This result is supported empirically by findings in Michaely and Womack (1999), among others. They find that the market responds positively, but not fully, to buy recommendations, indicating a discount on the value of analysts' recommendations.

In an application, we allow for 3 players: Social Investors, the informed agent and Non-Social investors. The informed agent is again risk-neutral with a compensation package that is affine on the stock price, while investors have mean-variance preferences. The social investors have a social-interactions-type utility function, where γ measures the strength of these interactions. As we show, the aggregate portfolio holdings of social investors is an increasing function of γ. Hence, the degree of social interactions plays the role of the general demand shock. This application leads us to testable predictions. For instance, do companies with huge 401(k) funds[3] allocated to company stock receive more buy recommendations and/or more positive reports from their CFOs? And, are these recommendations on average more incorrect? The empirical analysis is left for future research.

We also show that, for every level of social interactions, the ex-ante expected utility of the insider is weakly larger under a commitment strategy than under the equilibrium, being strictly larger for a non-negligible set of the social interactions parameter values.

As a final extension of this application, we lengthen the insider's horizon. The insider now is hit by a liquidity shock with some probability, in which case he has to collect his reward at the market price, otherwise he may wait until the company's payoff is realized.

Benabou and Laroque (1992), among others, also addresses the issue of conflicts of interest when an agent having privileged information may be the sole source of information to outsiders. This insider has incentives to lie in order to be able to profit more from his information. Not only he gains by trading against uninformed agents but he also tries to mislead them into believing the opposite of the truth. Their model is symmetric; hence incentives to lie exist in both good and bad times. As we argued above and stress later on this paper, empirically, lies seem to be more pervasive during bad times, e.g., analysts tend to issue buy recommendations even when the firm is not that good.[4] This feature is not captured in their model. We, on the other hand,

[3] The size of the 401(k) funds allocated to own company stock would serve as a proxy for the intensity of social interactions between the social investors, in this case the employees of the company. This would be justified because, as it will be clear below, the higher the social interactions the higher the allocation to the stock.

[4] See Michaely and Womack (1999) for an example in the IPO market. Analysts that work for the underwriting firm tend to be overoptimistic when compared to independent ones, and also when compared to the future performance of the stock.

postulate a model in which there is no misrepresentation of information in the case of good news.

This paper is organized as follows. In the next section we describe the general model, characterize its equilibrium and analyze its implications. Section III, where most of the work is concentrated, presents a detailed discussion of an application involving social interactions among investors, specific utility functions and a reward function for the insider that is affine on stock price. In this section, we also allow for the insider's horizon to be longer, i.e. he might be able to wait until the payoff realizes. Section 4 discusses the recent financial events under the light of the models presented here and concludes.

2 The general model

In this section, we characterize how the market demand changes depending on the shock and how the reporting policy of an insider varies accordingly.

2.1 Market conditions

Assume that an insider has a compensation package given by $h(P)$, where P is a company's stock price and the $h(.)$ function is $\mathbb{C}^2$, increasing and convex.[5] The company has m shares floating and the insider has to issue a report about it to the investors. This report is to be viewed as a public communication device, so that all market participants have access to its content.

We assume that investors have well-defined preferences represented by a thrice continuously differentiable utility function, $u(.)$, increasing and concave. Besides, $u(.)$ respects the restriction that $\forall \alpha > 0$,

$$V(z) := u'(R + \alpha(z - R))(z - R) \tag{1}$$

is a concave function of z.[6] This condition guarantees that when the riskiness of an asset decreases, in a sense to be made precise below, investors will definitely increase their allocation to it. A set of sufficient conditions for this to be true consists of the coefficient of relative risk aversion being less than one and increasing and the absolute risk aversion decreasing.

The company is good with prior probability of $\nu_0 > 1/2$ and bad with the complementary probability. If it is good, then its payoff $(\widetilde{V})$ has a cumulative distribution function F_1. If it is bad, the distribution is F_2. We assume that $F_1 \succeq^M_{SOSD} F_2$, where $\succeq^M_{SOSD}$ represents Monotone Second Order Stochastic Dominance.[7] Hence, the ex-ante distribution of asset returns is

$$F_{\nu_0} = \nu_0 F_1 + (1 - \nu_0) F_2. \tag{2}$$

[5] We believe that the continuous differentiability assumption is not necessary, however, it does simplify the proofs.

[6] Where R can be thought of as the gross return on a risk-free asset.

[7] See Huang and Litzenberger (1998) for a precise definition.

Under these assumptions, we have the following Lemma.

Lemma 1 *If* $\nu_1 > \nu_2$, *then* $F_{\nu_1} \succeq^{M}_{SOSD} F_{\nu_2}$.

Proof We know that

(i) $\int_0^y [F_1(z) - F_2(z)]\, dz \leq 0$, $\forall y$, and;

(ii) $\mathbb{E}_{F_1}\left(\widetilde{V}\right) \geq \mathbb{E}_{F_2}\left(\widetilde{V}\right)$.

Define

$$\mathbb{E}_{\nu} := \nu \mathbb{E}_{F_1}\left(\widetilde{V}\right) + (1-\nu)\,\mathbb{E}_{F_2}\left(\widetilde{V}\right).$$

Then, it is clear that $\mathbb{E}_{\nu_1} \geq \mathbb{E}_{\nu_2}$. We need to show that

$$\int_0^y \left[F_{\nu_1}(z) - F_{\nu_2}(z)\right] dz \leq 0, \quad \forall y. \tag{3}$$

The last condition is true if and only if

$$\int_0^y \left[(\nu_1 - \nu_2)\, F_1(z) + (\nu_2 - \nu_1)\, F_2(z)\right] dz \leq 0, \quad \forall y. \tag{4}$$

We can re-write this as

$$(\nu_1 - \nu_2)\int_0^y \left[F_1(z) - F_2(z)\right] dz \leq 0, \quad \forall y, \tag{5}$$

which holds given (i) above and $\nu_1 > \nu_2$. □

The interpretation for the distributional assumptions comes from the format of investors' preferences. With preferences as described above, the investors will allocate more to the risky asset if the probability attached to the good state is higher.

Investors' beliefs are updated using Bayes' rule and the insider's strategy, details of which are provided in the next Proposition. Let the demand function for the company stock be given by a function $\alpha(P;\nu;\gamma)$ where P is the stock price, ν is the probability that investors attach to the good state and γ measures a demand shock. With the model as described, we have that $\alpha_{\nu}(P;\nu;\gamma) > 0$, and we impose the additional restriction that $\alpha_{\gamma}(P;\nu;\gamma) > 0$.

Prices are formed in a competitive market guaranteeing that the market clearing condition is satisfied, i.e.,[8]

$$\alpha(P;\nu;\gamma) = m. \tag{6}$$

[8] Where m is the total supply of company shares.

Given the above assumptions, prices are an increasing function of ν and γ. Finally, we assume that γ is distributed on the unit interval and

$$\lim_{\gamma \to 0} P(\gamma; \nu) = \underline{P}, \tag{7}$$

$$\lim_{\gamma \to 1} P(\gamma; \upsilon) = \overline{P}, \tag{8}$$

where $\underline{P} \geq 0$ and $\overline{P} \leq \frac{\mathbb{E}_{F_1}(\widetilde{V})}{R}$. This assumption may be interpreted as basically saying that the market is neither "too risk averse" nor "too risk neutral".

We now mention some interpretations for γ. First, if we let investors have a utility function with decreasing absolute risk aversion, then it has been shown that[9], if we denote the initial wealth by W_0, we have

$$\frac{\partial \alpha (P; \nu; \gamma)}{\partial W_0} > 0. \tag{9}$$

Therefore, we can think of γ as initial wealth. Utility functions that satisfy this condition include:

$$u(z) = \frac{B}{B-1} z^{1-\frac{1}{B}}, \ z > 0, \ B > 0; \tag{10}$$

$$u(z) = \frac{1}{B-1} (A + Bz)^{1-\frac{1}{B}}, \ A \neq 0, \ z > \max\left[-\frac{A}{B}, 0\right], \ B > 0; \tag{11}$$

$$u(z) = \ln(A + Bz), \ A > 0, \ B > 0, \ z > 0. \tag{12}$$

We could also allow γ to represent shifts in the utility function such that higher values represent a strictly less risk averse utility function, in the sense described in Huang and Litzenberger (1998). Finally, γ can represent a social interactions parameter, as described in greater detail in Section III.

2.2 Timing

We now briefly describe the timing of the model. At $t = 0$, we assume that the informed agent (T) has a reward function $h(P)$. This company has m shares floating and is ex-ante extremely profitable, but its quality is uncertain. It can be either good or bad, as described above. The insider's information concerns its quality.

At $t = 1$, the insider has the option to liquidate the firm, getting $h(L)$, or get his compensation at the market price. Results would be qualitatively the same if we did not allow for liquidation (or if no value accrues to T) and incentives to lie would only be strengthened by this change. However, before there is trading in the market the informed agent has to issue a public statement about the quality of the company. He may send a good message (g) or a bad one (b). He faces conflicting interests: He wants

9 See Huang and Litzenberger (1998).

to be honest to avoid lawsuits, but he also wants to profit from higher share prices. Agents are not irrational, so they anticipate this and form beliefs about the relevance of the insider's report accordingly. Given their beliefs, they submit demand schedules and market clearing determines the price. We allow for the possibility of monitoring by an outside entity. We do not model the monitoring technology here. However, we assume that, with some given probability p and independently of all the other random variables, the informed agent is caught lying. In this case, he will incur a monetary punishment cost of K. Since the insider is risk-neutral we can concentrate on C $(:= pK)$, the expected costs of lying. We assume that liquidation is never punished, so if the insider lies but then liquidates the project, he is not punished. Notice that this would never happen in equilibrium: If he lies, he will never liquidate. Otherwise, anticipating liquidation, he would have had no incentive to lie. This assumption simplifies the algebra, but all results would follow if we relaxed it.

Unless the insider is caught lying, the true state of the world is never known with certainty by the public. This assumption is meant to capture the idea that even if informed agents are lying there is no easy way to tell it even ex-post, other than by using the above-mentioned monitoring technology. To make this assumption internally consistent, we have to restrict the support of the distributions: (support of F_2) = (support of F_1).

Returns realize at $t = 2$ provided that the firm is not liquidated. If the firm is liquidated, they are paid at $t = 1$. There is no liquidation value after the first period.

The following assumption deals with the profitability of liquidation.

A1: The liquidation value is assumed to satisfy:

$$h(L) + C > \lim_{\gamma \to 0} h(P(\gamma; 1)); \tag{13}$$

$$h(L) + C < \lim_{\gamma \to 1} h(P(\gamma; \nu_0)). \tag{14}$$

The interpretation of this condition is intuitive. The first part of this inequality says that for a very low demand shock it is better to liquidate the firm than to lie and get the price-dependent reward, running the risk of being sued. The second part of the assumption says that for high shocks liquidation is not optimal, even with lawsuit costs. This assumption helps guarantee that both liquidation and continuation could potentially take place in this market.

2.3 Equilibrium characterization

We characterize the actions of the informed agent depending on the demand shock parameter. It is shown that there exists a region of the γ-parameter space such that, for any γ in this region, it is ex-post optimal to lie in the bad state. Hence, no self-imposed commitment policy can be believed to hold in equilibrium. The conflicts of interest would always be present and, with self-interested individuals, lies and misleading reports would occur.

The model described here can be seen as an example of a signalling game played by the informed agent and the investors in periods $t = 1$ and $t = 2$. The insider is the sender (or leader) and the investors are the receivers (or followers). The quality of the company is to be interpreted as the type of the sender, even though it really concerns the company and not the informed agent. So, the sender has private information about his type and sends a message to the receivers, who must update their beliefs upon observing this message and then take actions. The message space is limited to g or b. Since we allow for multiple receivers, we concentrate on symmetric equilibria. The equilibrium concept to be used here is that of Perfect Bayesian Equilibrium, which guarantees that the receivers' strategies are optimal responses to the sender's action (message), given their beliefs. Their beliefs are updated using Bayes' rule and the equilibrium strategy of the sender. Finally, the sender's message maximize his utility given the responses of the receivers.[10]

Proposition 2 *There is a unique Perfect Bayesian Equilibrium of the game described above. The equilibrium is determined by two thresholds that we call $\gamma_1 < 1$ and $\gamma_2 \geq 0$, depicted in the proof.*

(i) *If $\gamma \geq \gamma_1$, T always issues a g report for the company stock. Beliefs remain equal to ν_0.* ***(Pooling.)***

(ii) *If $\gamma_2 < \gamma < \gamma_1$, there are no incentives to always lie. However, there are not enough incentives to be always truthful either. Hence, the insider uses a mixed strategy.* ***(Semi-separating.)*** *More precisely, in the case of good news he always says g, and in the case of bad news he says g with probability p_1, defined as*

$$p_1(\gamma) = \frac{\nu_0}{1-\nu_0}\frac{1-\nu(\gamma)}{\nu(\gamma)}, \tag{15}$$

where $\nu(\gamma)$ is such that

$$h(P(\gamma;\nu(\gamma))) = h(L) + C,\ \forall\, \gamma \in [\gamma_2, \gamma_1] \tag{16}$$

In this region, we have $P(G|g) = \nu(\gamma)$ and, if there is a bad report, then agents attach probability one to the bad state, $P(G|b) = 0$.

(iii) *Finally, if $\gamma \leq \gamma_2$, the insider always tells the truth and is fully believed by investors.* ***(Separating.)***

The actions of the insider are described in the proof.

Proof See appendix. □

The basic idea of the proposition is immediate. We have assumed that, for γ close to zero, liquidation is good when compared to the price given with optimistic beliefs. But, this is exactly the price that would emerge if the insider were to lie and be believed. Hence, for small γ, it is optimal to liquidate in the bad state implying always being truthful. As γ approaches 1, liquidation starts to look unprofitable, so there are incentives to lie.

For very high γ, it is optimal to always lie, even taking into consideration that investors will anticipate this behavior and will not respond to insiders' statements and

[10] For a formal definition and further discussion of Perfect Bayesian Equilibrium see, for example, Fudenberg and Tirole (1998).

that they might be punished. So, for a high enough demand shock, the informed agent always lies in the case of bad news. High γ leads to high demand and high price, enhancing the incentives to lie.

For $\gamma_2 < \gamma < \gamma_1$, he cannot be believed when he says g, otherwise he would lie. If he would always lie, agents would anticipate this. Given beliefs and the potential monetary punishment, he would prefer to liquidate. But, if he prefers to liquidate, lying just gives him extra costs, contradicting the assumption that he lies. Hence, as we show, the only equilibrium is in mixed strategies. When the state is good he always tells the truth and minimizes the punishment costs, and he lies sometimes in the bad state.

For $\gamma < \gamma_2$, we obtain a fully revealing equilibrium where agents correctly anticipate that the informed agent will be honest, and this is indeed the case in equilibrium.

The main point of the proposition is that the presence of "captive demand" may lead to increased incentives to misrepresent the truth. We name this captive since, for a given level of beliefs, for higher γ investors are more willing to hold the stock than for lower γ.

We also have the following.

Proposition 3 *The ex-ante probability of observing lies in equilibrium is increasing in γ.*

Proof The ex-ante probability of lies is

$$(1-\nu_0)\Pr(g|B) = \begin{cases} (1-\nu_0), & \text{for } \gamma \geq \gamma_1; \\ \nu_0 \frac{1-\nu(\gamma)}{\nu(\gamma)}, & \text{for } \gamma_2 < \gamma < \gamma_1; \\ 0, & \text{otherwise.} \end{cases} \tag{17}$$

Notice that $\nu(\gamma_1) = \nu_0$ and $\nu(\gamma_2) = 1$. Given that $\nu(\gamma)$ is decreasing in γ,[11] we have $\nu_0 \frac{1-\nu(\gamma)}{\nu(\gamma)}$ increasing in γ. $\square$

The last proposition states that, as we approach the smaller values of the demand strength parameter, the "amount of lies" is reduced, starting with always lying until no lies at all. In the intermediary region insiders/gurus are able to move the posteriors of investors by following this randomized strategy.

3 Application

In this section, we present a detailed discussion of an application involving social interactions among investors, specific utility functions and a reward function for the

[11] Because $h(P(\gamma;\nu))$ is increasing in ν and γ. Hence, when γ decreases, price decreases. In order to maintain the equality, we need to increase the implied beliefs, i.e., increase ν. Or, more formally,

$$\frac{d\nu}{d\gamma} = -\frac{\frac{\partial h(P(\gamma;\nu))}{\partial \gamma}}{\frac{\partial h(P(\gamma;\nu))}{\partial \nu}} < 0.$$

The inequality follows from the properties of the price function and the fact that $\frac{\partial h(P(\gamma;\nu))}{\partial \nu} < 0$.

insider that is affine on the stock price. More precisely, the insider has shares on the company. The reader may assume that any omitted details remain unchanged. We start by describing the format and the meaning of the demand shock.

3.1 The behavior of social investors

The main goal of this section is to show that the demand for the stock of the so-called social investors is a multiple of the "traditional" demand. If the demand in the standard framework is denoted β, we want the demand coming from the social investors to be $\theta(\gamma)\beta$, with $\theta(.) \geq 1$. Then we just need to associate $\theta(\gamma)\beta$ with what previously was $\alpha(\gamma)$.

In the specific case of 401(k) funds and employees, the result would be one of over-exposure to own company stock. This pattern is empirically pervasive on 401(k) holdings, substantiating the recent discussions of possible regulations on the retirement funds. In what follows, we develop a framework that serves to justify this pattern of 401(k) holdings.[12]

The basic element we try to model is a peer group effect: in a social environment, individuals' actions might be influenced by the actions of others in their peer group.[13]

Several studies in the empirical literature on social interactions run parallel to our interpretation of peer groups and actions. Duflo and Saez (2000) analyzes decisions of employees of a university to enroll in retirement plans and the subsequent choice of vendor. They find suggestive evidence that aggregate peer group decisions influence individual decision, not only on participation, but also on vendor choice.[14] In a similar study, Sorensen (2001) presents strong evidence that peers' choice of Health Plans at the University of California influence individual decisions. He also finds that closer neighbors have stronger influence. Hong et al. (2001) analyzes the effect of social interactions on stock market participation and shows that there is a statistically significant higher participation rate among social investors. This evidence points to the existence of social interactions and the impact of social elements on individual decisions.

To proceed with a formal analysis we set up a situation where individuals are concerned with relative performance. An agent cares about how well he is doing when compared to a benchmark. Namely, he cares about how he is doing in relation to the average individual in the company. This assumption has become known as "Keeping up with the Joneses".[15] The idea is one of consumption externalities. Agents

[12] For a thorough discussion of this framework and the empirical findings of excessive portfolio holdings refer to Pinheiro (2007) and references therein.

[13] For the purpose of this paper the definition of the peer group is mostly immaterial. All we need is the existence of a group of investors that are affected by each other's actions. Accordingly, the actions of interest are the group members' portfolio choices. For illustrative purposes we take the relevant peer group to be the coworkers and actions to be the funds allocated to 401(k) plans.

[14] A 1% increase in the participation in the department leads to an increase of 0.15% in individual participation in the same department. In the vendor choice the elasticity is even bigger, $\frac{1}{2}$ (1% increase leads to 0.5%).

[15] See Abel (1990), Gali (1994) and Campbell and Cochrane (1999), among others.

have preferences over personal consumption as well as over average consumption. The objective, then, is to connect these externalities with the aforementioned demand shock.

The stock has random payoff V and price P. We assume that there are I identical social investors.[16] After the insider's message, they update their beliefs about V.[17] We use E_S and σ_S^2 to denote the updated expected value of the project and its variance, respectively. Other than the stock we allow for the existence of a risk-free bond with gross return R.

Let us depict the optimal portfolio holdings as[18]

$$\beta_i^* = \arg\max_{\beta_i} \mathbb{E}\left[u(w_{i2})\right] = \mathbb{E}\left[u(w_{i1}R + \beta_i\,(V - PR))\right],$$

$$\alpha_{iS} = \arg\max_{\alpha_i} \mathbb{E}\left[u(w_{i2}, W_2; \gamma)\right] = \mathbb{E}\left[u\,(w_{i2} - \gamma W_2)\right],$$

where we define the benchmark as

$$W_2 = \left[\frac{1}{I}\sum_{j=1}^{I}\alpha_j\right](V - PR) =: \alpha\,(V - PR)$$

to reflect the fact that the agent is really interested in comparing his performance in the stock market with that of his peers. α_j to denotes the amount invested in the stock by agent j and γ is a measure of how much the individuals care about others. Finally, w_{i2} is agent i's final wealth.[19]

Since we are interested in having agents trying to keep up with the others, we need $\gamma > 0$. We also want this effect not to be too high, so $\gamma < 1$. In the Non-Market Interactions literature, these assumptions are sometimes referred to as *Strategic Complementarity* and *Moderate Social Influence*, respectively.[20]

In summary, β_i^* is the solution for the purely individualistic portfolio choice problem (non-social) whereas α_{iS} is the solution for the problem with social interactions. When beliefs are identical, we can write the solution as $\beta_i^* = \beta^*$. We concentrate in this case. Notice that, the first-order conditions for the first problem are

$$\mathbb{E}\left[\frac{\partial u(w_{i1}R + \beta_i\,(V - PR))}{\partial w_{i2}}\,(V - PR)\right] = 0,\ \forall i.$$

[16] The model can easily be extended to allow for heterogeneity.

[17] In models of this sort, agents usually condition on prices as well as their private information. However, in the present setting, price will only reflect information already possessed by agents. Hence, there is no need to further condition on price when updating beliefs.

[18] Note that we have made use of the agent's budget constraint:

$$w_{i2} = (w_{i1} - \beta_i P)\,R + \beta_i V.$$

[19] Where w_{i1} is the deterministic initial wealth.

[20] See, for instance, Glaeser and Scheinkman (2002).

Assume β_i^*, $i \in \{1, \ldots, I\}$, is the unique solution to this system of equations.

The second problem may be rewritten as

$$\max_{\alpha_i} \mathbb{E}\left[u(w_{i1}R + (\alpha_i - \gamma\alpha)(V - PR))\right], \tag{18}$$

which has first-order conditions

$$\mathbb{E}\left[\frac{\partial u(w_{i1}R + (\alpha_i - \gamma\alpha)(V - PR))}{\partial w_{i2}}(V - PR)\left(1 - \frac{\gamma}{I}\right)\right] = 0,\ \forall i.$$

Then, it is easy to show that

$$\alpha_{iS} = \frac{1}{1-\gamma}\beta^*,\ \forall i, \tag{19}$$

which exactly has the functional form we need, with $\theta(\gamma) = \frac{1}{1-\gamma}$.

If we restrict the utility function to be of the mean-variance family, i.e. the agents solve

$$\max_{\alpha_i} \mathbb{E}[w_{i2} - \gamma W_2] - \frac{1}{2}\rho Var[w_{i2} - \gamma W_2], \tag{20}$$

then

$$\alpha_{iS} = \frac{1}{1-\gamma}\frac{[E_S - PR]}{\rho\sigma_S^2},\ \forall i = 1, \ldots, I. \tag{21}$$

We adopt this specification in what follows.

3.2 Equilibrium analysis

At $t = 0$ an informed trader (T) holds m_1 shares of a company that has m shares outstanding, i.e., it is the maximum possible supply, available if the informed agent sells his shares. The rest of the market is comprised of m_2 shares with $m_1 + m_2 = m$, and $m_1 > m_2$. This gives the trader enough power to liquidate the company unilaterally. As before the company's quality is uncertain. At $t = 1$, the insider has the option to liquidate the firm or to sell the shares. We assume here that, if he does not liquidate, he has to sell the shares. Later we allow for the insider to be hit by a liquidity shock with some probability. If hit by this shock he has to sell the shares (or liquidate), otherwise he can hold on to them.[21] Results are qualitatively the same, but the ex-ante probability of lies changes, and we analyze how it changes in the appropriate section. The rest of the model is identical to what was previously described.

The market is comprised of two types of investors: Socials (S) and Non-Socials (N). The Non-Socials represent a measure λ of the market while Socials constitute a measure $1 - \lambda$.

As before, the company is good with prior probability of $\nu_0 > 1/2$ and bad with complementary probability. However, we impose a more detailed set of assumptions on the payoffs. These assumptions are analogous to the ones made before in this

[21] We approach the problems in two ways depending if these shocks are observed or not.

"mean-variance" set-up. We assume that, if the company is good, it has expected value $\mathbb{E}\left[\widetilde{V}^H\right]$ and variance σ_H^2. If the company is bad, then the moments are $\mathbb{E}\left[\widetilde{V}^L\right] = 0 < \mathbb{E}\left[\widetilde{V}^H\right]$ and variance $\sigma_L^2 > \sigma_H^2$.[22] The interpretation for these distributional assumptions comes again from the format of investors' preferences. Alternatively, we could have allowed for the same expected value and higher variance as long as we guaranteed that the price arising (with perfect information) in the bad state would be smaller than the liquidation value. Results would then follow with some minor modifications to the arguments provided here. We define the ex-ante variance by σ_0^2. This variance can be easily shown to equal [23]

$$\nu_0 \sigma_H^2 + (1 - \nu_0)\, \sigma_L^2 + \nu_0 (1 - \nu_0) \left(\mathbb{E}\left[\widetilde{V}^H\right]\right)^2 .$$

Note that the derivative of this ex-ante variance with respect to the prior probabilities is negative.[24] Also, notice that $\sigma_0^2 > \sigma_H^2$, since

$$(1 - \nu_0) \left(\sigma_L^2 - \sigma_H^2\right) + \nu_0 (1 - \nu_0) \left(\mathbb{E}\left[\widetilde{V}^H\right]\right)^2 > 0 \tag{22}$$

This property will be useful later and is valid for any ex-ante probability bounded away from 1.

Liquidation gives a payoff of L per share and can only occur at $t = 1$. After that, the liquidation value is zero.

Analogously to the Social investors, N update their beliefs after the report. Since all information is symmetrical and investors have common priors, they will have identical posteriors: $\mathbb{E}$ standing for the expected value, and σ^2 for the variance. Given these

22 The assumption of zero expected value and positive variance for the bad company might appear unsettling since it would imply positive probability of negative realizations of V, an unpleasant characteristic for equity. However, it is just a simplification. We could assume that V has a support bounded below by zero. Then, as long as we kept all other assumptions and assumed that $\mathbb{E}\left[\widetilde{V}^L\right] < L$, all results would follow with irrelevant modifications to the arguments.

23 Make use of the following formula:

$$Var\,[\phi\,(X, Y)] = \mathbb{E}_X\,(Var_Y\,[\phi|X]) + Var_X\,(\mathbb{E}_Y\,[\phi|X])\,,$$

where, for instance, $\mathbb{E}_X$ is the expected value with respect to the distribution of the random variable X.

24 It is equal to

$$\sigma_H^2 - \sigma_L^2 + (1 - 2\nu_0) \left(\mathbb{E}\left[\widetilde{V}^H\right]\right)^2 < 0,$$

where the inequality follows since $\nu_0 > \frac{1}{2}$ and $\sigma_H^2 < \sigma_L^2$. This holds for any ex-ante probability bigger than $\frac{1}{2}$.

beliefs, we are able to characterize the investors' demands. We first postulate their utility functions:

$$u_S(w_{S2}, W_2; \gamma) = \mathbb{E}[w_{S2} - \gamma W_2] - \frac{1}{2}\rho Var[w_{S2} - \gamma W_2]; \tag{23}$$

$$u_N(w_{N2}) = \mathbb{E}[w_{N2}] - \frac{1}{2}\rho Var[w_{N2}]; \tag{24}$$

where agents' final wealth can be written as

$$w_{i2} = (w_{i1} - \alpha_i P)\, R + \alpha_i V, \text{ for } i \in \{S, N\}. \tag{25}$$

We, then, get the following demand functions for the risky asset:

$$\alpha_S = \frac{1}{1-\gamma}\frac{[\mathbb{E} - PR]}{\rho\sigma^2}; \quad \alpha_N = \frac{[\mathbb{E} - PR]}{\rho\sigma^2}. \tag{26}$$

Note that the aggregate demand is given by

$$\lambda\frac{[\mathbb{E} - PR]}{\rho\sigma^2} + (1-\lambda)\frac{1}{1-\gamma}\frac{[\mathbb{E} - PR]}{\rho\sigma^2} = \frac{[\mathbb{E} - PR]}{\rho\sigma^2}\frac{1-\lambda\gamma}{(1-\gamma)}, \tag{27}$$

which clearly respects the required general properties used before. The market clearing condition determines price:

$$\frac{[\mathbb{E} - PR]}{\rho\sigma^2}\frac{1-\lambda\gamma}{(1-\gamma)} - m_1 = m_2;$$

$$\frac{[\mathbb{E} - PR]}{\rho\sigma^2}\frac{1-\lambda\gamma}{(1-\gamma)} = m. \tag{28}$$

Therefore, we can express the price as a function of 2 parameters (1 exogenous and 1 endogenous), $P(\gamma, \nu)$.[25] The following assumption is the analog to **A1**.

A1': The liquidation value is assumed to satisfy:

$$L + C > P(0, 1) = \frac{1}{R}\left[\mathbb{E}\left[\widetilde{V}^H\right] - m\rho\sigma_H^2\right] > 0 \tag{29}$$

$$L + C < \lim_{\gamma\to 1} P(\gamma, \nu_0) = \frac{1}{R}\nu_0\mathbb{E}\left[\widetilde{V}^H\right] < \frac{1}{R}\mathbb{E}\left[\widetilde{V}^H\right]. \tag{30}$$

As before, there will be instances in which the insider will randomize. Upon this randomization, assume that the strategy and their updating lead them to believe that $\Pr(G|g) = \nu$. In this case the stock price can be written as

$$P_\nu(\gamma) := \frac{1}{R}\left[\nu\mathbb{E}\left[\widetilde{V}^H\right] - m\rho\sigma_\nu^2\frac{(1-\gamma)}{1-\lambda\gamma}\right], \tag{31}$$

[25] The belief to be formed by the investors, ν, actually determines $\mathbb{E}$ and σ^2.

where σ_ν^2 is just the ex-ante variance if agents attach probability ν to the good state, i.e.:

$$\sigma_\nu^2 = \nu\sigma_H^2 + (1-\nu)\,\sigma_L^2 + \nu\,(1-\nu)\left(\mathbb{E}\left[\widetilde{V}^H\right]\right)^2. \tag{32}$$

We show later on this section that, even though it might be optimal to lie once a bad state has been observed, T would prefer to commit to telling the truth if he could. That is, the ex-ante expected utility from lying is strictly smaller than the one under truth telling. However, no such attempt can be credible if there are lies in equilibrium. The following is the analog to Proposition 2.

Proposition 4 *There is a unique Perfect Bayesian Equilibrium of the game described above. The equilibrium is determined by two thresholds that we call $\gamma_1 < 1$ and $\gamma_2 \geq 0$, depicted in the proof.*

(i) *If $\gamma \geq \gamma_1$, T always issues a g report for the company stock. Beliefs and prices are as described in the above discussion.* ***(Pooling.)***

(ii) *If $\gamma_2 < \gamma < \gamma_1$, there are no incentives to always lie. However, there are not enough incentives to be always truthful either. Hence, the insider uses a mixed strategy.* ***(Semi-separating.)*** *More precisely, in the case of good news he always says g, and in the case of bad news he says g with probability p_1, defined as*

$$p_1(\gamma) = \frac{\nu_0}{1-\nu_0}\frac{1-\nu(\gamma)}{\nu(\gamma)}, \tag{33}$$

where $\nu(\gamma)$ is such that

$$P_{\nu(\gamma)}(\gamma) = L + C,\ \forall\,\gamma \in \left[\gamma_2, \gamma_1\right] \tag{34}$$

We have, in this region, $P(G|g) = \nu(\gamma)$ and if there is a bad report then agents attach probability one to the bad state, $P(G|b) = 0$.

(iii) *Finally, if $\gamma \leq \gamma_2$, the insider always tells the truth and is fully believed by investors this time. Price is as characterized before.* ***(Separating.)***

The actions of the insider are described in the proof.

Proof This proposition is basically an application of the more general result discussed before. In the proof, presented in the appendix, we just need to check that the properties used before are verified here. □

The basic idea of the proposition is the same The only difference is on the interpretation of the demand shock parameter. The demand shock now happens because of the peer group effect present in the utility function of these investors. Since they are concerned with relative performance, they end up holding more of the company stock. For their holdings to be equal to the outsiders', they would have to expect a lower return, or higher variance, or a combination of both. This characteristic leads to a higher demand for higher γ.

We now show that if T could commit to telling the truth he would do so. Because the equilibrium ex-ante expected utility is strictly smaller than the one under truth telling.

Proposition 5 *Assume γ to be ex-ante distributed on the unit interval according to a continuously differentiable cumulative distribution function $F(.)$. This parameter is common knowledge at the very beginning of period 1 before any market interactions, ensuring that the model is the same as before. Then, ex-ante (before the realization of γ) and ex-post (after the realization of γ, but before the quality of the project is known) the insider would like to commit to a fully truthful equilibrium.*[26]

Proof See Appendix. □

Proposition 5 can be interpreted as a reason why one might observe practices like the Chinese Wall emerging internally in Wall Street firms. These practices should be seen as an attempt at separating their investment-banking arm from their research arm, in order to try and credibly eliminate the conflicts of interest present in an institution that has these two arms. One might ask, then, why we do not observe these institutions unilaterally deciding to go their own ways. The first observation is that research does not pay for itself, so the research arm needs someone to pay for his or her services. But, why is the other arm willing to pay for these services? We have just shown that this arm is better off with independent research firms that have the potential to credibly commit to being honest. So, why do they keep their analysts? The answer basically rests on the fact that the investment-banking arm needs to attract clients. These clients usually are companies that will later be taken public by them. These companies know that once they go public they will need analyst coverage. This is true since popular knowledge assumes the existence of an implicit understanding that underwriters will assign analysts to research the company and issue buy recommendations for the stock. Chen and Ritter (2000) presents evidence of an increased number of co-managers in IPOs, they take this as an indication that the issuing firm is basically buying additional coverage. This interpretation suggests that issuing companies "like" analyst coverage, it is a coveted commodity. Hence, it would be hard for an investment bank to be able to attract clients if it had no research arm. This is especially true given the structure of the IPO market in the United States, where the spreads charged by underwriters are above competitive levels, clustered around 7%.[27]

3.3 Liquidity shocks

In this section we briefly discuss the consequences of relaxing the assumption that the insider always sells his shares at period 1.

We now assume that at period 1 he is hit by a liquidity shock with probability δ, in which case he has to sell all shares on the company.[28] With complementary probability the informed trader might, but does not have to, sell his shares.

[26] Actually, since the statement is true ex-post, it is trivially true ex-ante. If the payoff is bigger under the separating equilibrium for each γ, then, by integrating over γ, we will also get an ex-ante payoff that is larger.

[27] See Chen and Ritter (2000) for an analysis of this clustering and possible explanations for it.

[28] If the insider is a Wall Street firm, this liquidity shock can be seen as clients requiring to withdraw funds from their accounts, or may be the discovery of a more profitable investment opportunity. More generally, it may just be a simple need for liquidity to pay for expenses.

The analysis of this extension depends crucially on the observability of this shock by investors and on the degree of anonymity in the market. Throughout this extension we assume that the insider cannot trade anonymously. In our model m_1 is known, and so is γ. Therefore, agents can see if there was any trading from the informed agent or not by observing prices. Besides, we know that there are laws prohibiting insiders from trading anonymously. Then, our assumption is obviously justifiable.

We divide this section into two subsections based on the assumption of observability of the liquidity shock. We first assume that all agents observe the liquidity shock. This assumption is very restrictive and we adopt it merely as a starting point. In the second part of the section we allow for unobservable liquidity shocks. Results are qualitatively the same under both assumptions. Finally, we compare the ex-ante probability of lies arising in each of the three equilibria discussed.

3.3.1 Observable shocks

Assume that the shocks are observable and common knowledge. We have the following Proposition.[29]

Proposition 6 *If T tries to sell the stock in the absence of a liquidity shock, then S and N correctly anticipate that the state is bad and offer less than L for the asset. Hence, he never sells in the absence of a liquidity shock. In the case of good news he holds on to the project, in the case of bad news he liquidates the company. If there is a liquidity shock, all the analysis from the previous section follows.*

This implies that, even though the main results do not change, there is a change in the situation of the market. Now, if the possibility of a liquidity shock is very close to zero so that the informed agent almost always holds on to the project, the risk of the project is almost entirely borne by him.

3.3.2 Unobservable shocks

We now allow the liquidity shock to be unobservable. Before proceeding, we need to introduce further notation. First, let δ denote not only the probability of the liquidity shock, but also the state in which there is a liquidity shock. We adopt the analogous notation for the complementary case. Also, let $\pi(j)$ denote the probability that the insider sells (or liquidates) in state $(1-\delta, j) \in \{(1-\delta, G); (1-\delta, B)\}$.[30] Finally, we define $p_{i,j}(\gamma)$ to be the probability that the insider issues a g report in state $(i, j) \in \{(\delta, G); (\delta, B); (1-\delta, G); (1-\delta, B)\}$, e.g., $p_{1-\delta,B}(\gamma)$ is the probability that the insider says g when he is not hit by a liquidity shock and the state is bad.

Given this strategy, we can easily calculate the updating rule of investors, i.e., the posterior probability attached to the good state given that the informed trader did not

29 The proof is omitted, but can be obtained from the author upon request.

30 By definition this probability in state δ is just 1.

hold on to the shares (represented by s)[31] and issued a good report. To be explicit, we get

$$\Pr\left(G|\left\{g,s\right\}\right) = \frac{\nu_0\left[\delta p_{\delta,G}(\gamma)+(1-\delta)\,p_{1-\delta,G}(\gamma)\pi\,(G)\right]}{\nu_0\left[\delta p_{\delta,G}(\gamma)+(1-\delta)\,p_{1-\delta,G}(\gamma)\pi\,(G)\right]+(1-\nu_0)\left[\delta p_{\delta,B}(\gamma)+(1-\delta)\,p_{1-\delta,B}(\gamma)\pi\,(B)\right]}.$$

We further assume that

$$L+C<\lim_{\gamma\to 1}P(\gamma,\overline{\nu})=\frac{1}{R}\overline{\nu}\mathbb{E}\left[\widetilde{V}^H\right], \tag{35}$$

where

$$\overline{\nu}=\frac{\nu_0\delta}{1-\nu_0+\nu_0\delta}. \tag{36}$$

The case in which this assumption is violated has a straightforward solution and is left to the interested reader.[32] We concentrate on one specification of parameters, $\delta>\nu_0$. However, the structure of the propositions and the proofs for other cases can be derived without difficulty.

Proposition 7 *Three thresholds, γ_1^{++}, γ_1^{+} and γ_2 (all inside the unit interval), determine the equilibrium. In equilibrium T adopts the following strategy:*

(i) *If $\gamma\geq\gamma_1^{+}$, T always issues a g report for the company stock and sets*

$$\pi\,(j)=\begin{cases}0, & \text{if } j=G;\\ 1, & \text{if } j=B.\end{cases} \tag{37}$$

Beliefs are equal to $\overline{\nu}$. ***(Pooling.)***

(ii) *If $\gamma_2<\gamma<\gamma_1^{+}$, $\pi\,(j)$ is as above, $\nu(\gamma)$ is such that*

$$\frac{1}{R}\left[\nu(\gamma)\mathbb{E}\left[\widetilde{V}^H\right]-m\rho\sigma^2_{\nu(\gamma)}\frac{(1-\gamma)}{1-\lambda\gamma}\right]=L+C,\ \forall\,\gamma\in\left[\gamma_2,\gamma_1^{+}\right]. \tag{38}$$

We characterize $p_{i,j}(\gamma)$ in two sub cases as

1− *If $\gamma_1^{++}<\gamma<\gamma_1^{+}$:*

$$p_{i,j}(\gamma)=\begin{cases}\frac{\nu_0}{1-\nu_0}\frac{1-\nu(\gamma)}{\nu(\gamma)}-\frac{1-\delta}{\delta}, & \text{if } (i,j)=(\delta,B)\,;\\ 1, & \text{if } (i,j)=(1-\delta,G)\cup(\delta,G)\\ 1, & \text{if } (i,j)=(1-\delta,B)\end{cases} \tag{39}$$

2− *If $\gamma_2<\gamma<\gamma_1^{++}$:*

$$p_{i,j}(\gamma)=\begin{cases}0, & \text{if } (i,j)=(\delta,B)\,;\\ 1, & \text{if } (i,j)=(1-\delta,G)\cup(\delta,G)\\ \frac{\nu_0}{1-\nu_0}\frac{1-\nu(\gamma)}{\nu(\gamma)}\frac{\delta}{1-\delta}, & \text{if } (i,j)=(1-\delta,B)\end{cases} \tag{40}$$

[31] We use s to represent *sale*. As a matter of fact, beliefs in the event of liquidation play no role in the equilibrium. Hence, one could in fact interpret s as the situation where T sells the shares.

[32] One only needs to slightly alter the proposition below. Specifically, without this assumption we have that $\gamma_1^{+}>1$. And, since $\gamma\in[0,1)$, the first region of the equilibrium disappears. The proof is identical.

Then, in both sub-cases, we have $P(Good|g, s) = \nu(\gamma)$. If there is a bad report, agents attach probability one to the bad state, $P(Good|b) = 0$. ***(Semi-separating)*** *Note that, if hit by a liquidity shock, in the bad state T is honest. Therefore he will have to liquidate the company.*

(iii) *Finally, if $\gamma \leq \gamma_2$, T always tells the truth, to be fully believed by investors.* ***(Separating.)*** *When hit by a liquidity shock, he may liquidate, instead of selling, even in the presence of good news. In the case of bad news, he always liquidates. In the case of good news and no liquidity shock, he always holds on to the shares.*

Proof See appendix. □

Hence, the same type of results obtained without liquidity shocks, or with observable shocks, remains valid with unobservable shocks. As shown in the proof, $\gamma_1 < \gamma_1^+$. Therefore, the region where there are always lies in the bad state is reduced by the presence of this unobservable liquidity shock. In turn, the semi-separating region is increased and the region of truthfulness is intact.

As a final result, we point out that we can actually rank the equilibria described in this application based on the expected ex-ante probability of lies. The following proposition explores and summarizes the outcome of this insight.

Proposition 8 *Let Π^1, $\Pi^{\delta,O}$ and $\Pi^{\delta,U}$ denote the ex-ante probability of lies in the model where T has to always sell, the model with observable liquidity shocks and the model with unobservable shocks, respectively. Then,*

$$\Pi^1 > \Pi^{\delta,U} > \Pi^{\delta,O}. \tag{41}$$

Proof See Appendix. □

Simply put Proposition 8 reveals that the informed trader has a better chance of distorting beliefs when the sales are less informative.

4 Discussion and conclusion

We showed, in Proposition 2 and/or 4, that it might be an equilibrium for Wall Street analysts to lie, even though agents are rational and there are punishments associated with it. This is the exact implication of the model if we believe in the assumption that research analysts benefit from higher stock prices, a very realistic one. Gompers and Lerner (1998) argues that the market does appear to perceive conflicts of interest at IPO if the underwriter has a stake on the company (through a venture capitalist branch). They find that issues underwritten by investment banks that are also venture investors are sold at a greater discount. This discount is thought to be compensating the investors for potential adverse selection problems. These findings are in accordance with our results. The market discounts the informational content of the informed agent's reports. Upon observing a positive report, investors anticipate that it may be tainted and they update their beliefs accordingly, not taking it at face value.

An article in the New York Times[33] argues that Merrill Lynch replaced an analyst who had angered Enron executives. The analyst had downgraded the stock to "neutral". His replacement upgraded it shortly after. Apparently, according to a memo circulated among Merrill executives, the brokerage firm had lost a lucrative underwriting deal. Merrill denies the alleged link between this loss and the stock rating. Add to this the fact that by the end of the 1990s 70% of stocks carried a buy recommendation and only 1% carried a sell. And, forecasted earnings were 6% higher in firms with an investment-banking arm than in firms without these ties as well as there were 25% more buy recommendations. Finally, The New York Times reported on April 9, 2002 that Merrill Lynch was under scrutiny of the attorney general of New York, Mr. Eliot L. pitzer, for issuing "tainted" investment advice. [34] A court order was issued mandating that M.L. disclose on their research reports if the company being analyzed has any ties, or potential future ties, with its investment-banking arm. So, overoptimism (or the pressure for it) seems to be pervasive, especially among firms that may benefit from inflated stock prices.

Clearly, in these situations, there is more at play than just incentives coming from a sort of captive demand. For instance, a lot of Wall Street firms receive payments from companies that they are also researching. These payments are usually fees for services provided by the investment-banking arm of the firm. This would only enhance the incentives to lie, since by issuing a sell recommendation they would have to liquidate the company losing all future fees. Even if the company was not liquidated after a sell recommendation, it might be the case that the company threatens to take its business elsewhere. So, the other issues at play seem to reinforce the idea that conflicts of interest exist.

In one application of our model we obtain an excessive holding of the company stock in the part of the employees when compared to purely individualistic outsiders. The extent of the excessiveness depends basically on 2 factors, the general level of optimism, reflected in employees' beliefs, and the degree of externalities, how much they care about their peers' performance in the holdings of the company stock, reflected in γ. The stronger the externalities, the more accentuated will be the effect of the social interactions on the distortion of the portfolio holdings. Similarly, the more optimistic the workers of a firm are, the higher the distortion. This would help explain the extreme holdings in companies like Enron and the destructions of employees' 401(k) funds. The executives were certainly trying to make the employees believe that the company, and they, had a brilliant future ahead. This could have been translated into excessive optimism regarding the company's stock performance, generating the pattern of holdings observed in this company 401(k). Also, the stronger the interaction between employees in one company, presumably, the higher γ should be. So, in companies with strong interactions the holdings would be even more excessive. If a measure of the degree of social integration is the number and dimension of social events in a company, then, by these standards, Enron was a company with strong interactions. Data released upon its investigation by the FBI revealed that weeks before the

[33] Oppel Jr. (2002).

[34] This matter and several other law suits have been settled by now. Merrill paid a fine and agreed to reveal if the company being researched is a (potential) client. As did most of other Wall Street firms involved.

bankruptcy Enron had set apart \$1.5 million for the 2001 company Christmas party. Also, it used to send employees out on vacations on resorts; all paid by the company, and had several parties per year. So, it seems that the amount of social contact was huge, from which we could conclude that the social interactions were significant as well. Hence, we would assign a relatively high γ for Enron. This combined with the excessive optimism can certainly account for the investment pattern of its employees.

We also see that the likelihood of observing these debacles is determined basically by 2 parameters: γ and ν_0. If we allow an increase in the social interactions parameter, or the demand shock in general, the incentives to lie are increased. And, as the likelihood of a bad project increases, i.e., $1 - \nu_0$ goes up, we would observe more losses. It is important to notice that in the first case, if employees could not invest in company stock (or were limited to investing less than a certain amount), then the loss would be borne by the informed traders (and anybody else selling at that point). In the second case, independently of lies existing or not, the cost would be partially borne by employees. So, this does not seem to be a perverse effect of lying, while the first effect certainly is.

In summary, this paper provided a model to help explain the recent cases of lawsuits based on the allegation that Wall Street firms are hiding, or even distorting, information in their reports. It also provided a formal model of the incentives for CEOs, and insiders in general, to divulge misleading information.

In terms of policy recommendation, it should be noted that more direct legislation should be put forth and that this would not necessarily hurt Wall Street firms. With this model we showed that if the firm could commit to being honest it would prefer that to lying. Hence, with exogenously imposed restrictions this commitment might be credible, allowing the firm to expect higher returns than in the absence of such regulations, ex-ante.

As a further policy recommendation, we note that a restriction on the maximum amount allowed to be allocated to own company stock in 401(k) funds could be a welfare increasing measure. By putting a cap on this amount, regulators could attenuate the overexposure of employees and at the same time reduce the profitability of lies. Overall, this would protect employees' welfare. This would hold true even if the legislation would not be able to prevent lies.

A Proof of Proposition 1

Notice that we assumed

$$h(L) + C > \lim_{\gamma \to 0} h(P(\gamma; 1)) \tag{42}$$

$$h(L) + C < \lim_{\gamma \to 1} h(P(\gamma; \nu_0)) \tag{43}$$

So, for small γ, it is not worth lying. T is better off liquidating the asset and telling the truth. However, for γ close to 1, it is optimal to lie. In order to show the existence of a unique pair (γ_1, γ_2) with the desired properties. We first note that $\frac{\partial h(P(\gamma;\nu))}{\partial \gamma} > 0$ and $\frac{\partial h(P(\gamma;\nu))}{\partial \nu} > 0$. Now we define the parameters

$$h\left(P(\gamma_1; \nu_0)\right) = h\left(L\right) + C; \quad h\left(P(\gamma_2; 1)\right) = h\left(L\right) + C. \tag{44}$$

Given the above properties of the price function and the assumptions we made, we know that these parameters exist and are unique. And, since $h\left(P(\gamma; 1)\right) > h\left(P(\gamma; \nu_0)\right)\ \forall\gamma$, we have $\gamma_1 > \gamma_2$.

Assume that $\gamma \geq \gamma_1$. The optimal strategy is to lie in the case of bad news and collect the reward iff $h\left(P(\gamma; \nu_0)\right) - C > h\left(L\right)$, this is verified given our definitions. In case of good news the insider also collects the reward since $h\left(P(\gamma; \nu_0)\right) > h\left(L\right)$. So, liquidation is not optimal.

Now let $\gamma \leq \gamma_2$. In this case, we have $h\left(P(\gamma; 1)\right) - C < h\left(L\right)$ by definition of γ_2. Assume that the investors believe the reports. In the case of bad news then, if the informed agent is truthful, he can only get $h\left(L\right)$. If he deviates and lies, he expects to get $h\left(P(\gamma; 1)\right) - C < h\left(L\right)$. So, he sticks with the truth and liquidates the firm (before, he issues a sell recommendation). In the case of good news, if he follows the equilibrium, he can get $h\left(P(\gamma; 1)\right)$ by collecting the reward or $h\left(L\right)$ by liquidating. So, he sells if $h\left(P(\gamma; 1)\right) \geq h\left(L\right)$ and liquidates otherwise. However, no matter what, he is truthful since by deviating he can only get L.

Finally, assume $\gamma_2 < \gamma < \gamma_1$. We first need to show the existence of the postulated $\nu\left(\gamma\right)$ function. We know that $h\left(P(\gamma_1; \nu_0)\right) = h\left(L\right) + C$ and $h\left(P(\gamma_2; 1)\right) = h\left(L\right) + C$. Hence, we must have $\nu(\gamma_1) = \nu_0$ and $\nu(\gamma_2) = 1$. We also have that $\frac{\partial h(P(\gamma;\nu))}{\partial \gamma} > 0$ and $\frac{\partial h(P(\gamma;\nu))}{\partial \nu} > 0$. Notice that with our assumptions $h\left(P(\gamma; \nu)\right)$ is a continuous function. So, it is trivial to see that for every $\gamma_2 < \gamma < \gamma_1$ there exists a ν, potentially dependent on γ, such that if beliefs are equal to this ν we have $h\left(P(\gamma; \nu\left(\gamma\right))\right) = L + C$.[35]

Let us turn now to the strategy of the informed agent and the beliefs he generates.

First, conjecture that T adopts the following strategy: If the state is good, he says g with probability $p\left(\gamma\right)$ and b with complementary probability (and liquidates the firm). If the state is bad, he says g with probability $p_1\left(\gamma\right)$. If this is the strategy followed by the insider, then investors will have beliefs given by

$$P(G|g) = \frac{\nu_0 p\left(\gamma\right)}{\nu_0 p\left(\gamma\right) + \left(1 - \nu_0\right) p_1\left(\gamma\right)}.$$

We want that $P(G|g) = \nu(\gamma)$. Hence, we need

$$\frac{p_1\left(\gamma\right)}{p\left(\gamma\right)} = \frac{\nu_0}{1 - \nu_0} \frac{1 - \nu(\gamma)}{\nu(\gamma)}.$$

It is clear that the proposed probabilities, $p\left(\gamma\right) = 1$ and $p_1\left(\gamma\right) = \frac{\nu_0}{1-\nu_0} \frac{1-\nu(\gamma)}{\nu(\gamma)}$ work fine.

35 We know that $\frac{d\nu}{d\gamma} = -\frac{\frac{\partial h(P(\gamma;\nu))}{\partial \gamma}}{\frac{\partial h(P(\gamma;\nu))}{\partial \nu}}$. Consequently, one could think of constructing the function using the following approximation $\nu\left(\gamma_1 + d\gamma\right) = \nu_0 - \frac{\frac{\partial h(P(\gamma;\nu))}{\partial \gamma}}{\frac{\partial h(P(\gamma;\nu))}{\partial \nu}} d\gamma$, where $d\gamma < 0$.

Now, notice that the ex-ante expected cost of punishment for lies, for any strategy, is equal to

$$\{\nu_0 (1 - p(\gamma)) + (1 - \nu_0) p_1(\gamma)\} C.$$

Since we have that $\nu_0 > \frac{1}{2}$, it is trivial that $\nu_0 > 1 - \nu_0$. Hence, we want to minimize $(1 - p(\gamma))$ and this delivers the desired result, $p(\gamma) = 1, \forall\gamma$.

Finally, we need to check that there is no other strategy that dominates this one, that there are no incentives to deviate. Suppose we are in the bad state. Consider deviating to $p_1'(\gamma)$. We need to show that

$$\begin{aligned} &p_1(\gamma) h(P(\gamma; \nu(\gamma))) + \left[1 - p_1(\gamma)\right] h(L) - p_1(\gamma) C \\ &\quad \geq p_1'(\gamma) h(P(\gamma; \nu(\gamma))) + \left[1 - p_1'(\gamma)\right] h(L) - p_1'(\gamma) C. \end{aligned}$$

By rearranging, we know that this is true if and only if

$$\left[p_1(\gamma) - p_1'(\gamma)\right]\left[h(P(\gamma; \nu(\gamma))) - C - h(L)\right] \geq 0. \tag{45}$$

This requires that for $p_1(\gamma) > p_1'(\gamma)$, $h(P(\gamma; \nu(\gamma))) \geq C + h(L)$, and that for $p_1(\gamma) < p_1'(\gamma)$, $h(P(\gamma; \nu(\gamma))) \leq C + h(L)$. Hence, for this to hold for any deviation, we need that $h(P(\gamma; \nu(\gamma))) = C + h(L)$. This is exactly what the definition of $\nu(\gamma)$ guarantees. So, there are no incentives to deviate in the case of bad news.

Let us turn now to the case of good news. In this case, the only possible deviation is to a $p'(\gamma) < p(\gamma) = 1$. We need to show that[36]

$$\begin{aligned} h(P(\gamma; \nu(\gamma))) \;\geq\; &p'(\gamma) h(P(\gamma; \nu(\gamma))) + \left[1 - p'(\gamma)\right] h(L) \\ &\Leftrightarrow \left[1 - p'(\gamma)\right]\left[h(P(\gamma; \nu(\gamma))) - h(L)\right] \geq 0. \end{aligned}$$

The last inequality holds, actually in its strict form, since $h(P(\gamma; \nu(\gamma))) = C + h(L) > h(L)$. We are done.[37]

[36] One should notice that, as mentioned before, we are assuming that liquidation is an uttermost right of the informed agent. That is, if lies lead to liquidation, then these lies will ultimately not be punished. Because no harm was done to the investors at the end. So, in the good news case, if the insider lies and issues a sell recommendation, beliefs will be such that the asset is worthless to risk-averse buyers. Hence, liquidation obtains and no punishment is inflicted on him. That is the reason why there are no punishment costs associated with the deviation. It holds true that even if there were costs associated with this deviation, this strategy would still be optimal.

[37] We assumed there exists a randomizing device available. After observing the bad state, he can use this randomizing device to say g with a certain probability. By the definition of a mixed strategy equilibrium, after this randomizing device has acted, he does not have incentives to try and go against the "recommended" action. So, he can actually credibly commit to use this device that tells him to randomize with certain probability for each $\gamma_2 < \gamma < \gamma_1$. And then, the investors are justified to hold the beliefs described above.

B Proof of Proposition 3

From **A1'**, we have $P_{\nu_0}(0) < P_1(0) < L + C < \lim_{\gamma \to 1} P_{\nu_0}(\gamma) < \lim_{\gamma \to 1} P_1(\gamma)$. Notice that

$$\frac{\partial P_\nu(\gamma)}{\partial \gamma} = \frac{1}{R}\left[m\rho\sigma_\nu^2 \frac{1-\lambda}{(1-\lambda\gamma)^2}\right] > 0;$$

$$\frac{\partial P_\nu(\gamma)}{\partial \nu} = \left\{\frac{1}{R}\left[\mathbb{E}\left[\widetilde{V}^H\right] - \frac{\partial \sigma_\nu^2}{\partial \nu} m\rho \frac{(1-\gamma)}{1-\lambda\gamma}\right]\right\} > 0$$

$$\frac{\partial^2 P_\nu(\gamma)}{\partial \gamma^2} = \frac{1}{R}\left[m\rho\sigma_\nu^2 \frac{2\lambda(1-\lambda\gamma)(1-\lambda)}{(1-\lambda\gamma)^4}\right] > 0.$$

for any $\nu \geq \nu_0 > \frac{1}{2}$, where the second and the third inequalities follow since we have shown that $\frac{\partial \sigma_\nu^2}{\partial \nu} < 0$. Hence, $P_\nu(\gamma)$ is a continuous, increasing and convex function of γ. Now we define the parameters $P_{\nu_0}(\gamma_1) = L + C$ and $P_1(\gamma_2) = L + C$.Given the above properties of the price function and the assumptions we made, we know that these parameters exist and are unique. And, since $P_1(\gamma) > P_{\nu_0}(\gamma)\ \forall\gamma$, we have $\gamma_1 > \gamma_2$. The rest of the proof is analogous to the previous one, just using the identity function in place of $h(.)$, and is therefore omitted.

C Proof of Proposition 4

Let us first define a new threshold $P_1(\gamma_3) = L$. Notice that we can certainly say that $\gamma_1 > \gamma_2 > \gamma_3$. We can calculate the expected utility under truth telling, the commitment equilibrium. If the insider is telling the truth and is believed, he can obtain ex-post[38]

$$EU(\gamma) = \begin{cases} \left[\nu_0 P_1(\gamma) + (1-\nu_0)L\right]R, & \text{if } \gamma \geq \gamma_3, \\ LR, & \text{if } \gamma < \gamma_3 \end{cases}.$$

Ex-ante he gets

$$\mathbb{E}_\gamma\left[EU(\gamma)\right] = \int_0^1 EU(\gamma)\,dF(\gamma)$$

$$= \left\{\int_{\gamma_3}^1 \left[\nu_0 P_1(\gamma) + (1-\nu_0)L\right]dF(\gamma) + F(\gamma_3)L\right\}R.$$

[38] We assume that the proceeds from the sale of shares or liquidation of the project at $t = 1$ are invested in the risk-free bond, to be consumed at $t = 2$.

Now, let us analyze what he gets in the proposed equilibrium. First, suppose $\gamma \geq \gamma_1$. In this case, we know that he gets

$$EU_{p1}(\gamma) = \left[\nu_0 P_{\nu_0}(\gamma) + (1-\nu_0)\left(P_{\nu_0}(\gamma) - C\right)\right] R.$$

The difference in utility is

$$\begin{aligned}
\Delta_1(\gamma) &= EU(\gamma) - EU_{p1}(\gamma) = \left\{\nu_0\left[P_1(\gamma) - P_{\nu_0}(\gamma)\right] + (1-\nu_0)\left[L - P_{\nu_0}(\gamma) + C\right]\right\} R \\
&= R\left\{\nu_0 \frac{1}{R}\left[\mathbb{E}\left[\widetilde{V}^H\right] - m\rho\sigma_H^2 \frac{1-\gamma}{1-\lambda\gamma}\right] - \nu_0 \frac{1}{R}\mathbb{E}\left[\widetilde{V}^H\right]\right. \\
&\quad \left. + \frac{1}{R} m\rho\sigma_0^2 \frac{1-\gamma}{1-\lambda\gamma} + (1-\nu_0)(L+C)\right\} \\
&= \nu_0 m\rho \frac{1-\gamma}{1-\lambda\gamma}\left(\frac{\sigma_0^2}{\nu_0} - \sigma_H^2\right) + R(1-\nu_0)(L+C) > 0,
\end{aligned}$$

where the inequality follows since $\frac{\sigma_0^2}{\nu_0} > \sigma_0^2 > \sigma_H^2$. Hence, $\Delta_1(\gamma) > 0$. So, ex-post, after γ realizes, it would be better to commit to a truthful equilibrium.

Now suppose $\gamma_1 \geq \gamma \geq \gamma_2$. He gets

$$EU_{p2}(\gamma) = \left[\nu_0 P_{\nu(\gamma)}(\gamma) + (1-\nu_0)\left[p_1(\gamma)\left(P_{\nu(\gamma)}(\gamma) - C\right) + (1-p_1(\gamma)) L\right]\right] R.$$

The difference in utility is

$$\begin{aligned}
\Delta_2(\gamma) = {} & R\nu_0\left[P_1(\gamma) - P_{\nu(\gamma)}(\gamma)\right] \\
& + R(1-\nu_0)\left[L - p_1(\gamma)\left(P_{\nu(\gamma)}(\gamma) - C\right) - (1-p_1(\gamma)) L\right].
\end{aligned}$$

The first term is strictly positive since $\nu(\gamma) < 1$ for $\gamma > \gamma_2$ and prices are increasing in ex-ante beliefs. Also, the second term is zero since we have

$$L - p_1(\gamma)\left(P_{\nu(\gamma)}(\gamma) - C\right) - (1-p_1(\gamma)) L = p_1(\gamma)\left(-P_{\nu(\gamma)}(\gamma) + C + L\right) = 0,$$

where the last equality follows from the definition of $\nu(\gamma)$. So, summing up we have $\Delta_2(\gamma) > 0$.

Suppose $\gamma_2 \geq \gamma$. In this case, the informed agent is honest and is believed. Hence, the payoffs (from liquidation ($\gamma_3 \geq \gamma$) or sale ($\gamma_2 > \gamma > \gamma_3$)) are the same as in the separating/commitment equilibrium ($\Delta_3(\gamma) = 0$).

We have shown that after the social interactions parameter is realized, it is weakly preferable to commit (if it were feasible). We now prove the remaining part of the proposition, i.e., ex-ante it is strictly better to commit. We have

$$\mathbb{E}_{\gamma}\left[EU(\gamma) - EU_p(\gamma)\right] = \int_{\gamma_1}^{1} \Delta_1(\gamma)\, dF(\gamma) + \int_{\gamma_2}^{\gamma_1} \Delta_2(\gamma)\, dF(\gamma) + \int_{0}^{\gamma_2} \Delta_3(\gamma)\, dF(\gamma) > 0,$$

where the strict inequality follows from the steps above. So, it is clear that the separating equilibrium gives a higher expected utility than the equilibrium that obtains in the case where conflicts of interest are present and there is no possibility of credibly committing to telling the truth.

D Proof of Proposition 6

The proof to this proposition follows the same lines as the proof of Proposition 1, subsequently some of the details are omitted. Define the parameters $P_{\overline{\nu}}(\gamma_1^{+}) = L + C$, $P_{\nu_1}(\gamma_1^{++}) = L + C$; $P_1(\gamma_2) = L + C$,where $\nu_1 := \frac{\nu_0\delta}{2\nu_0\delta+1-\nu_0-\delta} > \nu_0 > \overline{\nu}$. So, $\gamma_1^{+} > \gamma_1^{++} > \gamma_2$ and γ_2 is the same as in Proposition 1.

First, consider $\gamma \geq \gamma_1^{+}$. In this case, if beliefs are at least as favorable as $\overline{\nu}$, the informed trader will lie in the bad state and sell the shares. So, the equilibrium strategy must have exactly this characteristic. He always says g and sells, except in the good state with no shock, where he does not sell. Given this strategy, beliefs are equal to

$$\Pr(G|\{g,s\}) = \frac{\nu_0\delta}{\nu_0\delta + (1-\nu_0)\left[\delta + (1-\delta)\right]} = \overline{\nu} \tag{46}$$

as required. It is clear that $\overline{\nu} < \nu_0$. As a result we know that $\gamma_1^{+} > \gamma_1$.

Now let $\gamma \leq \gamma_2$. Still the proof is the same as before. That is to say that, he sells if $P_1(\gamma) \geq L$ and liquidates otherwise. However, no matter what, he is truthful.

Finally, assume $\gamma_2 < \gamma < \gamma_1^{+}$. With the definitions made in the text, we have that the ex-ante cost of lies is proportional to

$$\delta\left[\nu_0\left(1 - p_{\delta,G}(\gamma)\right) + (1-\nu_0)\, p_{\delta,B}(\gamma)\right] + (1-\delta)\left[\nu_0\left(1 - p_{1-\delta,G}(\gamma)\right)\pi(G) + (1-\nu_0)\, p_{1-\delta,B}(\gamma)\pi(B)\right]. \tag{47}$$

Note first that $\pi(G) = 0$. This has to hold, otherwise in the case of good news and no liquidity shock he has an incentive to deviate (holding on to the shares). Then the cost becomes:

$$\delta\left[\nu_0\left(1 - p_{\delta,G}(\gamma)\right) + (1-\nu_0)\, p_{\delta,B}(\gamma)\right] + (1-\delta)(1-\nu_0)\, p_{1-\delta,B}(\gamma)\pi(B). \tag{48}$$

With the assumptions made on the parameters, minimization of (48) implies that the informed trader will try to set the first 2 terms as low as possible and use $p_{1-\delta,B}(\gamma)\pi\,(B)$ in order to obtain the needed beliefs as long as possible, i.e., as long as $p_{1-\delta,B}(\gamma) < 1$.

Let us first concentrate on the second sub-case, $\gamma_2 < \gamma < \gamma_1^{++}$. Given this strategy beliefs are

$$\Pr\left(G|\{g,s\}\right) = \frac{\nu_0\delta}{\nu_0\delta + (1-\nu_0)\,(1-\delta)\,p_{1-\delta,B}(\gamma)\pi\,(B)}. \tag{49}$$

For this strategy to be an equilibrium, we need $\Pr\left(G|\{g,s\}\right) = \nu\,(\gamma)$. Solving this we obtain

$$p_{1-\delta,B}(\gamma)\pi\,(B) = \frac{\nu_0}{1-\nu_0}\,\frac{1-\nu(\gamma)}{\nu(\gamma)}\,\frac{\delta}{1-\delta}. \tag{50}$$

Clearly, we must have $\pi\,(B) = 1$. There are no reasons to hold on to shares in the bad state. Notice now that $p_{1-\delta,B}(\gamma) = 1$ if

$$\nu(\gamma) = \frac{\nu_0\delta}{2\nu_0\delta + 1 - \nu_0 - \delta} =: \nu_1. \tag{51}$$

So, $p_{1-\delta,B}(\gamma_1^{++}) = 1$. That is exactly why γ_1^{++} defines the sub-cases. Then, we have

$$\Pr\left(G|\{g,s\}\right) = \frac{\nu_0\delta}{\nu_0\delta + (1-\nu_0)\left[\delta p_{\delta,B}(\gamma) + (1-\delta)\right]}, \tag{52}$$

in the first sub-case. For this strategy to be an equilibrium, we need $\Pr\left(G|\{g,s\}\right) = \nu\,(\gamma)$. Solving this we obtain $p_{\delta,B}(\gamma) = \frac{\nu_0}{1-\nu_0}\frac{1-\nu(\gamma)}{\nu(\gamma)} - \frac{1-\delta}{\delta}$. We also know that $\nu(\gamma_1^{+}) = \overline{\nu}$ must hold. Hence, $p_{\delta,B}(\gamma_1^{+}) = \frac{\nu_0}{1-\nu_0}\frac{1-\overline{\nu}}{\overline{\nu}} - \frac{1-\delta}{\delta} = 1$, which implies that the ex-ante probability of lies at γ_1^{+} is $(1-\nu_0)\left[\delta p_{\delta,B}(\gamma_1^{+}) + (1-\delta)\,p_{1-\delta,B}(\gamma_1^{+})\right] = (1-\nu_0)$. This is consistent with the analysis before (T always says g, so lies occur with probability 1 in the bad state). Note that $\nu(\gamma_2) = 1$ as well. Thus, $p_{1-\delta,B}(\gamma_2) = 0$ and there are no lies at or below γ_2, as required.

E Proof of Proposition 7

We assume that γ is distributed as in Section 3. Let us then calculate the ex-ante probability of lies in each equilibrium

$$\Pi^1 = (1-\nu_0)\left[1 - F\,(\gamma_1) + \int_{\gamma_2}^{\gamma_1} p_1\,(\gamma)\,dF\,(\gamma)\right],$$

$$\Pi^{\delta,O} = (1-\nu_0)\left[\delta\left(1 - F\,(\gamma_1) + \int_{\gamma_2}^{\gamma_1} p_1\,(\gamma)\,dF\,(\gamma)\right)\right],$$

$$\Pi^{\delta,U} = (1-\nu_0)\left[\begin{array}{c} \delta\left(1 - F\left(\gamma_1^{+}\right) + \int_{\gamma_1^{++}}^{\gamma_1^{+}} p_{\delta,B}(\gamma)\, dF(\gamma)\right) \\ +(1-\delta)\left(1 - F\left(\gamma_1^{++}\right) + \int_{\gamma_2}^{\gamma_1^{++}} p_{1-\delta,B}(\gamma)\, dF(\gamma)\right)\end{array}\right].$$

Note that $p_{1-\delta,B}(\gamma) = \frac{\delta}{1-\delta} p_1(\gamma)$, for every $\gamma \in \left[\gamma_2, \gamma_1^{++}\right]$. Also, for every $\gamma \in \left[\gamma_1^{++}, \gamma_1\right]$ we have $p_{\delta,B}(\gamma) = p_1(\gamma) - \frac{1-\delta}{\delta}$. Finally, $\frac{\partial p_{\delta,B}(\gamma)}{\partial \gamma} > 0$, $p_{\delta,B}(\gamma_1) = \frac{2\delta-1}{\delta}$ and $p_{\delta,B}\left(\gamma_1^{++}\right) = 1$. With these remarks, we now have everything needed to prove the proposition.

First, we show that $\Pi^{\delta,O} < \Pi^{\delta,U}$.[39] For that, we calculate the difference

$$\begin{aligned}
\Pi^{\delta,O} - \Pi^{\delta,U} &= \delta\left(1 - F(\gamma_1)\right) - \left(1 - F\left(\gamma_1^{+}\right)\right) - (1-\delta)\left(F\left(\gamma_1^{+}\right) - F\left(\gamma_1^{++}\right)\right) \\
&\quad + \delta\left(\int_{\gamma_2}^{\gamma_1} p_1(\gamma)\, dF(\gamma) - \int_{\gamma_1^{++}}^{\gamma_1^{+}} p_{\delta,B}(\gamma)\, dF(\gamma)\right. \\
&\quad \left. - \frac{1-\delta}{\delta}\int_{\gamma_2}^{\gamma_1^{++}} p_{1-\delta,B}(\gamma)\, dF(\gamma)\right) \\
&= \delta\left(1 - F(\gamma_1)\right) - \left(1 - F\left(\gamma_1^{+}\right)\right) - (1-\delta)\left(F\left(\gamma_1^{+}\right) - F\left(\gamma_1^{++}\right)\right) \\
&\quad + \delta\left(\int_{\gamma_1^{++}}^{\gamma_1} \left[p_1(\gamma) - p_{\delta,B}(\gamma)\right] dF(\gamma) - \int_{\gamma_1}^{\gamma_1^{+}} p_{\delta,B}(\gamma)\, dF(\gamma)\right) \\
&= \delta\left(1 - F(\gamma_1)\right) - \left(1 - F\left(\gamma_1^{+}\right)\right) + (1-\delta)\left(F(\gamma_1) - F\left(\gamma_1^{++}\right)\right. \\
&\quad \left. - \left(F\left(\gamma_1^{+}\right) - F\left(\gamma_1^{++}\right)\right)\right) \\
&\quad - \delta\left(\int_{\gamma_1}^{\gamma_1^{+}} p_{\delta,B}(\gamma)\, dF(\gamma)\right) \\
&< \delta\left(1 - F(\gamma_1)\right) - \left(1 - F\left(\gamma_1^{+}\right)\right) + (1-\delta)\left(F(\gamma_1) - F\left(\gamma_1^{+}\right)\right) \\
&\quad - \delta\left(\int_{\gamma_1}^{\gamma_1^{+}} \frac{2\delta-1}{\delta} dF(\gamma)\right) \\
&= (\delta - 1)\left(1 - F\left(\gamma_1^{+}\right)\right) < 0
\end{aligned}$$

[39] Without any loss of generality, we abstract from the $(1-\nu_0)$ term.

Next, we show that $\Pi^{\delta,U} < \Pi^1$. For that, we calculate the difference

$$\begin{aligned}
\Pi^{\delta,U} - \Pi^1 &= \left(F(\gamma_1) - F\left(\gamma_1^{+}\right)\right) + (1-\delta)\left(F\left(\gamma_1^{+}\right) - F\left(\gamma_1^{++}\right)\right) \\
&\quad + \delta\left(\int_{\gamma_1^{++}}^{\gamma_1^{+}} p_{\delta,B}(\gamma)\, dF(\gamma)\right) + (1-\delta)\int_{\gamma_2}^{\gamma_1^{++}} p_1(\gamma)\frac{\delta}{1-\delta} dF(\gamma) \\
&\quad - \int_{\gamma_2}^{\gamma_1^{++}} p_1(\gamma)\, dF(\gamma) - \int_{\gamma_1^{++}}^{\gamma_1} p_1(\gamma)\, dF(\gamma) \\
&= \left(F(\gamma_1) - F\left(\gamma_1^{+}\right)\right) + (1-\delta)\left(F\left(\gamma_1^{+}\right) - F\left(\gamma_1^{++}\right)\right) \\
&\quad - (1-\delta)\int_{\gamma_2}^{\gamma_1^{++}} p_1(\gamma)\, dF(\gamma) \\
&\quad + \delta\left(\int_{\gamma_1^{++}}^{\gamma_1}\left[p_1(\gamma) - \frac{(1-\delta)}{\delta}\right] dF(\gamma) + \int_{\gamma_1}^{\gamma_1^{+}} p_{\delta,B}(\gamma)\, dF(\gamma)\right) \\
&\quad - \int_{\gamma_1^{++}}^{\gamma_1} p_1(\gamma)\, dF(\gamma) \\
&= \left(F(\gamma_1) - F\left(\gamma_1^{+}\right)\right) + (1-\delta)\left(F\left(\gamma_1^{+}\right) - F\left(\gamma_1^{++}\right)\right) \\
&\quad - (1-\delta)\int_{\gamma_2}^{\gamma_1^{++}} p_1(\gamma)\, dF(\gamma) \\
&\quad + \delta\int_{\gamma_1}^{\gamma_1^{+}} p_{\delta,B}(\gamma)\, dF(\gamma) + (\delta-1)\int_{\gamma_1^{++}}^{\gamma_1} p_1(\gamma)\, dF(\gamma) \\
&\quad - \delta\int_{\gamma_1^{++}}^{\gamma_1} \frac{(1-\delta)}{\delta} dF(\gamma) \\
&= \left(F(\gamma_1) - F\left(\gamma_1^{+}\right)\right) + (1-\delta)\left(F\left(\gamma_1^{+}\right) - F(\gamma_1)\right) \\
&\quad - (1-\delta)\int_{\gamma_2}^{\gamma_1} p_1(\gamma)\, dF(\gamma) + \delta\int_{\gamma_1}^{\gamma_1^{+}} p_{\delta,B}(\gamma)\, dF(\gamma) \\
&< \left(F(\gamma_1) - F\left(\gamma_1^{+}\right)\right) + (1-\delta)\left(F\left(\gamma_1^{+}\right) - F(\gamma_1)\right)
\end{aligned}$$

$$-(1-\delta)\int_{\gamma_2}^{\gamma_1} p_1(\gamma)\,dF(\gamma)+\delta\int_{\gamma_1}^{\gamma_1^+} dF(\gamma)$$

$$=-(1-\delta)\int_{\gamma_2}^{\gamma_1} p_1(\gamma)\,dF(\gamma)<0$$

Putting all together, we have $\Pi^{\delta,O} < \Pi^{\delta,U} < \Pi^1$.

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References

Abel, A.B.: Asset prices under habit formation and catching up with the Joneses. Am Econ Rev **80**(2), 38–42 (1990)

Benabou, R., Laroque G.: Using privileged information to manipulate markets: insiders, gurus, and credibility. Q J Econ **107**(3), 921–958 (1992)

Campbell, J.Y., Cochrane, J.H.: By force of habit: a consumption-based explanation of aggregate stock market behavior. J Polit Econ **107**(2), 205–251 (1999)

Chen, H., Ritter, J.R.: The seven percent solution. J Finan **55**(3), 1105–1131 (2000)

Duflo, E., Saez, E.: Participation and Investment Decisions in a Retirement Plan: The Influence of Colleagues' Choices, NBER Working Paper 7735 (2000)

Fudenberg, D., Tirole, J.: Game Theory. The MIT Press, Cambridge (1998)

Gali, J.: Keeping up with the Joneses: consumption externalities, portfolio choice, and asset prices. J Money Credit Bank **26**(1), 1–8 (1994)

Glaeser, E., Scheinkman, J.: Non-Market Interactions, Advances in Economics and Econometrics: Theory and Applications, Eight World Congress. Dewatripont, M., Hansen, L.P., Turnovsky S. (eds.) Cambridge University Press, Cambridge (2002)

Gompers, P., Lerner, J.: Conflict of Interest in the Issuance of Public Securities: Evidence from Venture Capital, NBER Working Paper 6847 (1998)

Hong, H., Kubik, J.D., Stein, J.C.: Social Interaction and Stock-Market Participation, NBER Working Paper 8358 (2001)

Huang, C., Litzenberger, R.H.: Foundations for Financial Economics. Prentice–Hall, Englewood Cliffs (1998)

Investment Company Institute: 401(k) Plan Participants: Characteristics, Contributions and Account Activity, ICI Research Series. Spring (2000)

Michaely, R., Womack, K.L.: Conflict of interest and the credibility of underwriter analyst recommendations. Rev Finan Stud **12**(4), 653–686 (1999)

Morgan, J., Stocken, P.C.: An analysis of stock recommendations. Rand J Econ **34**(1), 183–283 (2003)

Oppel Jr., R. A.: Merrill Replaced Research Analyst who Upset Enron. The New York Times, July 30 (2002)

Pinheiro, M.: Loyalty, Peer Group Effects and 401(k), Quart Rev Econ Finan (in press) (2007)

Shin, H.: Disclosures and asset returns. Econometrica **71**(1), 105–134 (2003)

Sorensen, A.T.: Social Learning in the Demand for Employer-Sponsored Health Insurance (unpublished) (2001)