Advisors with Hidden Motives

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Abstract. Why do people seek information from conflicted sources, such as Instagram influencers or financial advisors? In this paper, I provide an answer to this question by showing that an advisor's hidden motives may improve the informativeness of his advice. A sender acquires a signal about an object's quality and commits to a rule to disclose its realizations to a receiver, who then chooses to buy the object or to keep an outside option of privately known value. Optimal disclosure rules typically conceal negative signal realizations when the object's sale is very profitable to the sender and positive signal realizations when the sale is less profitable. Using such disclosure rules, the advisor is able to steer sales from lower- to higher-profitability objects. I show that, despite this strategic concealment of some signal realizations, the receiver may prefer being informed by a non-transparent sender, because the sender's hidden motives produce an additional incentive to invest in acquiring a precise signal of the object's quality. I use my model to evaluate policies that are commonly proposed in the context of financial advisors, such as mandatory disclosure of commissions and commission caps.

1. Introduction

Brokerage companies employ large teams of analysts to produce research on financial products for their clients. A typical report on an asset includes market forecasts, a detailed valuation model, and a recommendation to buy, sell, or hold. Though these reports provide valuable information to investors,[1] the interests of profit-seeking brokers may not align with maximizing their clients' welfare. It is well documented that brokers conceal bad news about companies in which they have financial interests and that financial advisors recommend unsuitable products with high commissions.[2] There are many other contexts in which people consult advisors with hidden motives: followers watch Instagram influencers exalt products they are paid to review,

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[1]According to Hung et al. (2008), a majority of Americans rely on professional advice from their brokers or other financial advisors when conducting stock market or mutual fund transactions.

[2]See, for example, Anagol, Cole and Sarkar (2017) and Eckardt and Rathke-Doppner (2010) about insurance brokers; Chalmers and Reuter (2020) on retirement plans; Inderst and Ottaviani (2012.2) on general financial advice. For a survey on quality disclosure and certification, see Dranove and Jin (2010).

studies on the effectiveness of drugs are sponsored by pharmaceutical companies, and schools selectively disclose grades of tuition-paying students to employers.

Why do such arrangements survive? Why do people seek information from sources they know to be conflicted? In this paper, I study an advisor's decision to produce and share information with a receiver. I provide one possible answer to these questions, by showing that an advisor's hidden motives may provide an additional incentive to produce information.

There are two agents in the model: a sender (he) and a receiver (she). The receiver takes a binary action, interpreted as buying or not buying an object. The object has two relevant characteristics – its *quality* to the receiver and its *profitability* to the sender. In the financial advisor context, a high quality object is a good investment for the client, while a highly profitable object yields high commissions to the advisor. Prior to the realization of either the profitability or the quality, the sender takes two actions. He acquires a costly signal of the object's quality and commits to a disclosure rule. This rule assigns to each realization of the quality signal and each profitability a probability of disclosing the realization to the receiver.

The sender has *hidden motives*: the profitability of the object is not observed by the receiver. In particular, if the distribution of profitabilities is degenerate, then the object's profitability is known, and I say the sender has *transparent motives*.[3] The receiver is Bayesian and updates beliefs based on any information the sender reveals and on the sender's policy itself. She buys the object if her posterior about its quality, net of some exogenously given price, exceeds the value of a privately known outside option.

In Section 3, I characterize the sender's Optimal Disclosure Rules. When choosing what information to share with the receiver, the sender treads a fine path. He wants to disclose positive evidence of the object's quality, so as to incentivize the receiver to make a purchase. He also knows that he can hide from the receiver any evidence that the object is of low quality. However, if he does so, the receiver becomes skeptical and reads any absence of information as a negative sign, lowering the probability of sale.

Since disclosure can be conditioned on profitability, the sender solves this balancing act by committing to a disclosure rule which hides some bad outcomes when the object's sale is very profitable and some good outcomes when the sale of the object is less profitable. By concealing bad news, he increases the probability that a highly profitable object is sold. At the same time, by concealing good news, he decreases the probability that less profitable objects are sold, but improves the receiver's posterior upon non-disclosure. Using this type of disclosure rule, the sender, who is biased in favor of more profitable objects, is able to steer purchases from low to high profitability objects.

[3]The term "transparent motives" was coined by Lipnowski and Ravid (2020) to refer to a problem where the sender's preferences are state-independent. In my model, this is precisely the case when the distribution of profitabilities is degenerate.

In Proposition 1, I show that, when the distribution of receiver outside options is uniform (so that its cdf is linear), the Optimal Disclosure Rule to a sender with hidden motives satisfies a threshold rule. There is an endogenously determined profitability threshold, as well as a quality threshold. Objects with profitability above the profitability threshold are treated as a high-profitability object, and below-threshold profitability objects are treated as low profitability objects. The sender optimally discloses *above threshold* quality signal realizations when the object has high profitability and of *below threshold* signal realizations if the object's profitability is low.

A special feature of the model when the receiver's distribution of outside options is linear is that the expected probability of sale of the object is constant across all disclosure rules available to the sender. Therefore, in choosing a disclosure policy, the sender is able to transfer some sales from low to high profitability objects, but the average sale probability stays the same regardless of how much information he acquires or discloses. The Optimal Disclosure Rule is the disclosure policy that maximizes the *covariance* between the object's profitability and its probability of sale. It is the rule that most efficiently steers sales probability from low- to high-profitability objects.

While in the linear case the expected sale probability is independent of the sender's policy, this is no longer so for other distributions of the receiver's outside option. I study two such variations from the baseline. When the distribution of receiver types is convex, an increase (in the Blackwell sense) in the amount of information provided to the receiver increases the expected probability that the object is sold. On the other hand, when the distribution is concave, providing more information to the receiver leads to a decrease in the expected probability of sale. This means that, in the convex case, a sender with transparent motives has strict incentives to produce and reveal information to the receiver; while in the concave case, that sender maximizes total sales by concealing all information from the receiver.

Proposition 2 characterizes the Optimal Disclosure Rule both when the distribution of receiver types is convex and concave, taking as given the underlying quality signal. In the convex case, a sender with hidden motives must weight two conflicting goals: he can maximize total sales by disclosing all signal realizations to the receiver, or increase the covariance between sales and profitability by strategically concealing some realizations.

As in the linear case, the Optimal Disclosure Rule is characterized by endogenous quality and profitability thresholds. When the object has above-threshold profitability, the sender reveals all signal realizations above the quality threshold and conceals *some* signal realizations below the quality threshold. More precisely, for a given high enough profitability, there is an interval to the left of the quality threshold such that a signal realization is concealed only if it belongs to that interval. At the other end, if an object has below-threshold profitability, the sender reveals all signal realizations below the quality threshold and and conceals an interval of signal realizations immediately above the quality threshold.

If the distribution is concave, the conflicting goals of a sender with hidden motives are flipped: to maximize total sales, he should conceal all signal realizations, but he can increase the covariance between sales and profitability by selectively disclosing some outcomes. A corollary of Proposition 2 is that, taking as given the underlying quality signal, a sender with hidden motives is less informative than a transparent one if the distribution of outside options is convex; and more informative than a transparent one if the distribution of outside options is concave.

In Section 4, I use the structure of the Optimal Disclosure Rules to study the relation between the degree to which the sender's motives are hidden and his decision to invest in acquiring a costly signal of the object's quality. In Proposition 3, I show that, if the distribution of receiver outside options is linear, the sender's hidden motives are an additional incentive to acquire a quality signal. In particular, the stronger the sender's hidden motives, the more he invests in the signal precision. In turn, this implies that, in the linear case, the amount of information provided to the receiver, as well as the receiver's surplus, may be *increasing in the sender's bias*. In Section 4.2, I show that this is the case when the profitability distribution has binary support.

For some intuition on this result, notice that the sender benefits from selectively disclosing information about the object's quality. But in order to manipulate it, he must have the information in the first place. The more precise the signal acquired by the sender, the more he is able to profitably steer the receiver. Moreover, the sender's gain from steering is higher for the stronger his hidden motives are, thereby increasing the incentive to acquire a precise signal.

This result has implications for commonly proposed policies aiming to mitigate advisors' biases. In the financial advisory context, regulators have proposed and implemented a variety of policies restricting the payment or requiring the disclosure of any commission payments to investors, as well as capping the size of commission payments.[4] In Section 5, I consider the effect of such regulations. I show that these policies may in fact reduce the receiver's surplus by curbing the sender's incentives to acquire a quality signal. Despite this negative effect on the surplus to the receiver, the policies may be welfare enhancing, as they prevent the sender from over-investing in signal acquisition.

1.1. **Related Literature.**

My paper contributes to the large literature on information design, mainly stemming from Kamenica and Gentzkow (2011) and Rayo and Segal (2010).[5]

In my model, the main feature of the disclosure schemes optimally chosen by the sender is that they pool good realizations for low profitability objects with bad realizations for high profitability objects, and transfer value from the former to the latter by doing so. This feature

[4]Since 2011, New York state law mandates that insurance agents disclose their general compensation scheme to clients. As a response to the Great Recession, the Dodd-Frank act also granted the SEC the ability to impose a fiduciary duty on broker-dealers, which is already required of financial advisors. Other countries, such as the UK and the Netherlands have altogether imposed bans on commission payments for some types of financial advisors.

[5]For a survey, see Kamenica (2019)

is equally the highlight of the optimal schemes in Rayo and Segal (2010).[6] My paper adds to that in three main ways. First, Rayo and Segal (2010) study an information design problem, while I am interested in characterizing disclosure of hard evidence; and I can characterize optimal disclosure for nonlinear distributions of receiver outside options, while Rayo and Segal (2010) focus on the linear case. Second, in my model, the sender endogenously acquires the underlying quality signal at a cost, while this signal is exogenous in their paper. Finally, while Rayo and Segal (2010) are mainly interested in characterizing the sender's optimal disclosure rule, my focus is in studying how the sender's hidden motives affects their decision to acquire and disclose information. The analogous comparative static is not studied in their framework.

Gentzkow and Kamenica (2017) consider the problem of a sender that acquires a costly signal and disclose some of it to the receiver. They show that the sender always fully discloses the acquired signal. A similar point is made in Pei (2015). In my paper, the fact that the sender has hidden motives implies that this statement no longer holds. Gentzkow and Kamenica (2014) show that, if transmitting a signal to the receiver is costly, and the cost function over signals satisfies certain requirements, then the optimal signal can be found with an adaptation of their earlier concavification arguments. In my paper, I consider a sender who only chooses whether to disclose hard evidence or not, and thus the concavification method does not apply.

A defining feature of Bayesian Persuasion models is that the sender is able to commit to a disclosure rule prior to the realization of an experiment that is informative about the state. The sender's ability to commit makes him credible, in that he is capable of delivering both good and bad news. Recent papers, such as Lipnowski, Ravid and Shishkin (2019) and Min (2020), study the effect of changing the sender's credibility by meddling with his ability to commit. Lipnowski, Ravid and Shishkin (2019) show that a receiver can be better off with a less credible sender. In my paper, the sender always has full ability to commit. Instead, I vary the degree to which the sender's motives are hidden and show that the receiver can be better off with a non-transparent sender.

In my paper, the sender produces a signal of the object's quality and commits to a disclosure rule which simply reveals or conceals each realization of the signal. This choice between revealing and concealing signal realizations is a feature of the voluntary disclosure literature started with Grossman (1981), Milgrom (1981) (for a survey, see Milgrom (2008)). A common result in that literature is that when the sender can choose to voluntarily disclose information, *unraveling* takes place and equilibria feature full revelation. In my paper, the sender is able to commit to a disclosure rule prior to the realization of the signal and of the object's profitability; and the usual unravelling argument does not apply. In fact, full revelation is often not an optimal disclosure rule in my model.

[6]While this feature is shared by the optimal schemes of my paper and theirs, the Rayo and Segal (2010) study an information design problem, while I am interested in characterizing disclosure of hard evidence. In Appendix C, I show how results about signal acquisition extend to a model where the sender uses his quality signal to design information a la Rayo and Segal (2010).

Dye (1985) and Jung and Kwon (1988) started a literature that studies a variant of voluntary disclosure models where the sender is informed about the state with an exogenous probability, but uninformed senders cannot prove that they are uninformed. In these models, when the sender does not disclose a signal realization, the receiver is unsure if the sender strategically chose non-disclosure or if he is uninformed. The sender optimally uses "sanitization" disclosure rules that reveal only good realizations of the signal. Bad realizations get pooled with the uninformative signal. In my model, the sender has hidden motives and chooses disclosure rules that depend on the object's profitability. When the object has higher profitability, the optimal disclosure rule has a similar flavor to sanitization: only good outcomes are revealed. On the other hand, when profitability is lower, the sender does the opposite and reveals only bad outcomes. [7]

Kartik, Lee and Suen (2017) and Che and Kartik (2009) also study environments with endogenous information acquisition and voluntary disclosure.[8] Kartik, Lee and Suen (2017) show that an advisee may prefer to solicit advice from just one biased expert even when others – of equal or opposite bias – are available. This can happen because, in the presence of more advisors, each individual expert is discouraged from investing in information acquisition, since they can free ride on the information acquired by the other experts. In my model, a single advisor may acquire more information when his motives are hidden because he can attain higher profits by discriminating across objects of different profitabilities. In Che and Kartik (2009), though sender and receiver share the same preferences, they hold different priors over the distribution of states. Che and Kartik (2009) show that the sender may have stronger incentives to invest in acquiring information when the "disagreement" between sender and receiver is larger.

In a series of papers in 2012, Inderst and Ottaviani (2012.1, 2012.2, 2012.3) propose models of brokers and financial advisors compensated through commissions. Competing sellers play a game of offering commissions to the advisor, knowing that he will steer business to the seller that offers highest compensation. In their model, the price of the asset is always equal to buyers' expected value for it, which means that information is not valuable to the consumer, as their surplus is always equal to zero. In that environment, biased commissioned agents may achieve efficiency when providing buyers with less information and steering business to high commission firms who are also more cost efficient.

My model takes an alternative approach, taking the sender's distribution of profitability as given and focusing on the value of the information provided to buyers. In my environment, information is always beneficial to the consumer and I show that hidden motives can improve surplus precisely by increasing the amount of information provided to the consumer.

[7] Shishkin (2019) and DeMarzo, Kremer, and Skrzypacz (2019) study information acquisition by the sender in a Dye (1985) framework.

[8] Szalay (2005) and Ball and Gao (2020) also study information acquisition by a biased agent in a delegation context.

The literature on commissioned financial advisors is scarce prior to the mentioned series and, after these papers, it has been mostly empirical.[9] However, there is a large literature that studies the provision of information by Credit Rating Agencies that are financed by fees paid by issuers of financial products. Some key papers in this literature are Bolton, Freixas, and Shapiro (2012), Opp, Opp and Harris (2013), Bar-Isaac and Shapiro (2012) and Skreta and Veldkamp (2009). In this literature, the Credit Rating Agency receives payments equally from all issuers of financial products; while in my paper, the main concern is that the advisor might choose to benefit some products over other because they have different profitabilities.

2. MODEL

There are two players: a sender and a receiver. The receiver can buy an object of unobserved quality[10] $x \in [0, 1]$, and unobserved profitability $w \in [\underline{w}, \bar{w}]$. Quality is distributed according to a common prior with mean $\bar{x}$ and profitability is independently drawn according to F, with positive average.[11] The sender is said to have *transparent motives* when F is a degenerate distribution, so that the object's profitability is known. He has *hidden motives* otherwise.

The receiver has access to an outside option $y \in [0, 1]$, unknown to the sender, which is drawn from distribution Y.[12] If the receiver buys the object, she gets value x and the sender gets value w. If the receiver does not buy the object, then she gets her outside option y and the sender gets value 0.

Prior to either the profitability or quality being drawn, the sender commits to two actions: he *acquires a costly signal* of the object's quality and *chooses a rule to disclose* that signal.

A signal is a mapping between the object's quality and a distribution of messages. Without loss of generality, messages can be labeled so that they represent the posterior means induced by them. Also without loss, the prior and the signal can be fully described by the distribution of posterior means they induce.[13] Signals are indexed by their precision θ, and are acquired

[9]An exception is Chang and Sydlowsky (2020), who model advisors competing for clients by choosing the quality of information provided. This is done in a directed search environment and they find that equilibrium features information dispersion and sorting between heterogeneous customers and advisors.

[10]Quality x is the value of the product to the receiver, *net of its price*. In various applications, such as the highlighted one where the sender is a financial advisor who receives kickbacks for sales of financial products, products' prices are pre-set and cannot be negotiated between the financial advisor and the buyer. In Appendix D, I consider an extension where the sender can also propose transfers.

[11]In Appendix E, I augment the model to a three player problem where the distribution of profitabilities to be determined by relation between the sender, who is now an intermediary, and the product provider.

[12]This setup can be interpreted either as the sender disclosing to a population of receivers with a distribution of outside options or literally to a receiver with unknown outside option. It encompasses the case where the outside option is known (where the distribution is degenerate). That case is less interesting in terms of welfare analysis, as the sender is able to extract all the surplus from the receiver.

[13]Formally, take a signal: $\pi : [0, 1] \to \Delta\mathcal{M}$, where $\mathcal{M}$ is a rich enough set of possible messages. Given a signal π and the players' common prior of the object's quality, each message $m \in \mathcal{M}$ can be mapped into a posterior

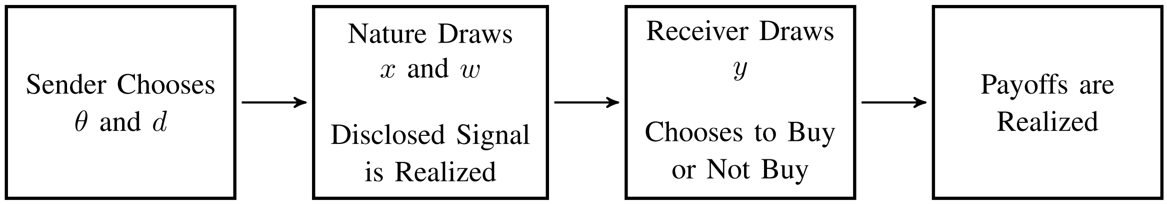

FIGURE 1. Timing of play.

at a cost $c(\theta)$, where c is continuous and non-decreasing, with $c(0) = 0$ and $c(\theta) > 0$ for all $\theta > 0$. Let $S(\cdot;\theta)$ be the distribution of posterior means induced by a signal of precision θ.

ASSUMPTIONS: (i) $\theta' \geqslant \theta$ implies $S(\cdot;\theta')$ is a mean-preserving spread of $S(\cdot;\theta)$;

(ii) $S(\cdot;0)$ is the degenerate distribution at $\bar{x}$;

Assumption (i) defines a more precise signal: more precise signals are Blackwell more informative than less precise ones. Assumption (ii) states that the signal with precision $\theta = 0$ is the perfectly uninformative signal.

Each of the signal realizations can be either revealed by the sender to the receiver or not. The choice to reveal or not can depend on the profitability of the object. A *disclosure rule* is then a measurable mapping from the object's profitability and signal realizations into a probability of disclosing the signal: $d : \{w_L, w_H\} \times [0,1] \to [0,1]$. A combination of acquired signal and disclosure rule (θ, d) produces a *disclosed signal*.

The receiver chooses to buy the object or not after observing the realization of the disclosed signal. She buys the object if its posterior expected quality is higher than her outside option. Therefore, if a realization of the disclosed signal induces a posterior expected quality of $\hat{x}$ on the receiver, then the sender expects that the object will be purchased with probability $Y(\hat{x})$, which is the probability that the outside option is lower than $\hat{x}$. The distribution of the receiver's outside option, Y, can thus be seen as the demand function faced by the sender. It maps the expected quality of the object (from the receiver's perspective) into probabilities of purchase. Throughout the paper, I refer to the distribution of outside options and to the demand function interchangeably. The solution concept is Perfect Bayesian Equilibrium.

Figure 1 summarizes the timing of play.

2.1. **Informativeness and Receiver's Surplus.**

When a signal realization x is disclosed, the receiver's posterior mean after observing it is x itself. On the other hand, when it is not

mean quality of the object using Bayesian updating. This procedure maps each signal π into a distribution over posterior means. Since the receiver is risk-neutral, her choice between buying the object or not depends only on her posterior mean of the quality, and thus the distribution of posterior means fully describes the combination of the signal and the underlying prior.

disclosed, the receiver's posterior mean is given by[14]

$$x^{ND} = \frac{\int_{[\underline{w},\bar{w}]}\int_{[0,1]}\left[x\left(1-d(w,x)\right)\right]dS(x;\theta)dF(w)}{\int_{[\underline{w},\bar{w}]}\int_{[0,1]}\left[1-d(w,x)\right]dS(x;\theta)dF(w)} \tag{1}$$

which is the expected quality over all the signal realizations that are not disclosed.

Given a precision θ and disclosure rule d, we use $S(\cdot;\theta)$ and (1) to generate the distribution of posterior means observed by the receiver, denoted $R(\cdot;\theta,d)$[15]. A disclosed signal produced by (θ,d) is *more informative than* one produced by (θ',d') if $R(\cdot;\theta,d)$ is more informative than $R(\cdot;\theta',d')$ in the Blackwell order.[16] The next observation is a known implication of this ordering.

Observation 1. *Receiver surplus is increasing in the informativeness of the disclosed signal.*

2.2. **An Interpretation of the Model.** The model describes a game between two players, where a sender informs a receiver about the quality of an object and also sells the object to this receiver. This setup where an advisor's interests are not aligned with those of the advisee is ubiquitous, but I highlight the case of financial advisors and brokers of financial products.

When you open a brokerage account at Morgan Stanley, you get access to research reports put together by their Equity Research team. In addition to publicly available data about companies and industries, a report on a particular product includes forecasts, valuations and recommendations to buy, sell or keep the asset in your portfolio. Upon seeing the provided research, an investor compares the perceived value of the product to an outside option, which could depend on their current appetite for investment, desire to reallocate their current portfolio, or even independent information she may have sourced about the financial product at hand.

As in the model, the incentives of the advisor/broker and those of the investor may not always be aligned. For instance, some of the products available in the brokerage system are proprietary products, which are investments that are issued or managed by Morgan Stanley. Upon selling one of these assets, the broker receives extra compensation. Another source of conflict is that third parties commonly pay the broker for marketing and selling their products, which may

[14]If $\int_{[\underline{w},\bar{w}]}\int_{[0,1]}\left[1-d(w,x)\right]dS(x;\theta)dF(w)=0$, we can set $x^{ND}=0$. This is a harmless assumption, since if not disclosing is used only for a measure zero of signals, then the event of a signal not being disclosed does not enter the sender's value.

[15]If $x < x^{ND}$,

$$R(x;\theta,d)=\int_{[\underline{w},\bar{w}]}\int_{[0,x)}d(w,\hat{x})dS(\hat{x};\theta)dF(w)$$

If $x \geqslant x^{ND}$,

$$R(x;\theta,d)=\int_{[\underline{w},\bar{w}]}\int_{[0,x)}d(w,\hat{x})dS(\hat{x};\theta)dF(w)+\int_{[\underline{w},\bar{w}]}\int_{[0,1]}(1-d(w_L,\hat{x}))dS(\hat{x};\theta)dF(w)$$

[16]Equivalently, if $R(\cdot;\theta,d)$ is a mean preserving spread of $R(\cdot;\theta',d')$.

make the sale of some products more desirable than others. These considerations can fuel the broker's desire to produce advice that steers investors to the more profitable products.

A feature of the model is that the sender produces information about a product and chooses only whether to share the outcome of the receiver or not. Similarly, when the research team at Morgan Stanley creates a report on a product, they cannot outright lie about their forecasts or valuation models, but they do have discretion in choosing whether and how to disclose the outcome of their research, as well as in picking which models to disclose.

The information that is *not* revealed by a report is as important as information that is provided. To the receiver, seeing that the outcome of research is not displayed is in itself an important signal. In the advisor/broker example, when an investor sees that the research team chose to not make a buy or sell recommendation and to display only very short-term forecasts for the performance of a stock or not much information about the expected trends of a particular industry targeted by a mutual fund, she creates a conjecture about the value of the product.

Suppose, for instance, that each time the advisor chooses not to disclose information it later comes out that the performance of the product is bad. In equilibrium, a buyer should become skeptical and understand the absence of news as bad news. In the other direction, now in the language of the model, if the sender commits to often concealing high realizations of the signal, the receiver interprets non-disclosure as a signal of the object's high quality. Importantly, when the sender in the model chooses a disclosure rule, they understand that it will have effects on their *reputation* – specifically, on the interpretation of non disclosed signals. When the Equity Research team chooses to disclose bad forecasts on a product they wish to sell, they do so eyeing the fact that they are building the reputation of Morgan Stanley's research reports.

3. Optimal Disclosure Rule

In this section, I take the signal precision θ as given and solve for the disclosure rule d that maximizes the value to the sender. The expected value to the sender with signal θ who chooses disclosure rule d is

$$\Pi(\theta, d) = \mathbb{E}\left[wP(w;\theta,d)\right] - c(\theta) \tag{2}$$

where $P(w;\theta,d) = \int_0^1 Y(x)d(w,x)dS(x;\theta) + \int_0^1 Y(x^{ND})(1-d(w,x))dS(x;\theta)$ is the expected probability of sale when the object has profitability w. The sender is biased towards higher profitability objects, since the expected probability of their sale is weighted more highly than that of lower profitability ones.

One useful rewriting of the sender's value in (2) is the following

$$\Pi(\theta, d) = \mathbb{E}(w)\mathbb{E}\left[P(w;\theta,d)\right] + \text{Cov}\left[w, P(w;\theta,d)\right] - c(\theta) \tag{3}$$

This expression displays that, in choosing the disclosure rule d, the sender's objective is twofold: first, the sender wishes to maximize the overall expected probability of sale, which is

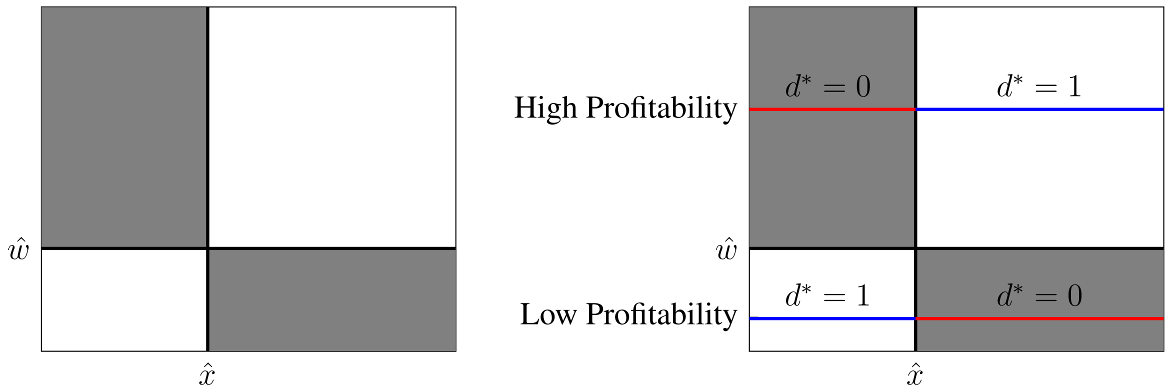

FIGURE 2. Optimal Disclosure Rule when Y is **linear**. The gray shaded areas represent signal realizations that are optimally concealed by the sender, and the white areas are optimally disclosed. On the right panel, two disclosure regimes are highlighted: for High Profitability objects ($w > \hat{w}$), low realizations are concealed; for Low Profitability objects ($w < \hat{w}$), high realizations are concealed.

multiplied by the average profitability in the first term; second, the sender seeks to maximize the covariance between the object's profitability and its probability of sale.

3.1. **Linear Demand.** First, I take the distribution of receiver outside options to be uniform over $[0, 1]$, so that Y is a linear function. Observation 2 states that the expected probability of sale is constant and equal to the underlying expected value of the object $\bar{x}$. This means that, in choosing a disclosure policy, there is no scope for the sender to increase or decrease the overall probability that the receiver buys the object. Rather, the sole concern of a sender with hidden motives is to distribute this constant value between the high and low realizations of the object's profitability. This a natural baseline to study the effect of the sender's hidden motives on the information produced and provided to the receiver.

Observation 2. *Let Y be linear ($Y(y) = y$). Then, for any θ and d,* $\mathbb{E}\left[P(w; \theta, d)\right] = \bar{x}$.

The following proposition shows that the optimal disclosure rule has a threshold structure. There is an endogenously determined profitability threshold $\hat{w}$ such that objects fall into one of two categories: high profitability, when $w > \hat{w}$; or low profitability, when $w < \hat{w}$. There is also a quality threshold $\hat{x}$ such that the sender optimally discloses signal realizations that are above $\hat{x}$ if the object has high profitability and below $\hat{x}$ if the object's profitability is low.

Proposition 1. *Let Y be linear. For a given $\theta > 0$:*

(1) *A sender with transparent motives is indifferent between all disclosure rules;*

(2) *To a sender with hidden motives, an optimal disclosure rule exists and a.e. satisfies:*[17]

If $w > \hat{w}$*:* $d^*(w,x) = 1$ *when* $x > \hat{x}$ *and* $d^*(w,x) = 0$ *when* $x < \hat{x}$*;*
If $w < \hat{w}$*:* $d^*(w,x) = 0$ *when* $x > \hat{x}$ *and* $d^*(w,x) = 1$ *when* $x < \hat{x}$*.*

To check that the first statement holds, note that, when the sender has transparent motives, F is a degenerate distribution, and so Cov $[w, P(w;\theta,d)] = 0$. Use this, along with Observation 2 to find $\Pi(\theta, d) = \bar{w}\bar{x} - c(\theta)$.

Now we turn to the case when the sender's motives are hidden. Using (1) and (2), and differentiating the sender's value with respect to $d(w,x)$ we get[18]

$$\frac{\partial \Pi}{\partial d(w,x)} = (x - x^{ND})(w - w^{ND})dS(x;\theta) \tag{4}$$

where w^{ND} is the average profitability across all the signals that do not get disclosed.

The marginal value of disclosing signal realization x for the object of profitability w is the product of the difference between x^{ND}, the posterior mean induced by non-disclosure, and x and the difference between w and w^{ND}. When $w > w^{ND}$, the marginal value of disclosing signal x when profitability is w is strictly negative if $x < x^{ND}$, equal to 0 if $x = x^{ND}$ and strictly positive if $x > x^{ND}$. These signs are all flipped when we look at objects with profitability $w < w^{ND}$. Now suppose there is a positive measure of signal realizations where either $d(w,x) \neq 0$ when (4) is negative or $d(w,x) \neq 1$ when (4) is positive. Then d cannot be optimal. So any optimal disclosure rule must be as stated in the proposition.

Figure 2 displays the disclosure rule d^*, and Figure 3 shows the posterior mean induced on the receiver as a function of the object's profitability and the signal realization. When the sender uses the optimal disclosure rule, the receiver's posterior mean for low profitability objects is *at best* equal to x^{ND}, which is the posterior mean induced when the signal realization is above x^{ND}. Conversely, the receiver's induced posterior mean for high profitability is *at least* equal to x^{ND}.

[17] Almost everywhere with respect to the joint distribution of profitabilities w and signal realizations x. Since these two objects are independently drawn, the joint distribution is the product of the the distribution of profitabilities F and the distribution of signal realizations, $S(\cdot;\theta)$.

[18]

$$\frac{\partial \Pi}{\partial d(w,x)} = w(x - x^{ND})dS(x;\theta)dF(w) + \left(\int_{[\underline{w},\bar{w}]}\int_{[0,1]}\left[w(1-d(w,\hat{x}))\right]dS(\hat{x};\theta)dF(w)\right)\frac{\partial x^{ND}}{\partial d(w,x)}$$

$$= \left[w(x - x^{ND}) + (x^{ND} - x)\left(\frac{\int_{[\underline{w},\bar{w}]}\int_{[0,1]}\left[w(1-d(w,\hat{x}))\right]dS(\hat{x};\theta)dF(w)}{\int_{[\underline{w},\bar{w}]}\int_{[0,1]}(1-d(w,\hat{x}))dS(\hat{x};\theta)dF(w)}\right)\right]dS(x;\theta)dF(w)$$

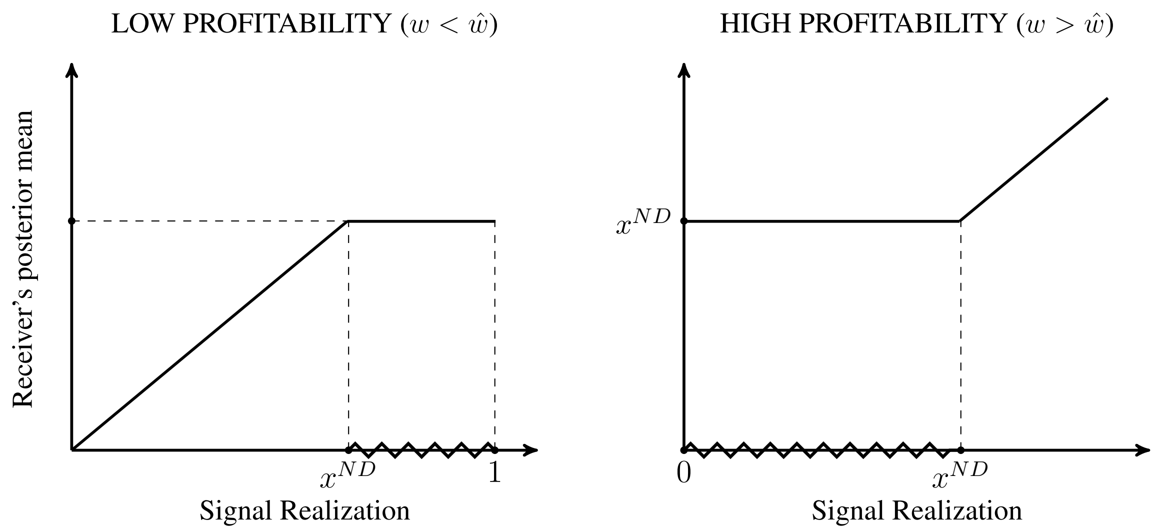

FIGURE 3. Posterior means induced on the receiver by the optimal disclosure rule when Y is **linear**. In both charts, I plot the posterior mean induced on the receiver as a function of the signal realization – it equals x when x is a disclosed signal realization and x^{ND} when x is not disclosed. The snaked intervals represent the signal realizations that are not disclosed by the sender under d^*.

Given linear demand, the objective of the sender is simply to maximize the covariance between the sale probability and the object's profitability. This maximal covariance is precisely what is achieved by the disclosure rule d^* as described in Proposition 1. Every time a low profitability object has a high signal realization, the sender can "transfer" part of that value to the high profitability objects by choosing not to disclose it. At the other end, when a high profitability object has a low signal realization, the sender omits this bad outcome and partially "transfers" it to the low profitability object. By strategically using the option of non-disclosure, the sender is able to *steer* sales from low profitability objects to high profitability objects.

Proposition 1 shows that there is a discontinuity between the policy chosen by the sender with transparent motives and that chosen by an even slightly biased one. The former is indifferent between all policies and, in particular, disclosing all signals is an optimal disclosure policy. However, any sender with hidden motives uses a two-regimes rule, whereby objects are classified as high- or low-profitability and accordingly assigned to threshold disclosure rules.

3.2. **Nonlinear Demand.** If the demand is not linear, the informativeness of the disclosed signal impacts the expected probability of sale. Remember that a more informative disclosed signal means that $R(\cdot;\theta,d)$ increases in the Blackwell order.

Observation 3. *Let disclosed signal (θ,d) be more informative than disclosed signal (θ',d').*

(1) *If Y is convex, then (θ,d) yields a weakly higher probability of sale than (θ',d');*

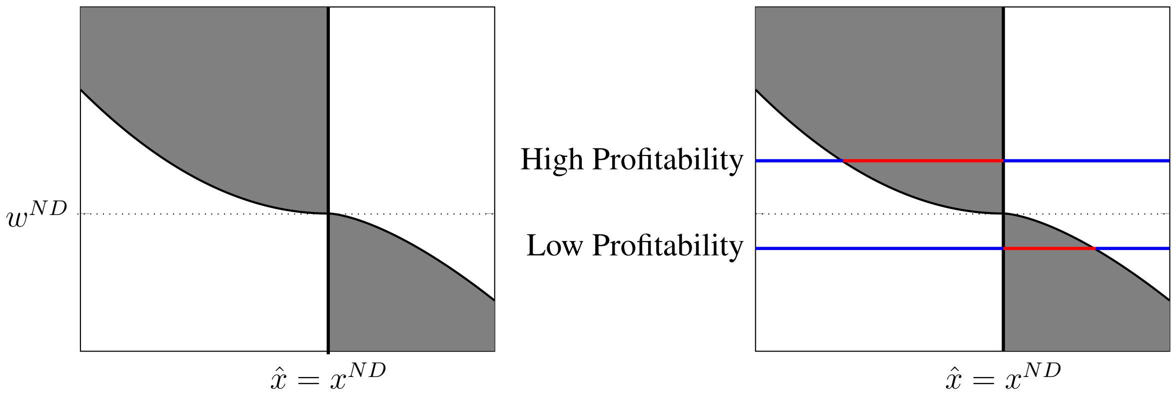

FIGURE 4. Optimal Disclosure Rule when Y is **convex**. The gray shaded areas represent signal realizations that are optimally concealed by the sender, and the white areas are optimally disclosed.

(2) *If Y is concave, then (θ, d) yields a weakly lower probability of sale than (θ', d').*

If the sender has transparent motives and faces a convex demand function, he is incentivized to produce and disclose information about the object's quality. On the other hand, if facing a concave demand, his incentives are to conceal any information from the receiver.

We saw that, when the distribution of receiver outside options is linear, the sender can use strategic disclosure to distribute probability of sale between realizations of the object's profitability. However, regardless of the disclosed signal chosen by the sender, the overall probability of sale is a constant. When the receiver's types no longer have a linear distribution, distributing probability of sale across profitabilities comes at the expense of the total probability that the object is sold.

Let $\bar{d}$ be the disclosure rule that reveals all signal realizations. That is, $\bar{d}(x, w) = 1$ for all $x \in [0, 1]$ and $w \in [\underline{w}, \bar{w}]$. Conversely, let $\underline{d}$ be the disclosure rule that conceals all signal realizations – $\underline{d}(x, w) = 0$ for all x and w.

Proposition 2. *An optimal disclosure rule exists.*

If Y is strictly convex, then, for a given $\theta > 0$:

(1) *To a sender with transparent motives, $\bar{d}$ is an optimal disclosure rule*[19]*;*

[19]There is a trivial multiplicity of optimal disclosure rules. If there is only one signal realization that is not disclosed, then, to the receiver, this is equivalent to all signal realizations being disclosed. Despite $\bar{d}$ not being the only solution, all optimal disclosure rules induce the same receiver's distribution of posterior means, equal to $R(\cdot; \bar{d}, \theta) = S(\cdot; \theta)$.

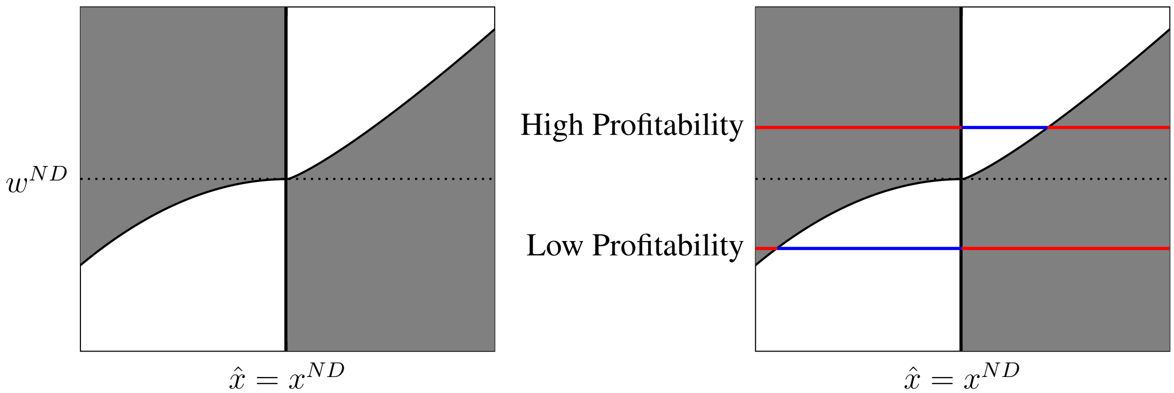

FIGURE 5. Optimal Disclosure Rule when Y is **concave**. The gray shaded areas represent signal realizations that are optimally concealed by the sender, and the white areas are optimally disclosed.

(2) *To a sender with hidden motives, an optimal disclosure rule a.e. satisfies:*

$$d^*(w,x) = 0 \textit{ if } x \in (X(w), \hat{x}) \textit{ or } x \in (\hat{x}, X(w))\,;$$

$$d^*(w,x) = 1 \textit{ if } x < \min\{X(w), \hat{x}\} \textit{ or } x > \max\{X(w), \hat{x}\}$$

for some decreasing function $X : [\underline{w}, \bar{w}] \to [0,1]$ *and* $\hat{x} \in [0,1]$*, with* $X(w^{ND}) = \hat{x}$.

If Y *is strictly concave, then for a given* $\theta > 0$*:*

(1) *To a sender with transparent motives,* $\underline{d}$ *is an optimal disclosure rule;*
(2) *To a sender with hidden motives, an optimal disclosure rule a.e. satisfies:*

$$d^*(w,x) = 1 \textit{ if } x \in (X(w), \hat{x}) \textit{ or } x \in (\hat{x}, X(w))\,;$$

$$d^*(w,x) = 0 \textit{ if } x < \min\{X(w), \hat{x}\} \textit{ or } x > \max\{X(w), \hat{x}\}$$

for some increasing function $X : [\underline{w}, \bar{w}] \to [0,1]$ *and* $\hat{x} \in [0,1]$*, with* $X(w^{ND}) = \hat{x}$.

The formal proof of Proposition 2 is in the Appendix. When Y is everywhere strictly convex, the optimal disclosure rule to an unbiased sender maximizes the total expected probability of sale by fully disclosing every signal realization – denoted $\bar{d}$. However, a sender with hidden motives is not solely interested in maximizing the total sale probability. He balances that objective with an opposing goal of increasing the covariance between sales and profitability, by steering sales to higher profitability objects at the expense of lower profitability ones.

A sender with hidden motives chooses to strategically hide some of the signal realizations. Again, as in the linear Y case, he conceals bad signal realizations for high profitability objects and good signal realizations for low profitability objects. However, unlike before, the pooled intervals are not "all below realizations below a threshold" if the object's profitability is high

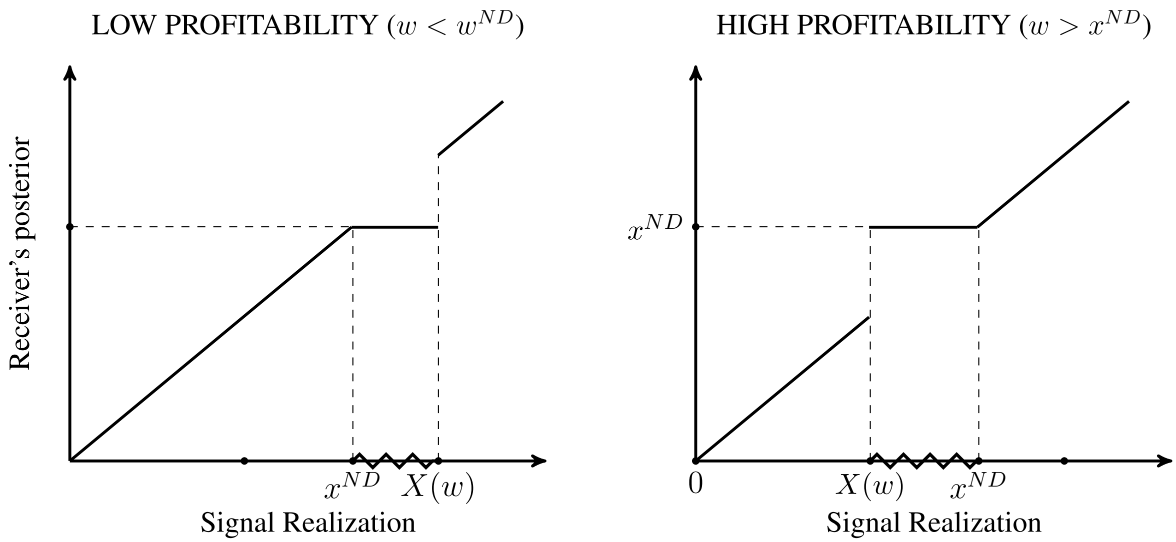

FIGURE 6. Posterior means induced on the receiver by the optimal disclosure rule when Y is **convex**. The snaked intervals represent non-disclosed signal realizations.

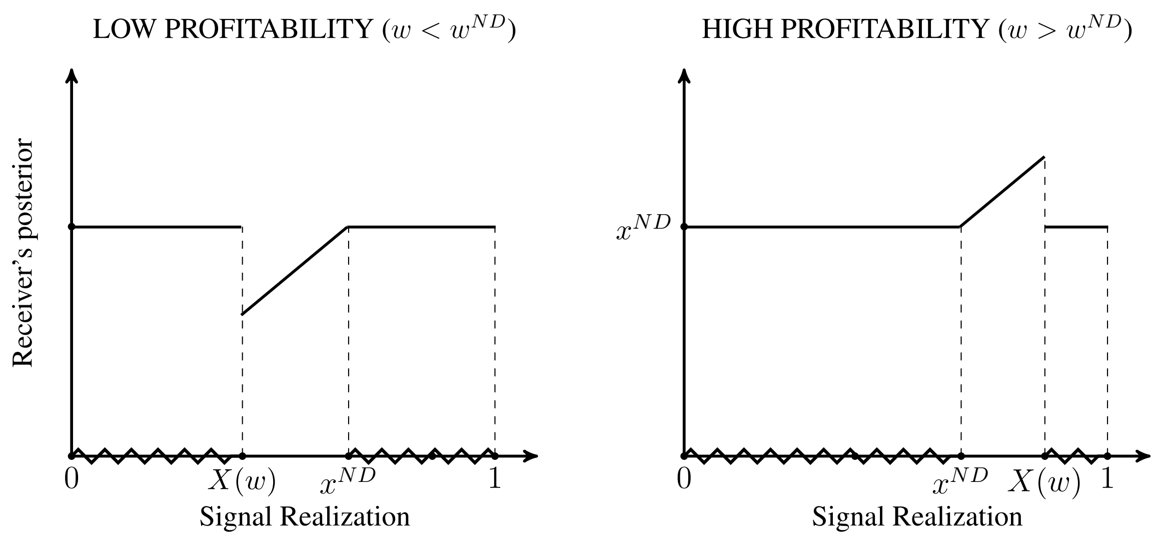

FIGURE 7. Posterior means induced on the receiver by the optimal disclosure rule when Y is **concave**. The snaked intervals represent non-disclosed signal realizations.

and "all realizations above that same threshold" if profitability is low. Such a disclosure rule may destroy too much total sale probability by hiding too many signal realizations.

Rather, there is some x^{ND}, the expected quality among all signals that are not disclosed, such that an interval of quality signal realizations right below x^{ND} are optimally concealed when profitability is high. Conversely, an interval of signal realizations right above x^{ND} is optimally concealed when profitability is low. These intervals are larger for more extreme profitability values. The optimal disclosure rule is represented in Figure 4.

In Figure 6, we can also see that when Y is convex, for each profitability, the receiver's posterior mean is increasing in the outcome of the quality signal. This means that, despite the fact that some signal realizations are not disclosed, higher signal realizations always map into higher probabilities that the object is sold.

Now let's consider the case where Y is strictly concave. Observation 3 tells us that more informative disclosed signals yield lower total sale probability. Therefore, a sender who wishes to maximize overall sales does so by fully concealing all signal realizations – the disclosure policy denoted $\underline{d}$. Hiding all signal realizations does maximize the total sales, but yields the same expected sale probability to objects of all profitabilities. A sender with hidden motives, again, has to balance two objectives: maximizing total sales, and distributing them from lower profitability objects to higher profitability ones. To that end, it is profitable to strategically reveal some outcomes of the quality signal, rather than fully concealing all signal realizations.

The optimal disclosure rule reveals signal realizations that fall in an interval right above x^{ND}, when the object has higher profitability, and an interval right below x^{ND} when the object has lower profitability. This rule is depicted in Figure 5. Unlike in the convex case, the posterior mean induced on the receiver, depicted in Figure 7 may not be increasing with respect to the realization of the quality signal. This means that, for a given profitability, higher signal realizations map into lower probabilities that the object is sold.

Corollary 1. *For a given θ, a sender with hidden motives*

(1) *Generates less probability of sale than a transparent sender;*
(2) *Is less informative than a transparent sender, if Y is strictly convex;*
(3) *Is more informative than a transparent sender, if Y is strictly concave.*

3.3. **An Example.** Suppose F is such that, with probability $1/2$, the object is of high profitability ($w = w_H$) and, with probability $1/2$, it has low profitability ($w = w_L$, where $w_H \geqslant w_L$). Moreover, let the true underlying quality distribution be uniform over $[0, 1]$ and the signal is such that sender perfectly observes the object's quality. Finally, let the distribution of receiver outside options be given by $Y(y) = y^2$, so we are looking at the strictly convex demand case.

In Appendix B, I show that the optimal disclosure rule is as in Proposition 2, with

$$X(w_H) = \frac{\tilde{w} + \Delta/2}{\tilde{w} + 3\Delta/2}, \quad X(w_L) = 1 \text{ and } \quad x^{ND} = \frac{X(w_L) + X(w_H)}{2} \tag{5}$$

where $\tilde{w} \equiv (w_H + w_L)/2$ is the average profitability, and $\Delta \equiv (w_H - w_L)/2$. The optimal disclosure rule based on (5) is pictured in Figure 8. In the Figure, I take $\tilde{w} = 1$ and vary Δ between 0 (so that $w_L = w_H = 1$) and 2 (so that $w_L = 0$ and $w_H = 2$).

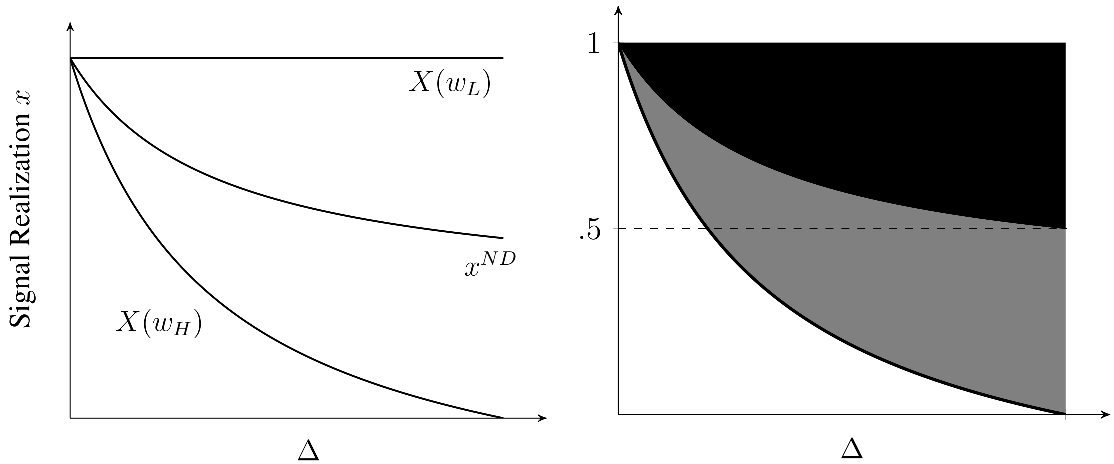

FIGURE 8. Optimal disclosure rules in Example 3.3, as a function of Δ, the difference between high and low profitability. In the left panel, I plot $X(w_H)$, x^{ND} and $X(w_L)$ as given in (5), which determine the optimal non-disclosure regions. In the right panel, the area in black is the non-disclosure region when the object's profitability is low; and the grey area is the non-disclosure region when the object's profitability is high.

As the difference between high and low profitability (Δ) increases, the non-disclosure region when the object is of low profitability increases, as $X(w_L)$ does not change and x^{ND} decreases. The non-disclosure region when the object has high profitability also increases in area as the sender's bias increases, because the difference between x^{ND} and $X(w_H)$ increases with Δ.

We can interpret an increase in Δ as the sender's motives becoming more opaque. In that sense, as the sender's motives become more opaque, the disclosed signal becomes strictly less informative, since the overall area of non-disclosure, given by $[X(w_H), X(w_L)]$ increases.

4. Hidden Motives and Signal Acquisition

In Section 3, the signal precision θ was taken as given and I characterized optimal disclosure rules. Now, I take a step back and study the sender's decision to acquire a costly signal about the object's quality, as well as how this decision is impacted by the extent to which the sender's motives are hidden.

To that latter end, I start by proposing a definition of a sender with *more opaque motives*. A sender's motives are more opaque when his distribution of profitabilities is more spread. In particular, I focus on linear spreads of the profitability distribution, as defined below. On the one end, if the sender is transparent, his profitability distribution is degenerate. At the other end, his motives grow more opaque when the profitabilities become more diffuse, while keeping the average profitability fixed.

Definition 1. *A distribution H' is a linear mean preserving spread of a distribution H if $\mathbb{E}_{H'}(x) = \mathbb{E}_H(x)$ and one of the following holds:*

(a) *H is the degenerate distribution at $\mathbb{E}_H(x)$;*
(b) *There exist $\alpha \geqslant 1$ and $\beta \in \mathbb{R}$ such that, for every $q \in [0, 1]$*[20],

$$H'^{-1}(q) = \alpha H^{-1}(q) + \beta$$

A linear mean preserving spread of a distribution is essentially a renormalization of that distribution that makes it more spread out. For example, increasing the variance of a normal distribution leads to a linear mean preserving spread of the original distribution. Likewise, increasing the support of a uniform distribution symmetrically around the mean also leads to a mean preserving spread of the original distribution. More generally, the relevant feature of a linear mean preserving spread is that the distance between every two quantiles of the distribution increases by a factor $\alpha \geqslant 1$.

Definition 2. *A sender with profitability distribution F' has* ***more hidden motives*** *than one with profitability distribution F if F' is a linear mean preserving spread of F.*

4.1. **Linear Demand.** Again, I proceed by evaluating the sender's signal acquisition decision first in the case where the receiver's distribution of outside options is uniform. The proposition below states that hidden motives provide incentives for the sender to acquire a precise signal. In fact, when the sender's motives are transparent, the sender is not willing to invest at all in signal acquisition.

Proposition 3. *Let Y be linear. Senders with more hidden motives acquire weakly more precise signals. In particular, a sender with transparent motives acquires $\theta = 0$, a perfectly uninformative signal.*

The full proof is in the Appendix. Although the proposition is stated "weakly", there are mild assumptions under which information acquisition strictly increases as the sender's motives become more hidden. More on that momentarily.

The main observation is that an increase in the signal precision increases the spread between the sale probability to high and low profitability objects. When the sender has access to more precise information, then his ability to reveal to the receiver that a high profitability object is "very good", or that a low profitability object is "very bad", is greater. Recall that by linearity of the demand function, the sender cannot affect the overall probability of sale by acquiring more information. In the linear setting, then, the *only* use of information acquisition is to create a transfer of sale probability from from low to high profitability objects. But the extent to which the sender's motives are hidden determine the value he gets from steering – when

[20] If H and H' are continuous and strictly increasing, their inverses are well defined. If not, then let $H^{-1}(q) = \inf\{x : H(x) \geqslant q\}$ and H'^{-1} accordingly.

motives are more hidden, steering is more profitable. It is natural, then, that senders with more hidden motives have stronger incentives to invest in acquiring precise signals.

A bit more formally, we can write the value of acquiring a signal of precision θ as

$$\max_{d} \ \Pi(\theta, d; F) = \mathbb{E}(w)\mathbb{E}(x) + \pi(\theta, F) - c(\theta) \tag{6}$$

$$\text{where } \pi(\theta, F) = \max_{d} \{\text{Cov}\,(w, P(w;\theta,d); F)\}$$

First notice that, since for a transparent sender, $\text{Cov}\,(w, P(w;\theta,d)) = 0$ for all d, then it must be that there is no benefit from acquiring a more precise signal and he chooses $\theta = 0$.

In the Appendix, I show two things. First, that $\pi(\theta, F)$ is increasing in θ.[21] Second, I show that, if F' is a linear mean preserving spread of F, with factor $\alpha > 1$, then $\pi(\theta, F') = \alpha\pi(\theta, F)$. Putting these two facts together, I find that the marginal benefit of acquiring precision is larger for senders with more hidden motives.

Proposition 3 has an almost immediate implication that senders with more hidden motives are no less informative than more transparent senders.

Proposition 4. *Informativeness of the optimal disclosed signal does not decrease as the sender's motives become more hidden. In particular, a sender with hidden motives produces a weakly more informative disclosed signal than a sender with transparent motives.*

Notice that, since the informativeness order is not complete, a not less informative signal is not the same as a weakly more informative signal. One can produce examples where, as motives become more hidden, the sender acquires more information, discloses a no less informative signal, and yet, the receiver's surplus shrinks. However, Proposition 4 does guarantee that the receiver is weakly better off when the sender has hidden motives, as opposed to fully transparent motives.

4.2. **An Example.** Suppose F is such that, with probability $1/2$, the object is of high profitability ($w = w_H$) and, with probability $1/2$, it has low profitability ($w = w_L$, where $w_H \geqslant w_L$). In that case, we can pin down the threshold quality in the optimal disclosure rule, as described in Proposition 1.

[21] I show in the Appendix that we can write

$$\pi(\theta, F) = \int_{[\hat{w},\bar{w}]} (w - \mathbb{E}(w))\, dF(w) \left[\int_{[0,\hat{x}]} S(x;\theta)dx + \int_{[\hat{x},1]} (1 - S(x;\theta))dx \right]$$

where $\hat{x}$ and $\hat{w}$ are as given in Proposition 1. Both $\int_{[0,\hat{x}]} S(x;\theta)dx$ and $\int_{[\hat{x},1]}(1 - S(x;\theta))dx$ weakly increase in θ, by the mean preserving spread property. I say that, for $\theta' > \theta$, $S(\cdot;\theta')$ provides more information than $S(\cdot;\theta)$ *across* $\hat{x}$ if either $\int_{[0,\hat{x}]} S(x;\theta)dx$ or $\int_{[\hat{x},1]}(1 - S(x;\theta))dx$ strictly increase with θ. In that case, Proposition 3 can be stated strictly.

Observation 4. *The threshold $\hat{x}$, described in Proposition 1, is equal to $\bar{x}$, the underlying average quality of the object.*

In this case, the optimal disclosure rule does not depend on the precision acquired by the sender, since, for all θ, the expected value of x under $S(\cdot;\theta)$ is always $\bar{x}$. The disclosure rule also does not vary with the degree to which the sender's motives are hidden (the difference between w_H and w_L). In fact, the sender always discloses *above average* realizations when profitability is high and *below average* realizations when profitability is low. In this case, using Proposition 3, we can show that the receiver's surplus is weakly increasing in the sender's hidden motives.

Observation 5. *Informativeness is increasing in the sender's hidden motives.*

Now let's further assume that the true underlying distribution of the object's quality is uniform over $[0, 1]$ and the available quality signals, indexed by $\theta \in [0, 1]$, are such that they reveal the object's true quality with probability θ and are perfectly uninformative with probability $1 - \theta$.

If the true quality is x and the signal perfectly reveals the quality, then the sender understands the quality to be exactly x. If, on the other hand, the signal is uninformative, then the sender gains no insight into the object's quality, so his quality estimate is equal to the average quality, $\bar{x} = 1/2$. Hence, for a given θ, the quality signal is defined by:

$$S(x;\theta) = \begin{cases} \theta x, \text{ if } x < 1/2 \\ \theta x + (1-\theta), \text{ if } x \geqslant 1/2 \end{cases}$$

With probability $1 - \theta$, the signal is uninformative, which induces a mass point at $1/2$. Otherwise, S follows the uniform distribution, which is the true underlying distribution of the object's quality. Applying the optimal disclosure rule from Proposition 1, we can also find the distribution of receiver posterior means when the acquired precision is θ.

$$R(x;\theta,d^*) = \begin{cases} \frac{\theta}{2}x, \text{ if } x < 1/2 \\ \frac{\theta}{2}x + \left(1-\frac{\theta}{2}\right), \text{ if } x \geqslant 1/2 \end{cases}$$

This distribution is pictured in Figure 9, for two different values of precision θ. Note that when the sender acquires a higher precision, the amount of information provided to the receiver is larger. If $\theta' > \theta$, then $R(\cdot;\theta',d^*)$ is a mean preserving spread of $R(\cdot;\theta,d^*)$. In the picture, we can see that the mass point on $1/2$ gets smaller and there is more weight on the tails of R.

At one extreme, if $\theta = 0$, the sender is perfectly uninformative and the receiver's distribution is degenerate at $1/2$. At the other end, when $\theta = 1$, the sender is *not* perfectly informative. Even though the sender perfectly observes the object's quality, he optimally hides "half" of the realizations from the receiver. Half of the time, the receiver is not informed of the object's quality, which leads to a mass point of probability $1/2$ at $\bar{x} = 1/2$.

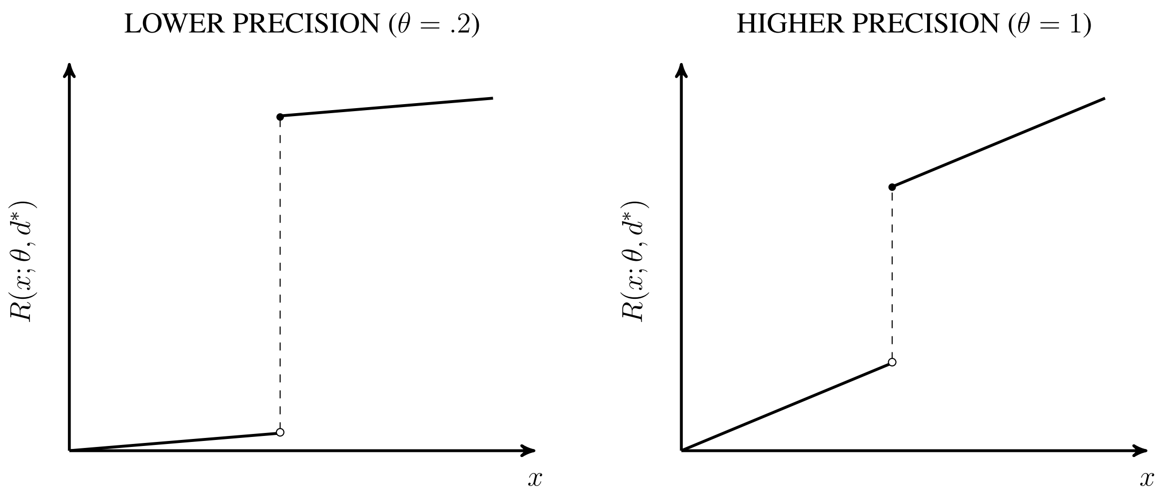

FIGURE 9. Example 4.2. I display the receiver's distribution of posterior means when the sender uses the optimal disclosure rule d^* from Proposition 1 and acquires signal precision θ.

Substituting the quality signal S from this example into (6), we find that the sender's profit from acquiring precision θ is

$$\Pi(\theta, d^*) = \frac{\tilde{w}}{2} + \Delta\frac{\theta}{4} - c(\theta)$$

where $\tilde{w} \equiv (w_H + w_L)/2$ is the average profitability, and $\Delta \equiv (w_H - w_L)/2$ is the degree to which the sender's motives are hidden. Assuming that c is differentiable and strictly convex, the sender's optimal precision choice is an increasing function of the sender's bias ϵ, given by

$$\theta^* = \min\left\{c'^{-1}\left(\frac{\Delta}{4}\right), 1\right\}$$

4.3. **Nonlinear Demand.** So far, we saw that in the case of a linear receiver type distribution, the bias of the sender acts as an incentive to acquire more precise quality signals. This result held for any increasing precision cost function.

When Y is not linear, the precision acquired by the sender is not necessarily increasing in the sender's bias for such a general class of cost function. However, Proposition 5 below shows that this still holds when acquiring a signal is a discrete choice — the sender acquires a signal of some precision at a positive fixed cost or no signal at all at zero cost.

Proposition 5. *Suppose precision $\hat{\theta}$ can be acquired at a fixed cost $k > 0$.*[22] *Senders with more hidden motives acquire weakly more precise signals. Moreover, a sender that acquires precision $\hat{\theta}$ is strictly more informative than one that does not.*

If the sender does not acquire the signal, then regardless of the disclosure policy, the distribution of posterior means induced on the receiver is the degenerate distribution at $\bar{x}$. The value to the sender in that case is $wY(\bar{x}) - c(\theta)$; which does not depend on the degree of the sender's hidden motives. On the other hand, the value to the sender conditional on acquiring the signal is higher for senders with more hidden motives. When the sender acquires the informative signal, then he has the ability to choose a disclosure rule that benefits high profitability objects at the expense of low profitability ones; and the benefit from doing so is higher when motives are more hidden.

5. Regulating Advisors

In this section, I focus on the case where F has binary support. With probability $1/2$, the object is of high profitability ($w = w_H$) and, with probability $1/2$, it has low profitability ($w = w_L$, where $w_H \geqslant w_L$).

5.1. **Mandatory Disclosure of Commissions.**

In the context of financial advisors, a commonly proposed mechanism that aims at protecting clients of is to mandate they be informed of commissions paid by product providers to their advisors/brokers.

In the model, this would mean that the receiver would not only observe the disclosed/not disclosed signal realization, but also the profitability of the object. If the signal realization is disclosed, then knowing the profitability of the object has no effect. However, when the sender does not disclose the signal realization, his extra information affects the receiver's posterior. Remember that, when the receiver is not informed about the profitability, upon observing that the signal is not disclosed, her posterior mean is

$$x^{ND} = \frac{\int_0^1 [1 - d(w_L, x)] x dS(x;\theta) + \int_0^1 [1 - d(w_H, x)] x dS(x;\theta)}{\int_0^1 [1 - d(w_L, x)] dS(x;\theta) + \int_0^1 [1 - d(w_H, x)] dS(x;\theta)}$$

Now if she is informed about the profitability, then upon observing that the signal was not disclosed and that the profitability is w, her posterior mean is

$$x_w^{ND} = \frac{\int_0^1 [1 - d(w, x)] x dS(x;\theta)}{\int_0^1 [1 - d(w, x)] dS(x;\theta)}$$

[22] There is some $\hat{\theta} \in [0, 1]$ such that $c(0) = 0$, $c(\theta) = k$ for all $\theta \in (0, \hat{\theta}]$ and $c(\theta) = \infty$ for all $\theta > \hat{\theta}$. The revenue to the sender is weakly increasing in θ, so we can assume that the sender never chooses $\theta \in (0, \hat{\theta})$.

And the value to the sender that chooses the disclosed signal (θ, d) is

$$\Pi(\theta, d) = w_H P(w_H; \theta, d) + w_L P(w_L; \theta, d) - c(\theta)$$
$$\text{where } P(w; \theta, d) = \int_{[0,1]} Y(x) d(w, x) dS(x; \theta) + \int_{[0,1]} Y(x_w^{ND})(1 - d(w, x)) dS(x; \theta)$$

Notice that in this case the disclosure rule for low profitability objects does not affect the expected sale probability to high profitability objects and vice-versa. This implies that any optimal disclosure rule must yield the same expected sale probability to both high and low profitability objects. That is, if d^* is an optimal disclosure rule, then $P(w_H; \theta, d^*) = P(w_L \theta, d^*)$. And in this case, the value to the sender is

$$\Pi(\theta, d) = (w_H + w_L) P(w_H; \theta, d) - c(\theta) = (w_H + w_L) P(w_L; \theta, d) - c(\theta)$$

which is exactly the objective function faced by a sender with transparent motives with average profitability $(w_H + w_L)/2$. Hence in order to evaluate the effectiveness of the policy, we need to compare the disclosed signal chosen by the sender with hidden motives to that of the transparent sender with the same average profitability. In the linear case, Observation 5 shows that the optimally chosen disclosed signal is more informative when the sender's motives are more hidden. This implies that the receiver's surplus decreases as a result of the policy.

Proposition 6. *If Y is linear, mandating commission disclosure* ***decreases receiver's surplus****.*

There exists $\bar{\Delta} \in \mathbb{R}_+ \cup \{+\infty\}$ such that, if $\Delta \equiv (w_H - w_L) > \bar{\Delta}$, mandating commission disclosure ***improves welfare****.*

Welfare takes into account the surplus to the receiver (positively) and the cost of acquiring information (negatively). By defining welfare in this way, I am taking the view that all other values are simply transfers between agents in the market. Proposition 6 states that, if the sender's hidden motives are too strong, he over-invests in acquiring signal precision. This may happen because the sender's value from investing in the signal is not aligned to the welfare value of the signal. Given the linear Y, to the sender, the optimal signal acquisition is:

$$\theta^* = \arg\max \left\{ \mathbb{E}(w)\mathbb{E}(x) + \Delta \mathbb{E}\left[|x - \bar{x}| \right] - c(\theta) \right\} \tag{7}$$

Taking into account that the sender will optimally disclose signal realizations, the welfare without mandating disclosure is given by $\frac{1}{2}\left(\bar{x}^2 + \mathbb{E}(x^2|\theta^*)\right) - c(\theta^*)$. With mandatory disclosure, the sender acquires no information and welfare is equal to $\bar{x}^2$. If $c(\theta^*) > \mathbb{E}(x^2|\theta^*) - \bar{x}^2$, mandatory disclosure is welfare-improving.

For nonlinear distributions of receiver outside options, we can evaluate the mandatory disclosure policy in the case of a fixed cost of signal acquisition.

Proposition 7. *Suppose there is a fixed cost to acquiring a signal. The surplus to the receiver weakly decreases with the policy if the transparent sender does not acquire the signal. If Y is convex, the converse also holds.*

If the transparent sender does not acquire the signal, then the receiver is weakly better off without the policy, in which case he is informed by a sender with hidden motives who acquires and discloses weakly more information (as per Proposition 5). If Y is convex and the transparent sender acquires the signal, then he also fully discloses that signal (Proposition 3), and so the receiver is weakly better off with the policy.

5.2. **Commission Caps.** A second commonly proposed policy is to cap the level of commissions that financial advisors are allowed to accept from product providers. In my model, a (perhaps coarse) way of imposing a commission cap is to set the high profitability w_H to be equal to the cap, $w_{CAP} \in (w_L, w_H)$. By doing this, the difference between high and low profitability becomes smaller, and so the sender's motives become less hidden.

The effect of commission caps is similar to that of mandatory disclosure. While mandatory disclosure makes the sender act as if he had transparent motives, commission caps can partially reduce the extent of the sender's hidden motives. To evaluate the effect on welfare, we can define the welfare-maximizing signal acquisition, taking into account the sender's optimal disclosure rule. It is given by

$$\theta^{**} = \arg\max \left[\frac{1}{2} \left(\bar{x}^2 + \mathbb{E}(x^2|\theta) \right) - c(\theta) \right] \tag{8}$$

Proposition 8. *Let Y be linear.*

Imposing a commission cap w_{CAP} decreases the surplus to the receiver.

If θ^{**}, as defined in (8), is smaller than θ^*, as defined in (7), then there is a commission cap $w_{CAP} \in [w_L, w_H)$ that improves welfare.

6. Conclusion

The paper studies a sender who acquires and discloses information about an object's quality. A receiver observes the information disclosed by the sender and chooses whether to acquire the object or take an outside option. The sender's motives are hidden: his profitability from the object's sale is not observed by the receiver, and is independent of the object's quality to the receiver. A sender with more hidden motives has stronger incentives to push the sale of some objects over others.

My analysis shows that the sender's hidden motives affect the amount of information he provides to the receiver through two channels. First, a more biased sender can be *more informative* because he has stronger incentives to acquire a precise signal of the object's quality. Secondly, his hidden motives determine his Optimal Disclosure Rule. In Section 3, I show that Optimal Disclosure Rules are characterized by a threshold structure. Typically, the sender discloses good signal realizations and conceals bad ones when the object is sufficiently profitable. Conversely, if the object's profitability is below threshold, the sender conceals good signal realizations and reveals bad ones.

These results inform the evaluation of instituting policies that are commonly proposed in the context of financial advisors, such as mandatory disclosure of commissions or commission caps. I find that instituting such a policies can backfire and reduce the surplus to the receiver by stripping the sender of his incentive to invest in acquiring precise quality signals.

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8. Appendix A - Proofs

8.1. **Proof of Observation 1.** The surplus to the receiver that has a posterior mean of x and outside option y is the maximum of $(x-y)$ and 0. To find the ex-ante expected surplus to the receiver when the sender picks (θ, d), we integrate with respect to the distribution of receiver outside options, as well as the distribution of posterior means the receiver faces:

$$\text{Receiver Surplus} = \int_0^1 \int_0^1 \max\{x-y,0\} dY(y) dR(x;\theta,d) = \int_0^1 \int_0^x Y(y)dy\, dR(x;\theta,d)$$

Since Y is a cdf, and thus nondecreasing, then $\int_0^x Y(y)dy$ is a weakly convex function of x. Using this and the definition of the informativeness order, we find that the receiver benefits from facing more informative disclosed signals.

8.2. **Proof of Observation 2.** For a given θ and d, we have:

$$\mathbb{E}\left[P(w;\theta,d)\right] = \int_{[0,1]} Y(x)dR(x;\theta,d) = \int_{[0,1]} x dR(x;\theta,d) = \bar{x}$$

where the last equality is due to $R(\cdot;\theta,d)$ being a mean preserving spread of the underlying distribution of the object's quality.

8.3. **Proof of Observation 3.** We know that, for a given θ and d,

$$\mathbb{E}\left[P(w;\theta,d)\right] = \int_{[0,1]} Y(x)dR(x;\theta,d)$$

If (θ,d) is more informative than (θ',d'), then $R(\cdot;\theta,d)$ is a mean preserving spread of $R(\cdot;\theta',d')$. This immediately implies that, if Y is convex, $\mathbb{E}\left[P(w;\theta,d)\right] \geqslant \mathbb{E}\left[P(w;\theta',d')\right]$. And, if Y is concave, $\mathbb{E}\left[P(w;\theta,d)\right] \leqslant \mathbb{E}\left[P(w;\theta',d')\right]$.

8.4. **Proof of Proposition 2.** Case 1 (Y everywhere strictly convex). If the sender has transparent motives, then Observation 3 guarantees that $\bar{d}$ is an optimal disclosure rule. Moreover, if $R(\cdot;\theta,d) \neq R(\cdot;\theta,\bar{d})$, then $R(\cdot;\theta,\bar{d})$ is a strict mean preserving spread of $R(\cdot;\theta,d)$. And since Y is everywhere strictly convex, $\bar{d}$ is strictly better for the sender. This means that the optimal disclosure rule is unique in terms of the distribution of posterior means it induces on the receiver.

Now suppose the sender has hidden motives. Using (2), for $w \in \{w_L, w_H\}$ and $x \in [0,1]$, we can take a derivative of the sender's value with respect to $d(w,x)$, to get

$$\begin{aligned}
\frac{\partial \Pi}{\partial d(w,x)} =& w\left(Y(x) - Y(x^{ND})\right) dS(x;\theta)dF(w) \\
&+ \left(\int_{[\underline{w},\bar{w}]} \int_{[0,1]} \hat{w}\left[1 - d(w_H,\hat{x})\right] dS(\hat{x};\theta)dF(\hat{w})\right) Y'(x^{ND}) \frac{\partial x^{ND}}{\partial d(w,x)}
\end{aligned} \tag{9}$$

Now from (1), we get

$$\frac{\partial x^{ND}}{\partial d(w,x)} = \frac{\int_{[\underline{w},\bar{w}]}\int_{[0,1]}(\hat{x}-x)(1-d(\hat{w},\hat{x}))dS(\hat{x};\theta)dF(\hat{w})}{\left(\int_{[\underline{w},\bar{w}]}\int_{[0,1]}(1-d(\hat{w},\hat{x}))dS(\hat{x};\theta)dF(\hat{w})\right)^2} dS(x;\theta)dF(w)$$

Substituting this into the previous equation, we get

$$\frac{\partial \Pi}{\partial d(w,x)} = \left[w\left(Y(x)-Y(x^{ND})\right) + w^{ND}Y'(x^{ND})(x^{ND}-x)\right] dS(x;\theta)dF(w) \tag{10}$$

Define $\Gamma(x,x^{ND}) = \frac{Y'(x^{ND})(x^{ND}-x)}{Y(x^{ND})-Y(x)}$ if $x \neq x^{ND}$ and $\Gamma(x,x^{ND}) = 1$ if $x = x^{ND}$.

$$\Gamma(x,x^{ND}) = \frac{Y'(x^{ND})}{\frac{\int_x^{x^{ND}} Y'(\hat{x})d\hat{x}}{x^{ND}-x}}, \text{ when } x \neq x^{ND}$$

which is the ratio between derivative of Y at x^{ND} and the average derivative of Y between x and x^{ND}. Notice that this ratio is not well defined at $x = x^{ND}$. However,

$$\lim_{x \uparrow x^{ND}} \Gamma(x,x^{ND}) = \lim_{x \downarrow x^{ND}} \Gamma(x,x^{ND}) = 1$$

This, along with the fact that Y is strictly convex implies that Γ is continuous.

Since Y is strictly convex, Y' is strictly increasing, and Γ is also strictly decreasing in x. In particular, for $x < x^{ND}$, $\Gamma(x,x^{ND}) > 1$ and, for $x > x^{ND}$, $\Gamma(x,x^{ND}) < 1$.

From (9), we know that, for $x < x^{ND}$,

$$\frac{\partial \Pi}{\partial d(w,x)} > (<) 0 \Leftrightarrow \frac{w}{w^{ND}} > (<) \Gamma(x,x^{ND})$$

And if $x > x^{ND}$:

$$\frac{\partial \Pi}{\partial d(w,x)} < (>) 0 \Leftrightarrow \frac{w}{w^{ND}} > (<) \Gamma(x,x^{ND})$$

From these conditions, we know that, if $w > w^{ND}$, there exists an $X(w)$ such that the derivative is negative if and only if $x \in [X(w), x^{ND})$. This $X(w)$ is defined by:

$$\Gamma(X(w),x^{ND}) = \frac{w}{w^{ND}}$$

whenever a solution to this equation exists in the interval $[0,1]$ and $X(w) = 0$ otherwise. Since Γ is decreasing in the first argument, then $X(w)$ is decreasing in w. Moreover, $\lim_{w \to w^{ND}} X(w) = x^{ND}$.

If, on the other hand, $w < w^{ND}$, then there exists $X(w)$ such that the derivative is negative if and only if $x \in [x^{ND}, X(w)]$. This $X(w)$ is defined by $\Gamma(X(w),x^{ND}) = \frac{w}{w^{ND}}$ whenever a solution exists in the interval $[0,1]$, and by $X(w) = 1$ otherwise. Since Γ is decreasing in the first argument, then $X(w)$ is decreasing in w. Moreover, $\lim_{w \to w^{ND}} X(w) = x^{ND}$.

Case 2 (Y everywhere strictly concave). If the sender has transparent motives, then Observation 3 guarantees that $\underline{d}$ is an optimal disclosure rule. Moreover, if $R(\cdot;\theta,d) \neq R(\cdot;\theta,\underline{d})$, then $R(\cdot;\theta,d)$ is a strict mean preserving spread of $R(\cdot;\theta,\underline{d})$. And since Y is everywhere strictly concave, $\underline{d}$ is strictly better for the sender. This means that the optimal disclosure rule is unique in terms of the distribution of posterior means it induces on the receiver.

Now suppose the sender has hidden motives. The derivative of the sender's value with respect to $d(w,x)$ is the same as in Case 1; and the conditions for it to be strictly positive or negative are also the same as before.

However, since Y is now everywhere strictly concave, we have $\Gamma(x, x^{ND})$ is continuous and strictly increasing in x, with $\Gamma(x^{ND}, x^{ND}) = 1$. In particular, for $x < x^{ND}$, $\Gamma(x, x^{ND}) < 1$ and, for $x > x^{ND}$, $\Gamma(x, x^{ND}) > 1$.

Following the same arguments as in Case 1, any optimal disclosure rule must be as stated in the proposition.

8.5. **Proof of Proposition 2 (continued): On Existence of d^*.** If F and $S(\cdot;\theta)$ have finite support, with cardinalities M and N respectively, then it is simple to argue that d^* must exist. Just note that effectively the sender picks $M \times N$ numbers in $[0,1]$:

$$\{d(w,x_1), d(w,x_2), ..., d(w,x_N)\}_{w\in\{w_1,...,w_M\}}$$

Since $[0,1]^{M\times N}$ is compact and the objective is continuous, then a maximizer exists.

Now suppose instead that F and $S(\cdot;\theta)$ are continuous and strictly increasing.[23] Let $\Pi^*_\theta \equiv \sup_d \Pi(d,\theta)$. Also let $S^N(\cdot;\theta)$ be a discretized version of $S(\cdot;\theta)$ with N "bins": it has a mass point of measure $1/N$ at each $x_n = \mathbb{E}\left[x|\frac{n-1}{N} \leqslant S(x;\theta) < \frac{n}{N}\right]$ for $n \in \{1,..,N\}$. Similarly, let F^M be a discretized version of F, with M "bins". We know that, for any $M, N \in \mathbb{N}^2$, there exists a disclosure rule that solves the sender's *discretized* problem.

Fact 1. For any $\xi > 0$, there exists some $M, N \in \mathbb{N}$ such that if $d_{M,N}$ is a solution to the sender's discretized problem, then $\Pi^*_\theta - \Pi(d_{N,M},\theta) < \xi$.

Furthermore, define a class of *threshold* disclosure rules $\mathcal{D}$ where for some $\hat{x}, \hat{w} \in [0,1] \times [\underline{w}, \bar{w}]$, $d(w,x) = 1$ if

$$(\hat{x} - x)\frac{w}{\hat{w}} > (\hat{x} - x)\Gamma(x,\hat{x})$$

And $d(w,x) = 0$ if

$$(\hat{x} - x)\frac{w}{\hat{w}} < (\hat{x} - x)\Gamma(x,\hat{x})$$

[23]This same argument applies if F or S have mass points or flat regions, but the notation becomes more cumbersome.

where Γ was defined in 8.4. Let $\mathcal{D}$ also include any disclosure rules that differ from that in at most a measure 0 set – where this measure is computed with respect to F and $S(\cdot;\theta)$, not the discretized distributions. From Proposition 2, we can see that

Fact 2. For each M, N, there is a solution $d_{M,N}$ to the sender's problem that belongs to $\mathcal{D}$.

Now take some $d \notin \mathcal{D}$. Again by Proposition 2, we know that $\Pi(d,\theta) < \Pi^*_\theta$. But then, by Fact 1 and 2, it must be that there is a $\hat{d} \in \mathcal{D}$ such that $\Pi(d,\theta) \leqslant \Pi(\hat{d},\theta)$.

So it must be that, if a disclosure rule is a solution to a constrained sender problem where the constraint is $d \in \mathcal{D}$, then it must also be a solution to the unconstrained problem. But, in fact, it is easy to show that a solution to the constrained problem must exist: just note that $(\hat{x},\hat{w}) \in [0,1] \times [\underline{w},\bar{w}]$, a compact set, and that the sender's objective is continuous.

8.6. **Proof of Proposition 3.** I use three steps in this proof.

Step 1. Showing that $\pi(\theta,F)$ is weakly increasing in θ. Using Proposition 1, we can write $\pi(\theta,F)$, defined in (6), as:

$$\begin{aligned}\pi(\theta,F) = &\int_{[\underline{w},\hat{w}]}(w-\mathbb{E}(w))dF(w)\left[\int_{[0,\hat{x}]}(x-\mathbb{E}(x))dS(x;\theta)+\int_{(\hat{x},1]}(\hat{x}-\mathbb{E}(x))dS(x;\theta)\right]\\ &+\int_{[\hat{w},\bar{w}]}(w-\mathbb{E}(w))dF(w)\left[\int_{[0,\hat{x}]}(\hat{x}-\mathbb{E}(x))dS(x;\theta)+\int_{(\hat{x},1]}(x-\mathbb{E}(x))dS(x;\theta)\right]\end{aligned}$$

where $\hat{x}$ and $\hat{w}$ are as given in Proposition 1. Using integration by parts, this can be rewritten as:

$$\begin{aligned}\pi(\theta,F) = &\int_{[\underline{w},\hat{w}]}(w-\mathbb{E}(w))dF(w)\left[(\hat{x}-\mathbb{E}(x))-\int_{[0,\hat{x}]}S(x;\theta)dx\right]\\ &+\int_{[\hat{w},\bar{w}]}(w-\mathbb{E}(w))dF(w)\left[(\hat{x}-\mathbb{E}(x))+\int_{[\hat{x},1]}(1-S(x;\theta))dx\right]\end{aligned}$$

Finally, noticing that $\int_{[\underline{w},\hat{w}]}(w-\mathbb{E}(w))dF(w) = -\int_{[\hat{w},\bar{w}]}(w-\mathbb{E}(w))dF(w)$, we get:

$$\pi(\theta,F) = \int_{[\hat{w},\bar{w}]}(w-\mathbb{E}(w))\,dF(w)\left[\int_{[0,\hat{x}]}S(x;\theta)dx+\int_{[\hat{x},1]}(1-S(x;\theta))dx\right] \tag{11}$$

Both $\int_{[0,\hat{x}]}S(x;\theta)dx$ and $\int_{[\hat{x},1]}(1-S(x;\theta))dx$ weakly increase in θ, by the mean preserving spread property. This, along with (11), implies that π is increasing in θ.

Step 2. Showing that if $\hat{F}$ is a linear mean preserving spread of F, with factor $\alpha > 1$, then $\pi(\theta,\hat{F}) = \alpha\pi(\theta,F)$.

Take any d, and let $\hat{d}$ be such that, for all $q \in [0,1]$, $\hat{d}(\hat{F}^{-1}(q),x) = d(F^{-1}(q),x)$. This implies that $P(\hat{F}^{-1}(q);\theta,\hat{d}) = P(F^{-1}(q);\theta,d)$.

Moreover, since $\hat{F}$ is a linear mean preserving spread of F with factor α, we have that $\hat{F}^{-1}(q) - \mathbb{E}(w) = \alpha\left(F^{-1}(q) - \mathbb{E}(w)\right)$. Putting all this together, we get that:

$$\text{Cov}\left[w, P(w;\theta,d);F\right] = \alpha\text{Cov}\left[w, P(w;\theta,\hat{d});\hat{F}\right]$$

Now suppose d^* maximizes $\text{Cov}\left[w, P(w;\theta,d);F\right]$. Then it must be that $\hat{d}^*$ such that, for all $q \in [0,1]$, $\hat{d}^*(\hat{F}^{-1}(q),x) = d^*(F^{-1}(q),x)$, maximizes $\text{Cov}\left[w, P(w;\theta,\hat{d});\hat{F}\right]$. And so, it must be that:

$$\pi(\theta;\hat{F}) = \text{Cov}\left[w, P(w;\theta,\hat{d}^*);\hat{F}\right] = \alpha\text{Cov}\left[w, P(w;\theta,d^*);F\right] = \alpha\pi(\theta,F)$$

Step 3.

Let $\Pi^*(\theta;F) \equiv \max_d \Pi(\theta,d;F)$. And let $\hat{F}$ be a linear mean preserving spread of F, with factor α. Step 1 and 2 imply that, for any $\theta' > \theta$, if $\Pi^*(\theta';F) \geqslant \Pi^*(\theta;F)$, then $\Pi^*(\theta';\hat{F}) \geqslant \Pi^*(\theta;\hat{F})$ as well. And so it must be that a sender with profitability distribution $\hat{F}$ acquires weakly higher precision than a sender with profitability distribution F.

8.7. **Proof of Proposition 4.** From Proposition 3, we know that a transparent sender acquires $\theta = 0$. Thus, he provides the receiver with a perfectly uninformative signal. And we can conclude that a sender with hidden motives is weakly more informative than a transparent sender.

Also from Proposition 3, we know that if there are two senders, such that sender 1 has more hidden motives than sender 2, then if θ_i is a signal optimally acquired by sender $i \in \{1,2\}$, $\theta_1 \geqslant \theta_2$. Moreover, from Proposition 1, we know that the optimal disclosure rule has a threshold structure. Let $(\hat{x}_i, \hat{w}_i)$ be the optimal thresholds for sender i.

Then the distribution of posterior means optimally induced on the receiver by sender i is as follows. If $x < \hat{x}_i$,

$$R_i(x) = F(\hat{w}_i)S(x;\theta_i)$$

If $x \geqslant \hat{x}$,

$$R_i(x) = F(\hat{w}_i) + (1 - F(\hat{w}_i))S(x;\theta_i)$$

Now suppose $\hat{w}_1 > \hat{w}_2$. This, along with the fact that $\theta_1 \geqslant \theta_2$ implies that, for all $0 < q < \min\{F(\hat{w}_1)S(\hat{x}_1;\theta_1); F(\hat{w}_2)S(\hat{x}_2;\theta_2)\}$:

$$\mathbb{E}_{R_1}(x|R_1(x) \leqslant q) < \mathbb{E}_{R_2}(x|R_2(x) \leqslant q)$$

which implies that R_2 is *not* a mean preserving spread of R_1 (and so sender 1 is no less informative than sender 2).

Now suppose otherwise that $\hat{w}_1 < \hat{w}_2$. Then for all $\max\{F(\hat{w}_1)S(\hat{x}_1;\theta_1); F(\hat{w}_2)S(\hat{x}_2;\theta_2)\} < q < 1$:

$$\mathbb{E}_{R_1}(x|R_1(x) \geqslant q) > \mathbb{E}_{R_2}(x|R_2(x) \geqslant q)$$

which again implies that R_2 is *not* a mean preserving spread of R_1.

Finally, suppose that $\hat{w}_1 = \hat{w}_2 \equiv \hat{w}$. Then, by optimality, it must be that either $R_1 = R_2$ or:

$$\mathbb{E}_{R_1}(x|R_1(x) > F(\hat{w})) - \mathbb{E}_{R_1}(x|R_1(x) < F(\hat{w})) > \mathbb{E}_{R_2}(x|R_2(x) > F(\hat{w})) - \mathbb{E}_{R_2}(x|R_2(x) < F(\hat{w}))$$

which implies that either $\mathbb{E}_{R_1}(x|R_1(x) > F(\hat{w})) > \mathbb{E}_{R_2}(x|R_2(x) > F(\hat{w}))$ or $\mathbb{E}_{R_1}(x|R_1(x) < F(\hat{w})) < \mathbb{E}_{R_2}(x|R_2(x) < F(\hat{w}))$. Therefore, R_2 is *not* a mean preserving spread of R_1.

8.8. **Proof of Observation 4.** Suppose $w_L < w^{ND} < w_H$. Let's verify that $d^*(w_H, x) = 0$ if $x < x^{ND}$, $d^*(w_H, x) = 1$ if $x > x^{ND}$, $d^*(w_L, x) = 1$ if $x < x^{ND}$ and $d^*(w_L, x) = 0$ if $x > x^{ND}$ implies that $x^{ND} = \bar{x}$. Suppose first that $\bar{x}$ is not a mass point of $S(\cdot; \theta)$. Then using d and (1), we get

$$x^{ND} = \frac{\int_{x^{ND}}^{1} x dS(x;\theta) + \int_{0}^{x^{ND}} x dS(x;\theta)}{\int_{x^{ND}}^{1} dS(x;\theta) + \int_{0}^{x^{ND}} dS(x;\theta)} = \int_0^1 x dS(x;\theta) = \bar{x}$$

If otherwise $\bar{x}$ is a mass point of $S(\cdot; \theta)$, then set $s(\bar{x}; \theta) \equiv S(x; \theta) - S^{\uparrow}(x; \theta)$ and find

$$x^{ND} = \frac{\int_0^1 x dS(x;\theta) - \bar{x} s(\bar{x};\theta)\left(\frac{1}{2} d(w_H, \bar{x}) + \frac{1}{2} d(w_L, \bar{x})\right)}{1 - s(\bar{x};\theta)\left(\frac{1}{2} d(w_H, \bar{x}) + \frac{1}{2} d(w_L, \bar{x})\right)} = \bar{x}$$

Now I want to show that there are no optimal disclosure rules where $w_L = w^{ND}$ or $w_H = w^{ND}$. To that end, let's check that $P(w_H; \theta, d^*) > P(w_L; \theta, d^*)$.

$$P(w_H \theta, d^*) = \int_0^{\bar{x}} \bar{x} dS(x;\theta) + \int_{\bar{x}}^1 x dS(x;\theta) > \int_0^{\bar{x}} x dS(x;\theta) + \int_{\bar{x}}^1 \bar{x} dS(x;\theta) = P(w_L;\theta, d^*)$$

This implies that the value to the sender when using d^* satisfies

$$\Pi(\theta, d^*) = \frac{w_H + w_L}{2}\bar{x} + \frac{w_H - w_L}{2}(P(w_H;\theta,d^*) - P(w_L;\theta,d^*)) - c(\theta) > \frac{w_H + w_L}{2}\bar{x} - c(\theta)$$

Now suppose by contradiction that $w_L = w^{ND} < w_H$, which means that $d(w_H, x) = 0$ almost everywhere. Then we can use (1) and (2) to see that $P(\theta, d; w_H) = P(\theta, d; w_L) = \bar{x}$, and thus $\Pi(\theta, d) = \frac{w_H + w_L}{2}\bar{x} - c(\theta)$ which is strictly lower than the value to the sender under d^*. Hence, it cannot be that $w_L = w^{ND}$ in any optimal disclosure rule. The same argument can be made to show that $w_H = w^{ND}$ cannot hold under an optimal disclosure rule.

8.9. **Proof of Proposition 5.** Let $\hat{F}$ be a linear mean preserving spread of F. I want to show that, if a sender with profitability distribution F acquires the signal at cost k, then a sender with profitability $\hat{F}$ must also acquire the signal at cost k.

First note that, since $\hat{F}$ is a mean preserving spread of F, then for any disclosure rule d, there exists another disclosure rule $\hat{d}$ such that $\Pi(\hat{\theta}, \hat{d}; \hat{F}) = \Pi(\hat{\theta}, d; F)$. This in turn implies that $\Pi^*(\hat{\theta}; \hat{F}) \geqslant \Pi^*(\hat{\theta}; F)$.

Second, the value from not acquiring the signal is the same under F and $\hat{F}$: $\Pi^*(\theta = 0; \hat{F}) = \Pi^*(\theta = 0; F) = \mathbb{E}(w)Y(\mathbb{E}(x))$.

So it must be that, if $\Pi^*(\hat{\theta}; F) - k \geqslant \Pi^*(\theta = 0; F)$, then $\Pi^*(\hat{\theta}; \hat{F}) - k \geqslant \Pi^*(\theta = 0; \hat{F})$.

9. APPENDIX B - ALGEBRA FOR EXAMPLE IN SECTION 3.2

9.1. **Convex Case:** $Y(y) = y^2$. We take the quality signal distribution S to be $U[0,1]$.

From Proposition 2, we know that there are $X(w_H)$, x^{ND} and $X(w_L)$ such that signal realizations in $[X(w_H), x^{ND}]$ are not disclosed when the object's profitability is high and signal realizations in $[x^{ND}, X(w_L)]$ are not disclosed when the object's profitability is low. All other realizations are revealed. Since x^{ND} is the average quality amongst non-disclosed signal realizations, then, given the uniform distribution, we must have $x^{ND} = \frac{X(w_H)+X(w_L)}{2}$. Moreover, again because of the uniform distribution, we must have $w^{ND} = \tilde{w} = \frac{w_H+w_L}{2}$.

A candidate solution must satisfy the following three conditions:

I. Either $X(w_H) = 0$ and $\frac{\partial \Pi}{\partial d(w_H, 0)} < 0$ (corner solution) or $\frac{\partial \Pi}{\partial d(w_H, X(w_H))} = 0$.

II. Either $X(w_L) = 1$ and $\frac{\partial \Pi}{\partial d(w_L, 1)} < 0$ (corner solution) or $\frac{\partial \Pi}{\partial d(w_L, X(w_L))} = 0$.

III. $\frac{X(w_H)+X(w_L)}{2} = x^{ND}$.

Using (10), we find that

$$\frac{\partial \Pi}{\partial d(w_H, X(w_H))} \leqslant 0 \Leftrightarrow w_H \left[X(w_H)^2 - x^{ND^2} \right] - 2\tilde{w}x^{ND} \left[X(w_H) - x^{ND} \right] \leqslant 0$$

$$\Leftrightarrow (\tilde{w} + \Delta/2) \left[X(w_H) + x^{ND} \right] - 2\tilde{w}x^{ND} \geqslant 0 \Leftrightarrow \Delta x^{ND} - (\tilde{w} + \Delta/2) \left(x^{ND} - X(w_H) \right) \geqslant 0$$

$$\Leftrightarrow x^{ND} - X(w_H) \leqslant \frac{\Delta}{\tilde{w} + \Delta/2} x^{ND} \tag{12}$$

Again using (10), we have

$$\frac{\partial \Pi}{\partial d(w_L, X(w_L))} \leqslant 0 \Leftrightarrow w_L \left[X(w_L)^2 - x^{ND^2} \right] - 2\tilde{w}x^{ND} \left[X(w_L) - x^{ND} \right] \leqslant 0$$

$$\Leftrightarrow (\tilde{w} - \Delta/2) \left[X(w_L) + x^{ND} \right] - 2\tilde{w}x^{ND} \leqslant 0 \Leftrightarrow -\Delta x^{ND} + (\tilde{w} - \Delta/2) \left(X(w_L) - x^{ND} \right) \leqslant 0$$

$$\Leftrightarrow X(w_L) - x^{ND} \leqslant \frac{\Delta}{\tilde{w} - \Delta/2} x^{ND} \tag{13}$$

From (12) and (13), we see that if both candidate $X(w_H)$ and $X(w_L)$ are interior, then the distance between $X(w_H)$ and x^{ND} is strictly smaller than the distance between $X(w_L)$ and x^{ND}. But this contradicts condition **III**.

So it must be that either $X(w_H) = 0$ or $X(w_L) = 1$. If $X(w_H) = 0$, then $\frac{\partial \Pi}{\partial d(w_H,0)} < 0$ does not hold, because $\Delta/2 \leqslant \tilde{w}$ (since $w_L \geqslant 0$). So we must have $X(w_L) = 1$.

Plugging $X(w_L) = 1$ and condition **III** into (12) and setting it to equality (so that $X(w_H)$ is interior), we have

$$X(w_H) = \frac{\tilde{w} - \Delta/2}{\tilde{w} + 3\Delta/2} \Rightarrow x^{ND} = \frac{\tilde{w} + \Delta/2}{\tilde{w} + 3\Delta/2}$$

Plugging this into (13), we can confirm that $\frac{\partial \Pi}{\partial d(w_L,1)} < 0$ is satisfied.

10. Appendix C - Extension to More General Information Schemes

In the baseline model, the sender is constrained to choosing to either disclose an observed signal realization or conceal it. However, in some applications it might be more fitting to allow the sender to choose more sophisticated signaling schemes. For example, Credit Rating Agencies assign grades to their rated assets, which reflect the underlying riskiness of these assets as investments.

In this extension, I focus on the case where F has binary support. With probability $1/2$, the object is of high profitability ($w = w_H$) and, with probability $1/2$, it has low profitability ($w = w_L$, where $w_H \geqslant w_L$).

In this section, I allow the sender to choose a grading technology $g : \{w_L, w_H\} \times [0,1] \to \mathcal{G}$, where $\mathcal{G}$ is a finite set of possible grades. Finiteness is without loss of generality if $S(\cdot;\theta)$ has finite support, which is an assumption I maintain in this section. An object of profitability $w \in \{w_L, w_H\}$, upon a signal realization which corresponds to the q^{th} quantile of $S(\cdot;\theta)$, is assigned grade $g(w,q)$. Notice that this notation allows the sender to used mixed grading strategies. For example, suppose $S(\cdot;\theta)$ is the degenerate distribution at $\bar{x}$ and that the sender chooses $g(w_H,q) = g_1$ if $q \leqslant .5$ and $g(w_H,q) = g_2$ if $q > .5$. Then the only possible signal realization is $\bar{x}$, but this realization is mapped into grade g_1 with probability $.5$ and to grade g_2 with probability $.5$.

After observing that an object has grade $\hat{g} \in \mathcal{G}$, the receiver forms a posterior that the expected quality of the object is the average quality amongst all signal realizations and profitabilities that map into grade $\hat{g}$. This average is given by

$$\hat{x}(\hat{g}) = \frac{\int_{g(w_H,\cdot)=\hat{g}} S^{-1}(q;\theta)dq + \int_{g(w_L,\cdot)=\hat{g}} S^{-1}(q;\theta)dq}{\int_{g(w_H,\cdot)=\hat{g}} dq + \int_{g(w_L,\cdot)=\hat{g}} dq} \tag{14}$$

For ease of exposition, I restrict to the case of linear demand $Y(y) = y$ and extend Proposition 3 from the main text to this case with more general information schemes. Propositions 1 and 5, which refer to the nonlinear demand cases, can also be similarly extended.

The sender's profit is given by:

$$\begin{aligned}\Pi(g,\theta) &= w_H \int_0^1 \hat{x}(g(w_H,q))dS(q;\theta) + w_L \int_0^1 \hat{x}(g(w_L,q))dS(q;\theta) - c(\theta) \\ &= \frac{w_H + w_L}{2}\bar{x} + \frac{w_H - w_L}{2}\left[\int_0^1 \hat{x}(g(w_H,q))dS(q;\theta) - \int_0^1 \hat{x}(g(w_L,q))dS(q;\theta)\right] - c(\theta)\end{aligned}$$

where the second equality is due to the fact that, under linear demand, regardless of the grading technology, the total expected probability of sale is equal to $\bar{x}$, the underlying average quality of the object.

Looking at the sender's objective, we can see that two results from the baseline model immediately extend. First, for a given θ, an unbiased sender is indifferent between all grading technologies. Second, for a given θ, the set of grading technologies that maximize the sender's profit is the same for all biased senders.

Taking as given the signal precision θ, the problem to the sender can be mapped into the model of Rayo and Segal (2010). From their results, we can learn some of the characterization of the optimal grading technology, of which I want to highlight two main features. First, if a grade pools together signal realizations for high and low profitability objects, then it pools at most one signal realization for each profitability. Second, these grades must each pool a lower signal realization for the high profitability object with a higher signal realization for the low profitability object. As with the optimal disclosure rules in the main text, these optimal grading technologies manage to steer sales probability from low profitability objects to high profitability objects by conflating good news about the former objects with bad news about the latter ones.

Proposition 9. *More biased senders acquire a weakly higher θ than less biased ones. In particular, an unbiased sender acquires the least precise signal, $\theta = 0$.*

The proof is analogous to that of Proposition 3. To see, let

$$\Delta(\theta) = \max_{g} \int_0^1 \hat{x}(g(w_H, q))dS(q;\theta) - \int_0^1 \hat{x}(g(w_L, q))dS(q;\theta).$$

Since for Let $\theta' > \theta$, then $S(\cdot;\theta')$ is a mean preserving spread of $S(\cdot;\theta)$, we know that for every $\int_0^1 \hat{x}(g(w_H, q))dS(q;\theta) - \int_0^1 \hat{x}(g(w_L, q))dS(q;\theta)$ attained by some g for θ, there exists a g' which delivers that same difference for θ'. This implies that Δ is weakly increasing in θ. Hence, the marginal revenue from a more precise signal is non-negative.

But we can see, from the expression of the sender's profit that the marginal revenue from acquiring a more precise signal is higher the more biased the sender is; while the marginal cost is the same regardless of the sender's bias. Therefore, a more biased sender must acquire a weakly higher signal than a less biased one.

Moreover, we can see that the profit of an unbiased sender is strictly decreasing in θ; and thus, he must acquire the least precise signal, given by $\theta = 0$.

11. Appendix D - Extension to Transfers between Sender and Receiver

In the highlighted application of a financial advisor who receives kickbacks for sales of financial products, the price of the asset is pre-set and there is no room for it to be negotiated between the buyer and the advisor. Accordingly, in the main model prices are taken as given and subtracted from the object's value to the receiver, so that the quality of the objects is taken to be its value to the receiver, net of its price.

Here, I consider the possibility that the sender can make transfers to the receiver to incentivize her to acquire the object. At the initial stage, where sender chooses θ and d, he also chooses a transfer scheme $(t_L, t_H) \in \mathbb{R}^2$ so that, upon a purchase of an object of quality x and profitability w_i, the sender's payoff is $w_i - t_i$ and the receiver's payoff is $x + t_i$. Notice that, if $t_L \neq t_H$, then by observing the offered transfer, the receiver is able to infer the profitability of the object.

In this extension, I focus on the case where F has binary support. With probability $1/2$, the object is of high profitability ($w = w_H$) and, with probability $1/2$, it has low profitability ($w = w_L$, where $w_H \geqslant w_L$).

Take the demand to be linear and suppose the support of all signal distributions are such that $x_{max} + w_H \leq 1$, where x_{max} is the largest possible signal realization. This support restriction guarantees that the demand is linear at the whole support of possible receiver values, considering that the sender might transfer up to his full profitability to the receiver.

Proposition 10. *The following three statements are true about transfers and informativeness:*

(1) *The sender is weakly less informative when he is allowed to make transfers.*
(2) *Conditional on choosing $t_L \neq t_H$, the optimal disclosed signal is perfectly uninformative, regardless of his bias.*
(3) *Conditional on choosing a single transfer ($t_L = t_H = t$), an unbiased sender is perfectly uninformative; and informativeness is weakly increasing in the sender's bias.*

If the sender chooses $t_L = t_H = t$, then the profitabilities can be taken to be $\hat{w}_L = w_L - t$ and $\hat{w}_H = w_H - t$; while, upon observing signal realization $\hat{x}$, the receiver's expected payoff from purchasing the object is $\hat{x} + t$. Since the receiver's value is simply shifted up by t upon every signal realization, it is easy to show that the sender's optimal choice of disclosure rule is the same as before, given in Proposition 1. As such, the value to the sender upon using this optimal disclosure rule can be written analogously to (6):

$$\Pi(\theta, d^*, t) = \left[\frac{w_H + w_L}{2} - t\right][\bar{x} + t] + \frac{w_H - w_L}{2}\int_0^1 |x - \bar{x}| dS(x;\theta) - c(\theta)$$

Optimizing the above expression with respect to t, we get $t^* = \frac{w_H + w_L}{4} - \frac{\bar{x}}{2}$ and

$$\Pi(\theta, d^*, t^*) = \left[\frac{w_H + w_L}{4} + \frac{\bar{x}}{2}\right]^2 + \frac{w_H - w_L}{2}\int_0^1 |x - \bar{x}| dS(x;\theta) - c(\theta)$$

From this expression, we see that, if the sender chooses the same transfer for both the high and low profitability object, then the benefit and cost of acquiring information is the same as without transfers. Hence, if $t_L = t_H = t$, then the sender chooses the same disclosed signal as if transfers were not allowed. This implies the third statement in the proposition.

Now suppose the sender chooses $t_L \neq t_H$. Then the receiver is able to infer the object's profitability based on the transfers. In that case, the sender is unable to use non-disclosure in order to pool signal realizations for high and low profitability objects. As such, in this case of linear demand, the sender is indifferent between all disclosure rules – in particular, we can assume that they disclose all realizations. The total expected sale probability is then $\bar{x} + t_H$ and $\bar{x} + t_L$ for high and low profitability objects, respectively. As such, the sender's value is

$$\Pi(\theta, d^*, t_L, t_H) = \frac{1}{2}(w_H - t_H)(\bar{x} + t_H) + \frac{1}{2}(w_L - t_L)(\bar{x} + t_L) - c(\theta)$$

Optimizing the above expression with respect to t_H and t_L, we get $t_i^* = \frac{w_i - \bar{x}}{2}$ and

$$\Pi(\theta, d^*, t_L^*, t_H^*) = \frac{1}{2}\left[\frac{w_H + \bar{x}}{2}\right]^2 + \frac{1}{2}\left[\frac{w_L + \bar{x}}{2}\right]^2 - c(\theta)$$

Since the sender's revenue does not depend on the information he acquires, then he always chooses to acquire no information. In that case, the optimal disclosed signal is perfectly uninformative. This delivers the second statement in the proposition. Along with the conclusion that, upon choosing a single transfer, the sender acts chooses the same disclosed signal as without transfers, this implies the first statement in the proposition.

12. Appendix E - Extension to a Three Player Model

In this extension, I interpret the sender as an intermediary for sales between a seller (unmodeled in the main text) and a buyer (the receiver). There are three players: a seller, a buyer and an intermediary.

The seller has an object of quality $x \in [0, 1]$ and a willingness to pay $\omega \in \{\omega_L, \omega_H\}$, with $\omega_L < \omega_H$, both equally likely. When a seller of willingness to pay ω expects to sell their object for the V and pay the intermediary a fee of t, they receive value $V - \frac{t}{\omega}$. The quality of the object is not observed by any of the players, and they all share a common prior over it. The willingness to pay of the seller is their own private information.

The buyer stands ready to pay the seller a value which is a non-decreasing function of the expected quality of the object, $Y(\mathbb{E}(x))$, with $Y \geqslant 0$, and where the expectation is computed using the common prior and any information the revealed during the path of play.

At the earliest stage, the intermediary takes two actions. First, they choose a signal precision θ, at cost $c(\theta)$. The conditions on the cost function and signals implied by different precisions are exactly the same as in the two player game introduced in the main text. Secondly, the intermediary posts a menu with two sets of disclosure policies and fees: $\{(d(\omega, \cdot), t(\omega))\}_{\omega \in \{\omega_L, \omega_H\}}$.

The seller then draws their willingness to pay ω and chooses one of the two disclosure policies, for which they pay the assigned fee. Then the quality signal is realized and the chosen disclosure policy is followed. The buyer observes the disclosed (or not) signal and pays $Y(\mathbb{E}(x))$ to the seller.

I am looking for a truth-telling equilibrium, where the seller of type ω self selects into the contract $(d(\omega,\cdot), t(\omega))$. To find the relevant incentive constraint in this contracting problem, let's first assume that the seller selects into the "correct" contract. Then, when no signal is disclosed, the buyer forms the following mean posterior:

$$x^{ND} = \frac{\int_0^1 [1-d(w_L,x)]x dS(x;\theta) + \int_0^1 [1-d(w_H,x)]x dS(x;\theta)}{\int_0^1 [1-d(w_L,x)] dS(x;\theta) + \int_0^1 [1-d(w_H,x)] dS(x;\theta)}$$

With this in hand, we can calculate the expected payment by the buyer when the seller picks contract ω to be given by

$$P(\theta,d;\omega) = \int_0^1 Y(x)d(\omega,x)dS(x;\theta) + \int_0^1 Y(x^{ND})(1-d(\omega,x))dS(x;\theta)$$

And the expected value to the seller of type ω when picking the contract ω' is then

$$\mathcal{V}(\omega,\omega';\theta,d) = P(\theta,d;\omega') - \frac{t(\omega')}{\omega}$$

The incentive constraint faced by the intermediary is that for $\omega,\omega' \in \{\omega_L,\omega_H\}$,

$$\mathcal{V}(\omega,\omega;\theta,d) \geqslant \mathcal{V}(\omega,\omega';\theta,d)$$

This constraint can be rewritten as

$$P(\theta,d;\omega_H) - \frac{t(\omega_H)}{\omega_H} \geqslant P(\theta,d;\omega_L) - \frac{t(\omega_L)}{\omega_H} \quad \text{and} \quad P(\theta,d;\omega_L) - \frac{t(\omega_L)}{\omega_L} \geqslant 0 \tag{15}$$

$$\Leftrightarrow t(w_H) \geqslant t(w_L) + \omega_H\left[P(\theta,d;\omega_H) - P(\theta,d;\omega_L)\right] \quad \text{and} \quad t(\omega_L) \geqslant \omega_L P(\theta,d;\omega_L)$$

In order to maximize their profit of $t(\omega_H) + t(\omega_L) - c(\theta)$, the intermediary must choose fees so as to bind both the inequalities in (15). Doing that and substituting the fee values into the intermediary's profit function, we find

$$\Pi(\theta,d) = \omega_H P(\theta,d;\omega_H) + (2\omega_L - \omega_H)P(\theta,d;\omega_L) - c(\theta)$$

Now let $w_H = \omega_H$ and $w_L = 2\omega_L - \omega_H$ to see that the objective of the intermediary is the same as the objective of the receiver given in (2).

The seller's willingness to pay parametrizes how costly it is for the seller to pay commissions to the intermediary. In the insurance market, for example, this parameter might be related to the cost effectiveness of the insurance provider. If a provider has a lower cost of funding, then for each dollar of insurance sold, they are able to secure a higher margin. In that case, this provider has more leeway to reward insurance brokers with high commissions. If we think that providers of financial products in general are paying brokers today for future rewards, then the willingness to pay can also reflect the seller's patience.