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Optimal (Non-)Disclosure Defaults [*]

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Abstract

It is well known that sellers have a general obligation to disclose "negative" information about hidden defects of their products. In contrast, buyers usually do not have a binding obligation to disclose "positive" information about the hidden qualities of the products. The leading explanation for the asymmetric treatment of the two sides - buyers and sellers - is provided by appealing to incentives to invest in relevant information. It is argued that the imposition of disclosure duties on buyers would undermine their incentives to acquire socially useful but costly information ex-ante. This explanation is unsatisfactory. First, the failure to correct asymmetric information problems ex-post would cause, as we will show, an inverse adverse selection problem ex-ante. This would lead to the uninformed sellers' withdrawal from the market. Consequently, resources would not move to (informed) buyers with higher valuations. In this paper, we develop a model to balance the benefits of information acquisition, on the one hand, with the costs of asymmetric information, on the other hand. We use the framework to study the incentives created by different default-disclosure and non-disclosure - rules. We examine the optimum default rules by showing that the choice of alternative disclosure rules makes a difference when parties can contract around defaults at a moderate cost. Unlike disclosure rules, non-disclosure default rules yield partially separating equilibria that preserve the buyers' incentives to acquire information and foster trade opportunities between expert and uninformed sellers.

JEL Codes : D44, D82, D86, K12.
Keywords: asymmetric information, penalty default rules, inverse adverse selection.

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1 Introduction

It is well known that sellers must disclose "negative" information about hidden defects of their products. In contrast, buyers usually do not have a binding obligation to disclose "positive" information about the hidden qualities of the products. No comparable protection exists for uninformed sellers, while informed buyers are not generally required to disclose "positive" private information (i.e., information or hidden qualities that would increase the seller's valuation of the traded good).[1] When considering compliance with duties of good faith and fair dealing, courts carve out a "safe harbour" for buyers who do not disclose positive information about the goods they buy. Restatement (Second) of Contracts § 161, Comment (a) articulates the general principle: "A party making a contract is not expected to tell all that he knows to the other party, even if he knows that the other party lacks knowledge on some aspects of the transaction." Restatement (Second) of Contracts § 161, Comment (d) introduces explicitly the distinction between duties to disclose hidden defects, on one hand, and (lack of) duties to disclose hidden qualities, on the other: "A seller of real or personal property is ordinarily expected to disclose a known latent defect of quality or title that is of such a character as would probably prevent the buyer from buying at the contract price. […] A buyer of the property is not ordinarily expected to disclose circumstances that make the property more valuable than the seller supposes".[2] Restatement (Second) of Contracts § 161, Illustration 10 provides an example of the "safe harbour" that buyers enjoy when they fail to disclose legally obtained[3] information:

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[1] Many legal systems create affirmative duties to disclose private information that may negatively affect the value of the transaction to the other contracting party—e.g., disclosure of hidden defects of a product, disclosure of prior employment record, and disclosure of preexisting health conditions. In the United States, non-disclosure of known defects by sellers is equivalent to misrepresentation. Restatement (Second) of Contracts § 161 (Am. Law Inst. 1981) describes situations where non-disclosure of relevant information can equate to an assertion that a defect does not exist. These situations present distinctions from the general principle that non-disclosure does not amount to a violation of the duties of good faith and fair dealing.

[2] In many other jurisdictions, courts grant protection in case of a violation of precontractual or contractual duties of good faith and fair dealing. Similarly, Restatement (Second) of Contracts, § 205 (on duties of fair dealing and good faith) and Restatement (Second) of Contracts § 208 (on unconscionability) mark the scope of judicial policing of contracts. Similarly, French law is among the most far-reaching systems in protecting aggrieved parties under these rules. However, even under French law these remedial venues do not support the claims of uninformed sellers dealing with buyers who have acquired information through costly investments. The French CODE CIVIL [C. CIV.] [CIVIL CODE], art. 1112-1 al. 4 requires the aggrieved party to prove the existence of an affirmative duty to disclose the information as a condition for obtaining relief, and art. 1112-1 al. 3 of the French *Code Civil* does not enlist the disclosure of privately acquired positive information among the items subject to disclosure duties.

[3] The buyer is not entitled to withhold positive information when that information was illegally

"A, seeking to induce B to make a contract to sell A land, learns from government surveys that the land contains valuable mineral deposits and knows that B does not know this, but does not disclose this to B. B makes the contract. A's non-disclosure does not amount to a failure to act in good faith and by reasonable standards of fair dealing. It is, therefore, not equivalent to an assertion that the land does not contain valuable mineral deposits. The contract is not voidable by B".[4] Similar "safe harbours" appear in civil law systems that exclude applying just-price laws in analogous situations.[5]

Even though contract law allows an informed buyer to refrain from disclosing hidden qualities of the good, the buyer is not allowed to proffer misleading or false information. Restatement (Second) of Contracts § 164 and

obtained (see Restatement (Second) of Contracts § 161, Illustration 11).

[4] In the U.S., concern over transactions involving uninformed sellers has been minimal compared to the attention and legal protection granted to uninformed buyers. *See, e.g.*, Daniel v. Ford Motor Co., 806 F.3d 1217 (9th Cir. 2015) (concluding that Ford Focus purchasers had provided sufficient evidence to establish a claim against Ford for failing to disclose known defects in the Ford Focus' rear suspension); Panther Partners Inc. v. Ikanos Commc'ns, Inc., 681 F.3d 114 (2d Cir. 2012) (requiring the chip maker to disclose its known "above average" defect rate to "inform the investing public" of the uncertainty associated with investing in the company); Vanderwier v. Baker, 937 N.E.2d 396 (Ind. Ct. App. 2010 (holding that sellers of real estate failed to adequately disclose known property defects to property buyers). Duties to disclose positive information by buyers are grounded in preexisting fiduciary relationships between parties. *See, e.g.*, Manning v. Dial, 245 S.E.3d 120 (S.C. 1978) (holding that the buyer of stock had a duty to disclose relevant facts that would have raised the value of stock because, due to the parties' preexisting fiduciary duty, non-disclosure amounted to fraud). Restatement (Second) of Torts § 551 (Am. Law Inst. 1977) provides tort remedies for misrepresentations and non-disclosures that cause a pecuniary loss. These legal duties are used to force the disclosure of negative information by sellers to buyers in the traditional lemons problem.

[5] In some civil law countries, an "action for lesion" gives a seller the right to rescind a sale when the price paid by the buyer falls below some threshold. *See* von Mehren (1974, pp. 321–23). Other jurisdictions grant just-price protection to parties when the price of goods is not adequate compared to their market value at the time of the sale. See, e.g., in Chile, the CÓDIGO [CÓD. CIV.] [CIVIL CODE] art. 1998 (protecting both sellers and buyers of movable and immovable property against unfair prices). France, the CODE CIVIL [C. CIV.] [CIVIL CODE] art. 1674 (protecting sellers of immovable property who sold their property for less than five twelfths of the fair market value); in Italy, the CODICE CIVILE [C.C.] [CIVIL CODE] art. 1448 (protecting sellers who enter a transaction involving movable or immovable property due to financial necessity). Under these laws, sellers who sell their goods at a price substantially lower than the fair market value are allowed to challenge the sale ex post and obtain an augmentation of the price or a rescission of the sale. However, if the price gap is driven by positive information acquired by the buyer, the market value of the property at the time of the sale does not yet reflect the information about the good's hidden qualities. In these cases, just-price disproportion cannot be established for the purpose of this remedy, and no relief is available to uninformed sellers. In contrast to these civil law jurisdictions, U.S. contract law does not grant just-price scrutiny of bargained-for exchanges. *See* Restatement (Second) of Contracts § 71, Comment (a) (excluding the element of "adequacy" as a requirement of a valid consideration).

Restatement (Second) of Torts § 551 (Am. Law Inst. 1977) provide tort remedies for misrepresentations that cause monetary losses, allowing courts to impose extra-compensatory damages for fraudulent misrepresentation.[6] As this paper will show, the legal distinction between untold truths and lies plays an important role in our problem.

The canonical economic rationale for the more favourable treatment of informed buyers compared to informed sellers was provided decades ago by Kronman (1978). Sellers, he argued, usually obtain information serendipitously by possession, use and experience with the good they sell—think of the owner of a house infested with termites[7]—while a buyer's superior information typically derives from costly investments in expertise, research or selection—as is the case with geological surveys to discover underground resources.[8] As Kronman aptly delineates, "[I]f information has been deliberately acquired […] and its possessor is denied the benefits of having and using it, he will have an incentive to reduce (or curtail entirely) his production of such information in the future […] One (seldom noticed) way in which the legal system can [sustain investment] in information is by permitting an informed party to enter—and enforce—contracts […] without disclosing the information to the other party" (Kronman, 1978, pp. 13-15).[9]

This argument is valid because it is reasonable to assume that the legal duty to disclose governs the parties' behaviour. This is, however, a strong assumption to make, primarily because contract law provisions about disclosure are default, not mandatory rules and hence can be altered by the parties to fit their objectives. Sellers under no duty to disclose may do so voluntarily, or their buyers may ask specific questions that trigger liability if they are not answered truthfully; similarly, parties subject to a duty to disclose may decide to waive it.[10] Extant literature has addressed this problem by contrasting voluntary disclosure with mandated disclosure, that is, by assuming that the parties cannot alter the dictates of the law because disclosure rules are mandatory (Shavell 1994) or because the costs of

[6] In the U.S., the caselaw that developed after *Laidlaw v. Organ*, 15 U.S. (2 Wheat.) 178 (1817) points to situations where non-disclosure of relevant information in response to an explicit question may be treated as equivalent to an assertion. This could lead to voidability of the contract and liability for misrepresentation. Similarly, the seller could trigger a duty to disclose information on the part of the buyer by making a representation of her belief that the buyer does not have any material non-public information.

[7] *Obde v. Schlemeyer*, 56 Wn.2d 449 (1960).

[8] *Neill v. Shamburg*, 158 Pa. 263, 27 Ati. 992 (1893).

[9] Restatement (Second) of Contracts, §161 Reporter's Note. Comment d. on the enumerated listing of cases where non-disclosure can be construed as concealment, cites Kronman (1978) as doctrinal support for the non-disclosure rule.

[10] It may be argued that opting out of a duty to disclose is different from opting out of a non-disclosure default. Note that any such difference is immaterial for our analysis, because our results rest, as will be clear, on the latter case.

opting out of a default rule are prohibitively high (Bar-Gill and Porat 2020). It has, therefore, left open the question of the effects of default provisions on information acquisition and trade when opting out is a feasible alternative.

A second problem arises from Kronman's argument. Protecting the informed buyer's right to be silent (if effectively done) fosters investments in information acquisition at the cost of creating an *inverse* adverse selection problem typical of markets in which transactions occur between an informed buyer and an uninformed seller, and hence may cause the latter to *increase* the price demanded so that only high-value buyers remain on the market. Next to preceding possible welfare-enhancing transactions with low-value buyers, high prices erode the gains from information acquisition of high-value buyers and hence recreate the problem of non-disclosure.[11] The default rule is intended to solve a problem. The literature exploring these "markets for gems" (Burkart and Lee, 2016; Dari Mattiacci et al., 2021) has not balanced adverse selection with acquiring socially valuable information.

In this article, we fill these two gaps in Kronman's argument by providing a model of information acquisition and trade in which both the default nature of disclosure rules and the problem of adverse selection are considered. We show two main results. First, we demonstrate that Kronman's positive conjecture is correct: non-disclosure default rules result in more information acquisition than disclosure default rules. They do not do so directly—as parties are not bound strictly by them—but rather indirectly, by allowing the informed buyer who discovers a "gem" to "hide" (in a semi-separating equilibrium) among uninformed buyers and hence make a profit. Expert buyers who find that the good has low quality can opt out of the non-disclosure default, signalling their valuation of the good to pay a lower price. By voluntarily disclosing their negative information (low value), they separate themselves from the other buyers. Sellers will infer that buyers who take advantage of a non-disclosure default rule are either uninformed or have positive information (high value). In this way, non-disclosure rules serve as a bottom-up information-forcing mechanism (Goetz and Scott, 1980; Ayres and Gertner, 1989) and mitigate the inverse adverse selection problem arising when buyers acquire socially valuable information.

In contrast, disclosure default rules, which require parties to reveal private information, result in a separating equilibrium that prices away the buyer's profits. Opting out of default rules works differently than in the previous case because buyers who opt out of a disclosure default signal their possession of positive information (high value), which works against them by increasing the price demanded by the seller so that opt-out would not occur in equilibrium. The key

[11] Note that we use the term "non-disclosure" to refer to the absence of a duty to disclose rather than to a positive duty not to disclose. The non-disclosure regime is in fact a *lassaiz-faire* regime, in which parties retain the freedom to voluntarily disclose information.

driver of our results is the parties' ability to opt out of default rules at a moderate but positive cost. If the cost of altering a legal default is too high, default rules become de facto mandatory; hence, signalling through opt-out becomes impossible. At the other end of the spectrum, in the limiting case where default rules could be modified costlessly, the choice of one default or the other would be immaterial, and the same equilibria would be observed regardless of the initial default.

Second, we address Kronman's implied normative conjecture: that fostering information acquisition provides social welfare gains that outweigh the social welfare costs of adverse selection and choking off trade. We show that there is more trade under a non-disclosure default than under a disclosure default, so that, counterintuitively, the adverse selection problem is less severe when buyers are allowed to conceal information. The reason is that non-disclosure rules facilitate the matching of low-value buyers with uninformed sellers. In turn, higher trade volumes and more information generally result in a higher level of social welfare under non-disclosure rules even though buyers may be investing too much from a social point of view. Overinvestment in information acquisition arises because buyers can capture the "distributional value" (higher prices) of their information in addition to its social value (higher valuation), as in Hirshleifer (1971), Shavell (1994) and Cooter and Ulen (2012: 357). Contrary to Kronman, we show situations where the disclosure default yields more significant social welfare gains.

Our analysis has implications for the design of legal rules, including substantive contract law provisions that regulate the exchange of information between contracting parties and "altering rules", or the rules that govern the process through which the parties can alter default legal requirements. Our analysis implies that the optimal substantive rule is a non-disclosure default rule and that the optimal altering rule is such that opt-out from the non-disclosure default is moderately costly—that is to say, the default is somewhat but not completely sticky. In their seminal paper, Ayres (2012) shows that it may be optimal to make it costly to alter a default in the presence of externalities—this happens in our case of asymmetric information.

The remainder of this article is structured as follows. Section 2 reviews the literature on markets for lemons (informed sellers) versus markets for gems (informed buyers). We also discuss the existing explanations for the different legal treatment of these otherwise symmetric manifestations of asymmetric information. In Section 3, we develop a model to provide a novel rationale for the different disclosure duties imposed on buyers and sellers in contract law. Section 4 discusses our results and concludes with some ideas for future extensions and applications.

2 Asymmetric rules for asymmetric information

Most of the problems of asymmetric information considered in legal and economic literature are characterized by transactions between informed sellers and uninformed buyers. Our analysis focuses on the reverse problem. This has been referred to as the "market for gems," mirroring Akerlof's (1970) "market for lemons." Markets for gems give rise to *inverse* adverse selection problems, which also mirror the standard adverse selection problems (Burkart and Lee, 2016; Dari Mattiacci et al., 2021).

Buyers, rather than sellers, may possess private information on unique goods of uncertain value—such as antiques or artwork—or in transactions between an expert and a novice—such as between a real estate investor and a homeowner, a diamond dealer and an individual seller; experienced publishers and authors; or music producers and musicians. Bankruptcy procedures provide another example where the individual overseeing a sale is most likely less informed about the quality of the goods than potential buyers. An informational advantage exists when art dealers select artists to be represented in their gallery or when professional sports scouts assess the talents of the athletes to be recruited for their teams.

When sellers are informed, their offer of low-quality goods (lemons) drives prices down and pushes high-quality goods out of the market. Conversely, when buyers are informed, their demand for high-quality goods (gems) drives prices up and pushes low-quality goods out of the market. From an allocative efficiency perspective, both problems result in equally undesirable outcomes—the market shrinks, and some goods that would otherwise have been traded under symmetric information remain unsold.[12]

Despite the symmetry in the problems, legal solutions are asymmetric (Dari-Mattiacci et al., 2021). A possible (positive) explanation is the differential availability of market solutions, such as auctions and expert appraisers. These market solutions, however, are not always effective. Scheppele (1988, pp. 21-22) distinguishes between "deep" secrets (those of whose existence the other contracting party has no reason to suspect) and "shallow" secrets (those where the other party knows that something is being concealed, although he or she has no knowledge of the nature or content of the undisclosed information). Although sellers may be aware of the possible existence of hidden qualities, the lack of knowledge about the nature and content of the hidden information can also make shallow secrets difficult to correct by experts and auctions.

A second source of asymmetry could be the practical enforceability of duties to disclose, which necessitates that previously unknown information reaches

[12] Dari-Mattiacci et al. (2021) identify conditions under which symmetric lack of information is allocatively preferable to asymmetric information.

the uninformed party after the contract. If the buyer is uninformed, use of and experience with the good may reveal its hidden defects.[13] In contrast, sellers lose direct access to the goods they sell, and thus are less likely to harvest information about hidden qualities after a sale. Thus, the argument goes, remedies utilized to correct lemons problems may not be equally effective for addressing gems problems.[14] In many situations, however, a seller can discover the hidden quality of the good she has sold by observing the actions of the buyer after the sale. An informed buyer's use of the good can reveal previously unknown information to the seller. If the geologist opens a goldmine on the farmland, this new land use reveals information to the uninformed sellers after the sale. Overall, in many gems situations, although sellers lose direct access to the good, they are more, rather than less, likely to discover the hidden qualities of the goods *after* the sale, so that disclosure duties could be effectively enforced. The absence of disclosure duties in gems situations thus merits additional consideration.

A third explanation is normative and focuses on the social desirability of information acquisition and, hence, of the need to preserve search incentives. In formalizing the original Kronman's conjecture, Shavell (1994) shows that mandatory disclosure is a disincentive for buyers because they cannot capture the full value of the information they have acquired. Sellers, instead, are protected by the fact that they already have the good in their possession when they invest in information acquisition. Shavell's argument, however, assumes that disclosure is mandatory and, hence, does not allow for the possibility that a default duty to disclose could be waived by the parties. We will tackle this problem formally in the next section.

Our analysis builds on a series of classic works in the economics of information. In models of informed sellers, Grossman's (1981) and Milgrom's (1981) analyses provide two building blocks for our model: warranties and damages can be used as signals of quality, and the lack thereof can be interpreted as bad news. Relatedly, Farrell (1986) shows that if only some sellers are informed, information unravels less easily—this will also happen in our model. In his setup, however, the fraction of informed sellers is assumed to be exogenous. In our model

[13] In some lemons settings, information may come from expertise. For instance, consider a pharmaceutical company (the seller) is better informed than buyers with respect to pharmaceutical products, but the company derives its special informational advantage from expertise rather than from use. For this reason, buyers of pharmaceutical products may never learn whether the products contributed to or hindered their recovery. Therefore, the buyer of a drug cannot rely on warranties to the same extent as a used-car buyer. Along these lines, Katz (2007) argues that extensive ex ante regulation of pharmaceutical products stems from the ineffectiveness of ex post warranty-type solutions.

[14] This asymmetry in information acquisition after the sale may be particularly relevant with experience goods—goods whose qualities can be known only trhough experience—as opposed to search goods—goods whose qualities and attributes are discoverable through search.

of informed buyers, in contrast, we preserve the choice of to acquire information at a cost and endogenize the fraction of informed individuals.

An earlier article by Hirshleifer (1971) deals specifically with informed buyers — a situation he calls "technological uncertainty"—and shows that private investments in information acquisition could be greater than is socially desirable because of the distributional value of the information. This aspect is also present in Shavell (1994) and in our model.

3 A model of disclosure and non-disclosure defaults

In this section, we develop a formal model that identifies (1) the equilibrium level of disclosure under disclosure and non-disclosure default rules and (2) assesses their impact on trade and social welfare. The crucial departure from the prior contributions in the literature is that, in our model, the parties can alter default contract rules about disclosure at a cost. We consider a stylized scenario with a seller who has no information about the quality of the good that she is selling but who rationally expects that the good possesses hidden qualities with some positive probability. We shall refer to a good with hidden qualities as a "gem,"[15] and to a good without hidden qualities as an "ordinary good." The seller faces two types of buyers: "expert buyers" and "ordinary buyers." Buyers are initially uninformed about the good's quality, but expert buyers can acquire information. As in Goldberg (1997), searching for information is costly and potentially valuable.

3.1 Setup

A risk-neutral seller (she) and a risk-neutral buyer (he) are randomly matched and interact only once. There is a mass 1 of sellers who each own a good of unknown quality. All parties are initially uninformed about the quality of the good but know that the good is a gem with probability $p \in (0,1)$ and an ordinary good with the complementary probability $1-p$. The buyer belongs to a population of mass 1 of two types of buyers and is an expert buyer with probability $\gamma \in (0,1)$ and an ordinary buyer (type-*O* buyer) with the complementary probability $1-\gamma$.

The seller and the ordinary buyer do not have the expertise necessary to acquire information and discover hidden qualities—formally, they face infinitely high information costs. Type-*O* buyers are active on the market as potential buyers of ordinary goods because they have a higher subjective valuation than the seller, $L^+ > 0$ (where the seller's value is normalized to 0), while they have no expertise to appreciate the gems and value them as much as the seller at H. These assumptions generate the potential for trade among uninformed parties, with ordinary buyers and

[15] The seller's knowledge about the possible existence of a hidden quality is what Scheppele (1988) refers to as a "shallow" secret.

sellers equally unable to capture the full value of a gem. The value H embeds the possibility that at some point in the distant future, either the seller or the ordinary buyer may serendipitously discover the hidden quality and profit somewhat from it, as sometimes reported in the news.[16]

An expert buyer is also initially uninformed but can acquire information at a cost $c \sim [0, \infty)$, which is a random variable with a distribution function G and associated density function g.[17] The expert buyer's valuation for the ordinary good is higher than the seller's but not as high as that of the ordinary buyer, $L^+ > L > 0$, while his valuation of the gem is higher than the seller's and the uninformed buyer's valuation, $H^+ > H$. The underlying idea is that expert buyers are specialized gem hunters and can put gems to good use, directly exploiting their full value. As an example, while ordinary buyers visit moving or estate sales to buy items for their houses, expert buyers go to such sales to search for items with unrecognized, valuable qualities. We will refer to expert buyers who have discovered that the good is a gem as type-*H* buyers, to expert buyers who have discovered that the good is an ordinary good as type-*L* buyers, and to expert buyers who remain uninformed as type-*E* buyers. Table 1 summarizes the parties' valuations.

		Good	
		Ordinary	Gem
Party	Seller	0	H
	Ordinary buyer (type-*O*)	L^+	H
	Uninformed expert buyer (type-*E*)	L	H
	Informed expert buyer (type-*L* and type-*H*)	L	H^+

Table 1: *Parties' valuation of the good, with* $L < L^+ < H < H^+$

Crucially, the expert buyer can capture the full value of the gem only after information acquisition. In this sense, information acquisition is socially valuable and not purely redistributive, as it generates a value $H^+ - H$ if the good is a gem (i.e., with probability p). Thus, information acquisition is socially efficient when $c \leq c^*$, where

[16] In a recent case, an art historian discovered that a broach she had bought for £20 more than 36 years earlier was worth about £10,000. The discovery was made while watching YouTube. See Jenny Gross, "A British Woman Bought a Brooch for 20 Pounds. It Sold for Nearly £10,000," *The New York Times*, March 20, 2024.

[17] The distribution of c is IID across expert buyers.

$$c^* = p(H^+ - H) \tag{1}$$

is the first-best threshold for information acquisition. Expert buyers should remain uninformed if $c > c^*$. The type of buyer and whether he has acquired information is unobservable to the seller at the time of trade, but this information may become verifiable in the future before the court, as explained below. In the interest of analytical simplicity and without loss of generality, we will consider a setting where the seller has all the bargaining power in contract negotiations and makes a take-it-or-leave-it price demand to the buyer.[18]

Given this assumption, buyers generally (but not always) break even in equilibrium and are hence indifferent between alternative outcomes. To break the tie, we assume that buyers prefer trading to being excluded from the market (irrespective of transaction costs) and that, between two trade opportunities, they prefer the option that does not involve transaction costs. These assumptions are plausible because they provide the buyer with the greatest payoff.

3.2 Uninformed trade

We start by analyzing trade among uninformed parties and consider the possibility that expert buyers may attempt to buy goods *prior* to acquiring information (but after learning their costs of information acquisition). By postponing the acquisition of information, buyers would avoid the need to make any disclosure and the potential liability associated with it. Ordinary buyers value a good of uncertain quality at

$$V^O = pH + (1-p)L^+ \tag{2}$$

Expert buyers are also initially uninformed and their valuations depend on their expectations about information acquisition. Those who anticipate acquiring information at no cost ($c = 0$) have the highest valuation, equal to

$$V^{E+} = pH^+ + (1-p)L \tag{3}$$

All other expert buyers who expect to acquire information at a positive cost value the good less, at $V^{E+} - c$. Similarly, buyers who expect to remain uninformed also value the good less than V^{E+}, namely, at

$$V^E = pH + (1-p)L \tag{4}$$

[18] This assumption simplifies the analysis and sharpens the results, which are robust to changes in the parties' bargaining power.

To avoid the analysis of uninteresting cases, we make two assumptions that capture the characteristics of the problem under consideration: gems are valuable ($H^+ - H$ is large relative to $L^+ - L$), rare (p is low) and there are few expert gem hunters in the population (γ is low).[19]

Assumption 1: $p < \frac{L^+ - L}{H^+ - H + L^+ - L}$;

Assumption 2: $\gamma < \frac{pH + (1-p)L^+ - pH^+ - (1-p)L}{pH + (1-p)L^+}$.

Assumption 1 allows us to focus on situations where ordinary buyers' expected valuation of the good is higher than that of uninformed experts, for any cost c (i.e., the share of gems, p, is low enough, so that $V^O > V^{E+}$). Given this assumption, the seller can charge more to ordinary buyers than to uninformed expert buyers. Sellers can therefore choose between charging a price equal to the valuation of ordinary buyers and selling only to them (with a probability $1 - \gamma$), or lowering the price and also selling to uninformed expert buyers.

Assumption 2 ensures that $(1 - \gamma)V^O > V^{E+}$ so that it is better for the seller to sell only to ordinary buyers than to lower the price and sell to any buyer. Under these conditions, a market in which expert buyers never acquire information prior to purchasing the good would be plagued by inverse adverse selection and only ordinary buyers would be willing to buy goods at relatively high prices. As a result, we would never observe situations where experts purchase a good without information, searching for information after the sale. We can now examine the case of greater practical and theoretical interest, where expert buyers invest in information before the sale to decide whether to purchase the good.

3.3 Legal regimes and timing

We consider two possible default legal regimes: (1) a *disclosure default*, which imposes a duty to disclose private information about the quality of the good, and (2) a *non-disclosure default* under which parties are not required to disclose private information about the quality of the good. In both cases, parties can opt out of the applicable default legal rule by bearing a transaction cost, $\tau \geq 0$.[20]

[19] Although Assumption 2 implies Assumption 1, we state the two assumptions separately for ease of exposition and because they will play a different role in our numerical simulations. Additionally, Assumption 1 guarantees that the RHS of the inequality in Assumption 2 is greater than 0, so that there exists a value of γ that satisfies the inequality.

[20] We assume symmetric opt-out costs. Our results are qualitatively robust to moderate differences in the costs of opting out from the two different default rules.

We allow the buyer to make one of the following representations of his type and thereby of the quality of the good, by sending a message $\mu \in \{\emptyset, L, H, U\}$ to the seller. Message $\mu = \emptyset$ dicates that the buyer does not disclose information. In contrast, with messages $\mu = L$ and $\mu = H$ the buyer reveals information announcing that the good is of low or high quality, respectively. With message $\mu = U$ the buyer indicates that he is uninformed.

The default term determines the cost of sending such messages. A message sent in adherence to the default is costless, while opting out of the default entails the transaction cost τ. Under a disclosure default, the message $\mu = \emptyset$ implies opting out of the default and hence entails the cost τ. Meanwhile, the other messages are costless. Conversely, under a non-disclosure default rule, the buyer bears the cost τ only if he chooses to opt out of the legal default by affirmatively conveying information about his type to the seller. That is, messages $\mu \in \{L, H, U\}$ are costly, while the message $\mu = \emptyset$ is costless.

	Message: μ			
	$\emptyset$ "I will not say anything"[21]	L "This is an ordinary good"	H "This is a gem"	U "I do not know"
Disclosure Default	Cost τ	No cost	No cost	No cost
Non-disclosure Default	No cost	Cost τ	Cost τ	Cost τ

Table 2: *Default rules and opt-out costs*

We think of opt out in the following way. The decision whether to opt out is controlled by the buyer, who sends a message to the seller during negotiations. The actual cost of opting out is paid by the buyer when the contract is formed because the contract clauses that deviate from legal default have to be drafted, discussed and agreed upon by the parties.

Parties can opt out of default rules in a variety of ways, all of which entail some transaction costs. Disclosure default rules can be avoided by obtaining

[21] "I will not say anything" is short for "I will not represent whether I have material nonpublic information."

waivers or agreeing to a "big boy letter,"[22] which entail negotiation and often require legal assistance. Parties can dilute the effect of non-disclosure default rules by asking a question about a fact that the other has no duty to disclose, but so that any answer to the question except a straightforward lie would reveal the fact. The cost of opting out may also be due to the legal design of altering rules—the rules that determine the process through which a legal default can be altered by the parties—as in Ayres (2012). The parameter τ captures the magnitude of these transaction costs and the resulting stickiness of the legal default: the higher the value of τ, the more costly it is for the parties to meaningfully opt out of the default.

If the good is traded, courts impose liability on buyers who disclosed inaccurate information whenever the good's actual quality is found to be higher than what the buyer had represented. Crucially, liability is triggered only if the good is a gem. A type-*H* buyer who sent a message *L* or *U* is exposed to liability. Type-*L* buyers obviously cannot underrepresent the quality of the good. Uninformed buyers (i.e., type-*O* and type-*E* buyers) are exposed to liability only if they sent message *L*.

$d = 1$	Nature draws the quality of the good (gem or ordinary) and the type of buyer (expert or ordinary)
$d = 2$	If the buyer is an expert buyer, he learns about *c* and decides whether to invest in information acquisition.
$d = 3$	The buyer is randomly matched with a seller and sends one of the available messages to her, possibly triggering an opt out from the legal default. (The buyer chooses the option without transaction costs if indifferent between two trade opportunities.) The seller makes a take-it-or-leave-it price demand to the buyer, who either accepts or rejects (accepts if indifferent). If the parties agree, the good is traded and the opt-out cost (if any) is paid.
$d = 4$	The quality of the good becomes known to all and, when applicable, damages are paid.

Table 3: *Timeline*

We assume that the total liability will include compensatory damages (equal to the difference between the actual value of the good to the seller and the value of the

[22] "Big boy letters" are commonly used pre-sale agreements in securities transactions between sophisticated parties. The parties thereby agree not to sue over non-disclosure of material information.

good announced by the buyer), plus an additional penalty for fraudulent misrepresentation. For instance, if an expert buyer falsely represents to the seller that a gem is an ordinary good, he incurs liability equal to the difference between the two values of the good for the seller plus a penalty.[23] We assume throughout that total damages are large enough to deter lies (we do not state this formally to economize on notation and unnecessary details). This allows us to focus on the issue of information disclosure more closely.[24] The parties play the sequential game in four dates without discounting summarized in Table 3.

We emphasize that, while information acquisition costs are borne prior to the contract and thus by both those who may or may not trade, opt-out costs are paid only by parties moving forward with the contract. The intuition is that the opt-out message only informs the seller that the buyer is willing to pay the costs of drafting a contract that alters the legally provided default if the parties agree to trade.

3.4 Disclosure defaults

We proceed backwards and start from the trade stage, at which point information (if any) has already been acquired. Throughout, we assume that, when indifferent, buyers will trade. Since the seller has all the bargaining power, her price demands will be such that the buyer is indifferent between accepting and rejecting the offer, unless different types of buyers pool in the equilibrium. We then examine the decision to acquire information.

3.4.1 Trade under disclosure defaults

Under a disclosure default rule, buyers who do not opt out of the default can disclose their type by sending a message $\mu \in \{L, H, U\}$ at no cost. Liability is imposed on informed buyers when hidden qualities are discovered after the sale, unless the buyer sent message $\mu = H$ (disclosing positive information at no cost) or message $\mu = \emptyset$ (opting out of the duty to disclose at a cost τ). Similarly, liability is imposed on uninformed buyers when hidden qualities are discovered after the sale, unless the buyer sent either message $\mu = U$ (disclosing his information type at no cost) or message $\mu = \emptyset$ (opting out of the duty to disclose at a cost τ). Informed buyers

[23] Even though contract law allows informed buyers to not disclose hidden qualities of the good, the buyer is not allowed to provide misleading or false information. *Restatement (Second) of Contracts* § 164 and *Restatement (Second) of Torts* § 551 (Am. Law Inst. 1977) provide extra-compensatory damages for fraudulent misrepresentation. As we will explain later, it is assumed that type-*O* buyers will never incur liability for lack of disclosure. This is because their ordinary use of the good will not unveil any new information about the existence of a gem.

[24] There is an important literature on contract damages, which deals with questions we do not address here and it too large to be reviewed in this paper.

purchasing ordinary goods clearly face no liability as they cannot underrepresent the quality of the good.

No buyer has an incentive to send a message reporting higher quality than what is known to him. This also implies that the type-*L* buyer has no incentives to send message *U*. Given our assumptions about liability, no type of buyer has an incentive to lie. Therefore, we only need to consider the incentives for informed and uninformed buyers to opt out of the default, facing the opt-out cost to modify their duty to disclose. The opt-out message $\mu = \emptyset$ signals that the buyer must have some information he prefers not to disclose. Since disclosing negative information (low value) would be advantageous to the buyer (as it would lower the price the seller can demand), message $\mu = \emptyset$ further signals that the informed buyer has positive information about the good's value. Thus, opting out of the disclosure default would have a signaling effect that goes against the buyer's interest, so that we should expect no buyer to opt out in equilibrium, as we explain below.

Type-*L* buyers (i.e., expert buyers who have discovered negative information about the good) clearly have no reason to opt out of the disclosure default. They can disclose their information sending message *L*, to which the seller will respond with a price demand equal to L^+, the highest price the buyer is willing to pay for an ordinary good. Opting out of the default would not reduce the price type-*L* buyers would have to pay and may impair their chances to trade if they were to pool with higher-value buyers. Given that type-*L* buyers do not opt out, neither do uninformed buyers as this strategy can again only impair their chances to trade, and will send message $\mu = U$ to the seller. Being unable to distinguish between type-*O* and type-*E* buyers, the seller will demand a price equal to the reservation price of the ordinary buyers, V^O. Under the assumptions made in Subsection 3.2, it is advantageous for the seller to sell only to ordinary buyers for a higher price than to sell to all uninformed buyers.[25]

Once left alone with the decision to opt out, type-*H* buyers will be forced to disclose and pay a price equal to *H* or opt out, being readily identified as informed gem-hunters, and thus paying a high price in addition to the opt-out cost. Under a disclosure default, the parties' incentives lead to an equilibrium of the game that fully separates buyers according to the information they have.

Lemma 1. Consider the Bayesian game at $d = 3$ under a disclosure default rule. In equilibrium all buyers contract under the legal default and disclose truthfully the information they possess. The seller then demands the prices indicated in Table 4. Uninformed expert buyers (type-*E* buyers) are priced out of the market, while all other buyer types pay their reservation price and trade.

[25] Under Assumption 2, we have $(1-\gamma)V^O > V^{E+} > V^E$ and thus the seller is better off not servicing uninformed expert buyers.

Buyer	Message	Opt out	Price	Trade
Type $-H$	H	No	$H+$	Yes
Type $-O$	U	No	V^O	Yes
Type $-E$	U	No	V^O	No
Type $-L$	L	No	L	Yes

Table 4: *Equilibrium under a disclosure default rule*

Proof. See the Appendix.

3.4.2 Information acquisition under disclosure defaults

The combined use of a disclosure default rule and an effective liability system seems to essentially resolve the asymmetric information problem in gems markets, forcing buyers to reveal the available information about the quality of goods. Under a disclosure default rule, in equilibrium, all trades between an informed buyer and an initially uninformed seller would happen under symmetric information about the good's quality.[26] As a result, informed buyers would pay their reservation price, giving up any gain from information acquisition, so that the equilibrium threshold for information acquisition under a disclosure default is $c^D = 0$. This would leave only ordinary buyers on the market because, as observed above,[27] the price charged to ordinary buyers would be too high for uninformed experts, with a resulting inverse adverse selection problem.

Proposition 1. Under a disclosure default rule, the expert buyer's investment in information is zero, and hence lower than the socially efficient level. Thus, expert buyers remain uninformed and do not trade. Only ordinary buyers trade and do so under the default disclosure rule, with an aggregate contract surplus equal to:

$$W^D = (1-\gamma)(1-p)L^+ \qquad (5)$$

Proof. See the text.

[26] Type-*E* buyers do not trade because of asymmetric information about the buyer's idiosyncratic valuation of the good not about the good's quality, which is perfectly revealed to the extent that it is known in equilibrium.
[27] See note 25.

Only ordinary buyers (who are $1-\gamma$) trade, yielding gains from trade equal to the difference between the valuations of ordinary goods (which are $1-p$) for sellers and ordinary buyers (which are equal to 0 and L^+, respectively). If the good is a gem, there are no gains from trade between uninformed parties.

3.5 Non-Disclosure defaults

3.5.1 Trade under non-disclosure defaults

Under a non-disclosure default rule, no liability arises when hidden qualities are discovered after the sale. To remain subject to the non-disclosure default rule, the buyer needs to take no action—formally, he sends message $\mu = \emptyset$ to the seller—facing no transaction costs. Alternatively, the buyer can opt out of the default non-disclosure regime by making an affirmative statement regarding the quality of the good and sending a message $\mu \in \{L, H, U\}$ with a cost τ.[28]

As shown below, under a non-disclosure default rule, parties' incentives and behavior will unravel differently, resulting in a semi-separating equilibrium. Let us begin by recalling that, given the assumptions made in Section 3.2, in a market without information the seller is better off charging V^O and selling only to ordinary buyers with probability $1-\gamma$ rather than lowering the price to V^{E+} and selling with certainty to a larger number of prospective buyers. A fortiori, the same logic implies that, in a market with some information acquisition, the seller would not want to further reduce the price to attract type-*E* and type-*L* buyers.[29] Moreover, if the seller charges V^O, type-*H* buyers will also buy the product, which increases the seller's profits at this price.

Therefore, the seller can demand one of two prices of the buyers who do not opt out. If the seller demands V^O, she will sell with probability $1-\gamma+\gamma pG(c^{ND})$—where c^{ND} is the equilibrium level of information acquisition to be determined below. That is to say, she will sell to all the ordinary buyers (type-*O*) and to the expert buyers who acquired positive information (type-*H*). If the seller demands H^+, she will only sell to type-*H* buyers. The buyer chooses the former iff

[28] In this case, opt out costs arise because buyers need to make persuasive and legally relevant statements. This often necessitates a written form that can be used by the seller as admissible evidence in case of fraud.

[29] Recall that V^{E+} is the highest price that type-*E* buyers are willing to pay when they expect that they will acquire information after the sale. Assumptions 1 and 2 ensure that this strategy is not viable and hence buyers remain uninformed after the sale. The price they are willing to pay drops thus to $V^E < V^{E+}$, where V^E is defined in (4). Type-*L* buyers buy only if the price is less than or equal to *L*.

$$(1-\gamma)V^O > \gamma pG(c^{ND})(H^+ - V^O) \qquad (6)$$

which is always satisfied by Assumption 2.[30] Thus, the seller will charge a price equal to V^O. Without opt out—that is, if disclosure rules were mandatory or when the opting out cost are prohibitively large—the market would be affected by inverse adverse selection and only the higher-valuing buyers (type-*O* and type-*H* buyers) would trade, while lower-valuing buyers (type-*E* and type-*L*) would be excluded from trade.

Let us now consider the possibility of opting out of the default non-disclosure rule. If $\tau < L$, there is a positive contract surplus obtainable by type-*L* and type-*E* buyers through opting out of the non-disclosure default. Higher opt-out costs, $L < \tau < V^E$, will induce only type-*E* buyers to opt out, leaving type-*L* buyers out of the market. Type-*H* buyers who were previously trading under the non-disclosure default have no incentive to opt out, as the legal penalties would induce them to truthfully reveal their type and hence pay H^+ instead of $V^O < H^+$. Type-*O* buyers instead potentially pay a lower price if they opt out and mimic type-*E* buyers, so that the opting out cost must be high enough for them not to have an incentive to do so, namely, $\tau > V^O - V^E$. The latter condition is essential, because the expert buyer's incentives to acquire information rest on the possibility of pooling with ordinary buyers and obtain a profit. Therefore, in the following lemma we focus on the case where this condition is satisfied.

Lemma 2. Consider the Bayesian game at $d = 3$ under a non-disclosure default rule with $\tau > V^O - V^E$. In equilibrium only type-*O* and type-*H* buyers adopt the legal default, without any disclosure, paying the same price. If the opt-out cost τ is sufficiently low ($\tau < L$) type-*E* and type-*L* buyers opt out of the non-disclosure default and disclose their types, paying different prices, as summarized in Table 5. An increase in opt-out costs results in less trade for the lower-valuing range of buyers. With $L < \tau < V^E$, type-*L* buyers would not opt out and hence would not trade; with $\tau > V^E$, both type-*L* and type-*E* buyers would exit the market.

[30] Note that by using Assumption 2 and Expression (3) we can write $(1-\gamma)V^O > V^{E+} > \gamma pG(c^{ND})(H^+ - V^O)$, which in turn implys that the inequality in (6) must always be satisfied.

Buyer	Message	Opt out	Price	Trade
Type $-H$	$\emptyset$	No	V^O	Yes
Type $-O$	$\emptyset$	No	V^O	Yes
Type $-E$	U	Yes	$V^E-\tau$	Yes
Type $-L$	L	Yes	$L-\tau$	Yes

Table 5: *Equilibrium under a non-disclosure default rule (for $V^O - V^E < \tau < L$)*

Proof. See the Appendix.

Lemma 2 focuses on the case of moderate opt-out costs. If $\tau < V^O - V^E$, type-*O* buyers would prefer to opt out and pay $V^E - \tau$, thereby destabilizing the equilibrium. In fact, if type-*O* buyers were to opt out, type-*H* buyers would be the only ones left to contract under the default non-disclosure regime and would be readily identified as expert buyers with positive information, leading them to pay a higher price. This, in turn, would take away their incentives to invest in information, recreating the withdrawal problem discussed under the disclosure default.

These considerations emphasize the important role of alternative default rules in the presence of opt-out costs. Although in a world of frictionless default rules, $\tau = 0$, either disclosure regime would reach the same equilibrium, different equilibria will be observed when positive opt-out costs are introduced. Non-disclosure defaults can yield a robust semi-pooling equilibrium, which is not obtainable under a disclosure default and which is essential to incentivize experts' investment in information.

3.5.2 Information acquisition under disclosure defaults

Let us start from the case depicted in Table 5, where $V^O - V^E < \tau < L$.[31] Given the results provided above, type-*L* buyers break even, while type-*H* buyers make a

[31] Note that the condition is meaningful if $V^O - V^E < L$, which implies $p > \frac{L^+-2L}{L^+-L}$. Taken together, this condition and Assumption 1 bound the range of admissible values of p and are mutually compatible if $\frac{L^+-2L}{L^+-L} < \frac{L^+-L}{H^+-H+L^+-L}$, that is, if the ordinary buyer's valuation of ordinary goods is not too large $L^+ < L\frac{2(H^+-H)-L}{H^+-H-L}$. To illustrate, the latter inequality is always satisfied if $L < L^+ < 2L$. In this case, the allocative gains from placing ordinary goods in the hands of ordinary buyers rather than uninformed expert buyers are not too large, as seems plausible.

positive profit. This gives expert buyers incentives to invest in information up to the difference between their valuation of a gem and the price they would pay for it, so that

$$c^{ND} = p(H^+ - V^O) \tag{7}$$

and the expert invests iff $c \leq c^{ND}$. Now recall that information acquisition was null under a disclosure default, so that the adoption of a non-disclosure default yields a definite improvement in information incentives compared to the disclosure default, $c^{ND} > c^D$. Second, note that $V^O < H$, and hence $c^{ND} > c^*$, so that information acquisition is excessive when the default is non-disclosure. This is because type-*H* buyers capture not only the social value of information but also its distributional value—that is, the possibility to pay a lower price. Interestingly, if that were not the case—that is, if we had $c^{ND} < c^*$—there would necessarily be some buyer with costs $c^{ND} < c < c^*$ who would have an incentive to acquire information *after* the purchase. Therefore, excessive investment in information acquisition is a feature of situations where buyers acquire information *prior* to trade, as we assume at the outset (see Assumption 2).

Note that since type-*L* buyers break even in the equilibrium of Lemma 2, the equilibrium level of information acquisition is unchanged if type-*L* buyers exit the market, that is, if $L < \tau < V^E$. The same applies to type-*E* buyers when $\tau > V^E$. Therefore, Expression (7) is valid for any $\tau > V^O - V^E$.

Proposition 2. If $\tau > V^O - V^E$, expert buyers make larger investments in information under a non-disclosure default rule than under a disclosure default rule. Information investments are socially suboptimal under a disclosure default and socially excessive under non-disclosure default, $c^D < c^* < c^{ND}$. The probability of trade is higher under a non-disclosure default than under a disclosure rule, $G(c^D) < G(c^*) < G(c^{ND})$.

Under a non-disclosure default, type-*H* buyers adopt the default, pooling with ordinary buyers. If opt-out costs are low enough, $0 < \tau < L$, uninformed expert buyers (type-*E*) and expert buyers who found negative information (type-*L*) opt out of the non-disclosure default disclosing their type and trade. The contract surplus is then equal to:

$$
\begin{aligned}
W^{ND} = (1-\gamma)(1-p)L^{+} &+ \gamma G(c^{ND})p(H^{+}-H) \\
&+ \gamma G(c^{ND})(1-p)(L-\tau) \\
&+ \gamma\big(1-G(c^{ND})\big)(1-p)(L-\tau) \\
&- \gamma\int_{0}^{c^{ND}} c\,dG(c)
\end{aligned}
\tag{8}
$$

With $L < \tau < V^{E}$, type-*L* buyers would exit the market and hence the third term in Expression (8) would equal 0. With $\tau > V^{E}$, both type-*L* and type-*E* buyers would exit the market and so both the third and the fourth terms in Expression (8) would equal 0.

The expression for the contract surplus in (8) captures the gains from trade with type-*O* buyers (first term) and type-*H* buyers (second term), both of which trade under the non-disclosure default. The next two terms capture the gains from trade with type-*L* buyers (third term) and type-*E* buyers (fourth term), who opt out of the non-disclosure default, disclosing their type with transaction cost τ. The last term captures the costs of information acquisition by expert buyers. An increase in opt-out costs may lower the contract surplus, as type-*L* and type-*E* buyers may exit the market.

3.6 Welfare effects of alternative disclosure rules

Under a disclosure default, expert buyers remain uninformed, pool with ordinary buyers and are unable to trade due to inverse adverse selection, because sellers face asymmetric information on the buyers' valuation of ordinary goods. Recall that ordinary buyers value ordinary goods at L^{+}, while uninformed expert buyers value them only at *L*. As a result, sellers find it advantageous to increase the price above what uninformed experts are willing to pay and sell only to relatively high-value buyers (type-*O* buyers, in this case). A disclosure default is sticky in equilibrium, as no buyer opts out of it.

In contrast, some opting-out will be observed under a non-disclosure default, with a two-fold effect on expert buyers' incentives. First, non-disclosure defaults allow expert buyers with positive information (type-*H*) to pool with uninformed ordinary buyers (type-*O*). As a result of this pooling, expert buyers pay a lower price than they would under a disclosure default. Second, the possibility to opt out of the non-disclosure default allows expert buyers with negative information (type-*L* buyers) to disclose information about the (low) value of the good and to trade at a lower price. These low-value buyers would be excluded from trading in an uninformed market. Both effects increase the benefit of information acquisition for expert buyers, boosting their incentives to invest in information.

There is a downside, however, to non-disclosure defaults. The protection they afford to experts who discover a gem may overshoot—in fact, this occurs in

our model. The expert buyers' private incentives to acquire information hinges upon the difference between the informed expert's valuation of a gem, H^+, and the price the buyer pays for it. In a social optimum, information incentives should, instead, be driven by the difference between the value of a gem for an informed expert and the value of a gem in the hands of an uninformed party, $H^+ - H$. The alignment of private and socially optimal incentives to invest in information is thus driven by the relationship between H and the price of the gem. The price of a gem in a non-disclosure default regime reflects the workings on the market under asymmetric information and, in our model, is equal to the valuation of the ordinary buyer, V^O, which is lower than H because it factors in the possibility that the good is an ordinary one—see Expression (2). In short, the expert buyer who has discovered a gem pays less than H and hence has excessive incentives to invest in information. Whereas under a disclosure default we observe too little investment in information, under a non-disclosure default we may observe excessive investment:

$$c^D < c^* < c^{ND} \tag{9}$$

We can now proceed to consider the overall welfare effect of our two default rules. Comparing the aggregate contract surplus under disclosure defaults with that under non-disclosure defaults for the case with low but positive opt-out costs, $0 < \tau < L$, we can see that non-disclosure defaults yield a greater surplus, $W^{ND} - W^D > 0$, if the following condition is satisfied:

$$\int_0^{c^*} (c^* - c)dG(c) + (1-p)(L-\tau) > \int_{c^*}^{c^{ND}} (c - c^*)dG(c) \tag{10}$$

Expression (10) balances the costs and benefits of a non-disclosure default compared to a disclosure default. On the LHS, the first term captures the *information-acquisition* benefit, that is, the fact that under a non-disclosure default all efficient investment in information ($c < c^*$) will be undertaken, while no information will be acquired under a disclosure default. The information-acquisition benefit is thus given by the benefits of trade by type-*H* buyers—$c^* = p(H^+ - H)$—net of the cost of information acquisition, c. The second term on the LHS accounts for the *information-forcing* benefit of non-disclosure defaults: uninformed expert buyers (type-*E* buyers) and expert buyers who acquired negative information (type-*L* buyers) opt out of the default of non-disclosure (at a cost τ) and trade, while they are excluded from the market under the disclosure default. The

information-forcing benefit is thus given by trade by type-*E* and type-*L* buyers. (Recall that all ordinary buyers trade in both cases). On the RHS of Expression (10) we have the costs of non-disclosure defaults, which derive from excessive information acquisition (above c^*). The excess stems from expert buyers who should not acquire information in the social optimum because their cost of information acquisition exceeds the social value of information. However, those experts engage in excessive investment in information anyway because they pay too little for gems.

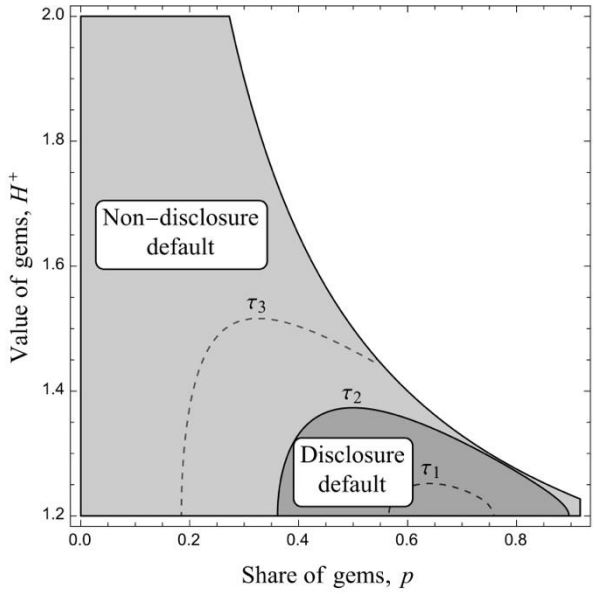

Figure 1: *Optimal default rule (with* $L = 0.3$, $L^+ = 0.6$, $H = 1.2$, $\tau_1 = 0.275$, $\tau_2 = 0.285$, $\tau_3 = 0.295$, *and* $c \sim U[0,1]$*)*

Higher opt-out costs naturally reduce the information-forcing benefits. Specifically, an increase in τ has two effects. It has a marginal effect—simply raising the costs of opt out—and an inframarginal effect that progressively excludes potential buyers from trade by making it too costly for them to opt out and disclose. An increase in the value of gems, H^+, has the natural effect of increasing the contract surplus under non-disclosure rules. An increase in the share of gems in the market, p, has an ambiguous effect because it increases the value of information while decreasing the information-forcing benefit and exacerbating the problem of excessive investment in information. The share of expert buyers, γ, has no direct effect on the comparison as it scales both costs and benefits. Figure 1 illustrates these effects and identifies the optimal default rule for given value, H^+, and prevalence, p, of gems for the reported values of the other parameters. The dashed lines show how increasing or

decreasing the cost of opt out expands or reduces, respectively, the scope of disclosure defaults; the white area indicates the region where the share of gems is too large and Assumption 1 fails to apply.[32] Our model supports Kronman's contention that non-disclosure rules may generate a social-welfare enhancing level of information acquisition, but it also demonstrates that this is not always the case, even in the most favorable scenario in which opt-out costs are low enough for all buyers to trade under the non-disclosure default.

4 Conclusion

We depart from the assumption of much of the existing literature that considers default rules completely sticky, nullifying the difference between mandatory and default rules. In this paper, we explored the effects of alternative disclosure rules when parties can contract around them. In practical terms, parties can alter the de facto application of default rules through various means that do not entail formal renegotiation. The effect of non-disclosure rules can be undermined by one party questioning that the other party has no duty to disclose yet that any answer except an outright lie would be revealed.[33] Parties can demand warranties or guarantees, refuse to trade if not given more information, or opt out of applicable default rules.[34] Various other legal and contractual instruments are used to correct asymmetric information problems. In lemons markets, implied or express warranties give

[32] The lower bound for H^+ is equal to H, while its upper bound guarantees that both c^* and c^{ND} are lower than 1. This is necessary because in the simulation we assume that c is uniformaly distributed on the unit interval. The upper bound for p guarantees that the chosen levels of the opt-out cost are such that $\tau > V^O - V^E$. Finally, since $L^+ - 2L = 0$ in the simulation, the lower bound for p such that $V^O - V^E < L$ is equal to 0.

[33] Even in cases in which the law allows the informed party to be silent, that party is not allowed to provide misleading or false information. Porat and Yadlin (2016, pp. 623-33), for example, discuss the legal distinction between untold truths and lies. They point out that parties can alter default rules at will through a variety of means, such as by asking questions that would trigger liability for fraud. *See* Laidlaw v. Organ, 15 U.S. (2 Wheat.) 178 (1817), Restatement (Second) of Contracts § 164, and Restatement (Second) of Torts § 551 (Am. Law Inst. 1977) (providing extra-compensatory remedies for misrepresentations and non-disclosures that cause a pecuniary loss)*; see also* Gaines v. Krawczyk, 354 F.Supp.2d 573, 587 (W.D. Pa. 2004) (citing *Gibbs v. Ernst*, 647 A.2d 882, 207 n.12 (Pa. Super. Ct. 1994)) ("The tort of intentional non-disclosure has the same elements as the tort of intentional misrepresentation except that in a case of intentional non-disclosure the party intentionally conceals a material fact rather than making an affirmative misrepresentation.").

[34] In our problem, even without recourse through legal remedies, responding to a direct question with silence reveals the existence of information. Craswell and Schwartz (2012) consider a scenario where a mining company learns about the existence of valuable minerals under a farmer's land and attempts to buy the farm. The company does so without disclosing its information. They point out: "Flatly refusing to answer the questions . . . would probably suggest to the farmer that the company did know something about the presence of minerals under the land."

buyers a right to return a defective good, to obtain its replacement, and to receive compensation for any additional loss incurred due to the failed disclosure of negative information at the time of sale. These warranties operate as information-forcing instruments, penalising informed sellers who do not disclose relevant negative information to their buyers (Priest, 1981).[35]

In gems markets, symmetrical instruments are available. For example, buyers can affirmatively state that the purchased item is not a gem, subjecting themselves to liability for fraudulent misrepresentation if the seller later discovers positive information. Sellers would be entitled to rescind a sale or obtain over-compensatory damages if they found that the informed buyers committed a fraudulent misrepresentation.[36] Another possible way to signal a lack of positive information would be to grant sellers the right to receive a percentage (possibly up to 100%) of the profit generated by a resale. Buyers granting such a right could credibly signal an absence of private information.[37]

Our analysis offers a novel rationale for the different disclosure obligations

[35] In a market for lemons, informed sellers can signal the lack of negative information (i.e., the fact that the sold good is not a lemon) by subjecting themselves to a disclosure regime and offering a warranty or by giving unsatisfied customers a right to rescind the contract and return the defective good (Grossman, 1981).

[36] In a market for gems, buyers can signal the lack of positive information (i.e., the fact that the sold good is not a gem) by voluntarily subjecting themselves to a disclosure regime or making an affirmative statement of lack of hidden qualities, such that, if hidden qualities are discovered after the sale, the seller could obtain some form of legal protection.

[37] Although the implementation and enforcement of this instrument can be problematic in transactions between anonymous parties, in cases where the resale activities are possible—such as for registered property, patents and other intellectual property rights, professional athletes, archived works of art, and goods traded at public auctions—this signaling solution may be effective. In the European Union, a *droit de suite* has been used to pursue different policy objectives, such as incentivizing artists to continue working so as to increase the value of their previously sold art. For example, following Directive 2001/84, a right to follow guarantees that artists receive a percentage of the resale price of their works of art. Each buyer of a piece of art who resells must transfer a percentage of the resale price. For a discussion concerning the limited acceptance of the right to follow in U.S. jurisdictions, see Reddy (1995). The right to follow appears in regulations related to transfers of professional soccer players in an effort to subsidize the junior leagues that provide training for many prospective athletes. Professional soccer teams may have a systematic informational advantage in detecting promising players through scouting. The mandated right to follow may reflect this pattern. The FIFA Regulations on the Status and Transfer of Players in Article 20 establishes that a "[t]raining compensation shall be paid to a player's training club(s): (1) when a player signs his first contract as a professional and (2) each time a professional is transferred until the end of the season of his 23rd birthday." FIFA, Regulations on the Status and Transfer of Players (2017), https://perma.cc/DNP7-DGGC. Moreover, "[t]he training costs are set for each category and correspond to the amount needed to train one player for one year multiplied by an average "player factor," which is the ratio of players who need to be trained to produce one professional player," (Id. Annex 4, Article 4), so that the training compensation covers the full ex ante costs of training professional players.

imposed on buyers and sellers in asymmetric information problems, which rests on the information-forcing effects of alternative default rules. As the model presented in Section 3 formally shows, allowing parties to opt in or out of default disclosure regimes will enable them to signal their information type. Buyers can bargain from the default disclosure regime, but doing so would reveal some information to their prospective sellers. For example, informed buyers could opt out of disclosure rules and obtain a waiver from their legal duty to disclose. This would likely lead to an increase in price but would eliminate the risk of liability or rescission of the contract if positive information is later discovered.

In gems problems, non-disclosure rules operate as bottom-up information-forcing default rules that mitigate the parties' information gap. Non-disclosure defaults foster trade opportunities between informed buyers and uninformed sellers, preserving the incentives of expert buyers to invest in socially valuable information and avoiding the withdrawal of prospective sellers. Our results support Kronman's (1978) conclusion to the extent that expert buyers should not be required to disclose their positive information to uninformed sellers, unveiling a fundamentally different rationale for this conclusion. We show that choosing alternative default rules in gems situations (duty to disclose vs. no duty to disclose) makes a big difference. Specifically, when parties can contract around the applicable default rules, we show that non-disclosure rules have greater information-forcing effects than disclosure default rules. Although expert buyers need not disclose positive information, other buyers will be more likely to separate themselves, signalling a lack of private information. In the presence of positive but moderate opt-out costs, this results in a partially separating equilibrium, which preserves buyers' search incentives and mitigates sellers' withdrawal problem identified by Burkart and Lee (2016) and Dari-Mattiacci et al. (2021).

The problems of asymmetric information appear at the core of most principal-agent issues, from insurance to labour markets, to mention a few. Akerlof's scenario focuses on the case of informed sellers and uninformed buyers, whereas the principal-agent literature mainly focuses on relationships between informed agents and uninformed principals. Future research may extend the results of our paper to other cases of asymmetric information. For example, the cases that mirror the contractual principal-agent scenarios consider situations where the principal, rather than the agent, has private information.

An extension of our analysis should consider that disclosure defaults may endogenously affect the parties' bargaining power. A seller may plausibly have greater bargaining power under a disclosure default, given her ability to identify informed buyers and leverage their sunk investments under such a disclosure rule. Further, in some situations in the market for gems, sellers may experience difficulties detecting the presence of hidden qualities after transferring the goods to the buyer.

Appendix

A.1 Proof of Lemma 1

At date $d = 3$, the game between the buyer and the seller can be defined as: $\Gamma = \{N, T, (\sigma_i, A_i, u_i)_{i \in N}\}$, where $N = \{\text{Seller, Buyer}\}$; T is the set of types of the buyer (states of nature); $T = \{H, L, E, O\}$; u_i denotes the payoff function of player $i \in N$. The game is played in two sequential stages. In the first stage of the game at $d = 3$, the buyer sends a signal of his type. In the second stage, the seller makes a TIOLI demand, as described in the timeline.

The buyer privately knows about his type $t \in T$. Recall, the share of expert buyers is γ. Assuming that an expert buyer invests in information if and only if $c \leq \tilde{c}$, the common prior can be expressed as:

$$(\forall i \in N), \sigma_i(.) = \begin{cases} \sigma(H) & = & \gamma p G(\tilde{c}) \\ \sigma(L) & = & \gamma(1-p)G(\tilde{c}) \\ \sigma(E) & = & \gamma\big(1 - G(\tilde{c})\big) \\ \sigma(O) & = & 1 - \gamma \end{cases}$$

A strategy of the buyer comprises of sending a signal μ disclosing the information he has or opting out of the disclosure rule, $\mu \in \{H, L, U, \emptyset\}$. So, the strategy set of the buyer is $\mu(t)$. Note that truthful disclosure implies that type *H* sends message *H*, type *L* sends message *L*, and types *E* and *O* both send the same message *U*, as they have the same information.[38]

The seller makes a TIOLI price demand in the second stage, having received a message μ from the buyer. So, the strategy set of the seller is $p(\mu)$, where p is a TIOLI price demand. Under a disclosure default rule, in view of the liability for misreporting, [39] the following seller's pricing strategy

$$p(.) = \begin{cases} p(H) & = & H^+ \\ p(L) & = & L \\ p(U) & = & V^O \\ p(\emptyset) & = & H^+ - \tau \end{cases}$$

induces truthful reporting of the good's quality. Assumptions 1 and 2 guarantee that

[38] The law only sanctions misrepresentation of information about the quality of the good, not about the idiosyncratic valuation of the buyer. So, in the model, we do not allow messages about the buyer's valuation and hence types *E* and *O* pool when they truthfully disclose.

[39] Under our assumptions, the legal sanctions on under-reporting are severe enough to make this strategy not viable and the seller's price strategy makes over-reporting disadvantageous.

the seller is better off charging V^O in response to message *U* and thereby selling only to type-*O* buyers, excluding type-*E* buyers from trade. If the seller reacts to opt out ($\mu = \emptyset$) by charging the highest price (H^+), no buyer will opt out in equilibrium. Moreover, truthful reporting becomes the buyer's dominant response to the above strategy of the seller.

Since, in equilibrium, there is truthful reporting of the good's quality, the posterior beliefs of the seller (conditional on the message she receives) are

$$\sigma_S(t|\mu) = \begin{cases} \sigma_S(H|H) & = & 1 \\ \sigma_S(L|L) & = & 1 \\ \sigma_S(\{O,E\}|U) & = & 1 \\ \sigma_S(t|\emptyset) & = & 0 \end{cases}.$$

Any other price strategy would result in opt out and a loss for the seller. In particular, $p(\emptyset) = V^E - \tau$ would make type-*E* buyers able to opt out and trade but would also result in opt out of type-*H* and type-*O* buyers with a loss for the seller. Given the relatively high share, $1 - \gamma$, of type-*O* buyers, this is not a rational choice for the seller.[40] Therefore, in equilibrium buyers truthfully report the quality of the good, type-*E* buyers are priced out of the market, and all other types pay their reservation price and trade.

Finally, note that given the equilibrium prices and Assumption 2, uninformed buyers do not have an incentive to buy for a price equal to V^O and aquire information after the sale.

A.2 Proof of Lemma 2

The game played by the parties under a non-disclosure default can be defined as in the proof of Lemma 1. We will prove Lemma 2 for $V^O - V^E < \tau < L$. The other two cases with higher τ can be proved in an analogous way.

Assuming that an expert buyer invests in information if and only if $c \leq c^{ND}$, the common prior can be expressed as:

[40] Our unverified conjecture is that the perfect Bayesian equilibrium is unique, as the above strategy of the seller seems to be a dominant choice in our setup. Note also that Proposition 1 would be valid under possible alternative equilibria so long as type-*H* buyers are unable to pool with lower types. In turn, pooling with type-*H* under opt out cannot be an optimal response for lower types because the lowest type in the pool pays his reservation price. Thus, the lowest type is indifferent between opting out and paying the transaction cost, and not opting out and saving the transaction cost. As we assume, they will choose the latter option. Similar considerations apply to Lemma 2.

$$(\forall i \in N),\ \sigma_i(.) = \begin{cases} \sigma(H) &= \gamma p G(c^{ND}) \\ \sigma(L) &= \gamma(1-p)G(c^{ND}) \\ \sigma(E) &= \gamma\left(1 - G(c^{ND})\right) \\ \sigma(O) &= 1-\gamma \end{cases}$$

where $c^{ND} = p(H^+ - V^O)$. Now consider the following strategy of the seller:

$$p(.) = \begin{cases} p(H) &= H^+ - \tau \\ p(L) &= L - \tau \\ p(U) &= V^E - \tau \\ p(\emptyset) &= V^O \end{cases}$$

where $p(H)$ is an out-of-equilibrium demand. Given this set of prices, it is optimal for the buyers of type *H* and *O* to contract under the default of non-disclosure and pay V^O, while buyers of type *L* and *E* opt out and reveal their information, paying accordingly. Recall that the legal sanctions on misreporting guarantee that there cannot be underreporting.

In equilibrium, the beliefs of the seller are:

$$\sigma_S(t|\mu) = \begin{cases} \sigma_S(L|L) &= 1 \\ \sigma_S(E|U) &= 1 \\ \sigma_S(\{O,H\}|\emptyset) &= 1 \end{cases}$$

Given these beliefs, the seller's pricing strategy is the optimal response to the buyer's strategy. As explained in the text, the pooling of types *H* and *O* is supported by Assumption 2, and hence holds because the share γ of expert buyers is typically low. In turn, this gives expert buyers the possibility to profit from information acquisition, as explained in the text.

Finally, note that in equilibrium uninformed expert buyers have a cost of information acquisition equal to $c > c^{ND} > p(H^+ - H)$ and hence do not have incentives to acquire information after the purchase.

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