Strategic Mis-Selling and Pre-Contractual Cognition*

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Abstract

The paper studies asymmetric awareness of the appropriateness of a status quo product between a seller and a buyer, where the latter can invest cognitive resources before contracting à la Tirole (2009). In the one-shot interaction, we show that there is no separating equilibrium in which the seller always truthfully reports the appropriate product. If the extent of mis-selling and the transfer from the seller to the buyer in the case of mis-selling are low, we have a pooling equilibrium where the seller always announces that the status quo product is appropriate. Otherwise, we obtain a semi-separating equilibrium where the seller randomizes between telling the truth and mis-selling if the status quo product is inappropriate. The transaction cost of pre-contractual cognition increases with the extent of mis-selling as the extent of mis-selling is small and decreases thereafter. Finally, reputation with a "tip" mechanism or competition between sellers may yield a separating equilibrium where the transaction cost vanishes.

Keywords: Mis-selling, cognition, unforeseen contingencies, asymmetric information
JEL Classification: D82, D83, D86, L14, L15

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1 Introduction

Mis-selling inappropriate products (goods or services), which do not deliver proper utility levels for the consumers, is of practical importance in many industries. It is especially serious in modern-day industries where consumers are unaware and therefore do not know all the payoff-relevant features of the products, unless they incur sufficient cognitive costs in the fields.

As a result of information disadvantages, consumers may be unaware of some low-quality aspects of products, say harmful radiations of computer monitors or cellphones, deliberately-added chemicals in foods, and side-effects of medicines. Consumers may be also harmfully surprised by add-on costs of cartridge after buying a printer, or the costs of using the telephone, watching in-room movies in a hotel. Consumers in financial services are increasingly exposed to the mis-selling of complex financial products, such as endowment mortgages or private pensions. In the UK, the Financial Services Authority noted already as early as 2000 that one in eight consumers who had bought a financial product in the past five years later regretted her choice.[1] More recently, the Office of Communications in the UK found mis-selling in the telecom services a growing problem.[2]

Economists have noticed the importance of the mis-selling problem, but they are emphasizing only one particular downside of mis-selling, namely that the consumers are hurt at the post-contractual stage.[3] However, the overall significance of mis-selling problem is largely underestimated when only looking at consumer complaints, which is merely the "tip of the iceberg". In fact, sometimes mis-selling per se does not reduce social surplus. It hurts the consumer, and yet benefits the seller. In these cases, mis-selling is purely a problem of welfare redistribution. In this paper, we shed light on a different and probably more important problem of the mis-selling: the transaction cost of pre-contractual cognition by the consumers, which is the "submerged part of the iceberg".

Hayek (1945) argues that not only does the price mechanism help to utilize knowledge dispersed among individuals, but it also promotes the efficient division of knowledge. However, when consumers have unforeseen contingencies, the price mechanism may fail. If the regulator also lacks the corresponding knowledge and therefore cannot promote the awareness of consumers, mis-selling bars the way to divide and share knowledge among individuals. Although consumers may be unaware, they are aware that they may be unaware of something. The possibility of mis-selling induces too much cognitive resources being spent on pre-contractual thinking by the consumers in order to prevent themselves from being potentially hurt. To come back to the examples mentioned above, in order to avoid being exploited, consumers have to be familiar with computer technology or acquire knowledge in food safety, medication, finance and telecommunications, which results in socially wasteful duplication of cognitive

[1] See *Informed decisions? How consumers use Key Features: a synthesis of research on the use of product information at the point of sale,* Financial Services Authority, November 2000.

[2] See *Protecting citizen-consumers from mis-selling of fixed-line telecoms services,* Office of Communications, UK, 22 November 2004.

[3] For example, Inderst and Ottaviani (2008) study the mis-selling problem in the principal-agent framework. Furthermore, their paper focuses on the intra-organizational incentives for an employee, while our paper sheds light on the direct interaction between a buyer and a seller in the market.

efforts.

In this paper, we address this issue through a model along the lines of Tirole (2009). We study the interaction between a seller (he) and a buyer (she) who is aware of the possibility that the status quo product may not be appropriate, meaning that at the post-contractual stage the buyer may not be satisfied with it. However, the buyer can think about the product-appropriateness before contracting.

We deviate from Tirole (2009) in two main aspects.[4]

First, we assume that the seller knows whether the status quo product is appropriate for the buyer or some novel product, which is unforeseen by the buyer, is appropriate, whereas in Tirole's model both parties are uninformed ex ante. The assumption that the seller is better informed is natural in the mis-selling context because of the seller's specialization in the industry. Given his knowledge, the seller can strategically announce the appropriateness of the product to the buyer. If some novel product is appropriate, the seller either mis-sells the status quo product or unveils the novel product that opens the buyer's eyes. After introducing asymmetric information, we focus on the problem of strategic mis-selling.

Second, we allow a transfer of money from the seller to the buyer in the case of mis-selling. This can be as a result of a litigation process. Since it is commonly known that the seller knows the product-appropriateness, the transfer is to deter the seller's intent of mis-selling. By contrast, in Tirole's model, the seller is uninformed ex ante as well, so selling inappropriate products is not the seller's willful action.

In the model, three key parameters determine the equilibrium. The first parameter is the a priori probability that the status quo product is not appropriate, which may lead to mis-selling. We call it the *extent* of mis-selling problem. The second parameter is the loss of the buyer (or the rent for the seller) when the seller successfully mis-sells. We call it the *effect* of mis-selling problem. The last parameter is the transfer of money from the seller whose mis-selling behavior is found out by the buyer.

We show that there is no *separating* equilibrium in which the seller always truthfully reports the appropriate product. In the case where the status quo product is inappropriate, if the seller does not mis-sell, namely the seller reveals the appropriate novel product, the buyer has no incentive to think. But it jeopardizes the seller's incentive to report truthfully, as mis-selling can never be found out before contracting.

When the extent of mis-selling and the transfer from the seller in the case of mis-selling are low in the economy as in many developed countries, there is a *pooling* equilibrium where the seller always announces that the status quo product is appropriate. The buyer has a low incentive to think to refrain her from being mis-sold, thus the seller prefers to mis-sell as the probability of being punished without getting any rent is low. Therefore, developed countries produce "simple man".

When the extent of mis-selling and the transfer are high as in some less-developed countries, we have no pure-strategy equilibrium. If the seller mis-sells with certainty whenever possible, the buyer has to keep her on her toes so as to prevent from

[4]Besides these two differences, we assume that the buyer has the full bargaining power for analytic simplicity. Moreover, we abstract away from the adjustment cost in Tirole's model by assuming that mis-selling does not directly reduce social surplus. The role of a positive adjustment cost in his model is to produce the potential result of the buyer's insufficient cognition as a free riding problem. However, since the seller here is informed about the product-appropriateness in our mis-selling context, pre-contractual cognition of the buyer is purely rent-seeking and therefore wasteful.

mis-selling. Then the seller has no incentive to mis-sell, since the probability of being caught is high. Conversely, the argument for no separating equilibrium applies. Thus, given that the status quo product is inappropriate, only when the seller randomizes between two alternatives with an appropriate probability, the buyer can choose a corresponding cognition such that seller is indifferent between telling the truth and mis-selling, which generates a *semi-separating* equilibrium. In these countries, consumers are relatively know-it-all. This is in contrast to Tirole (2009) where, in the absence of the transfer, the seller would strictly prefer to mis-sell.

In our model, there is only one source for a welfare loss: the cognition cost for the buyer. The transaction cost is the expected cognition cost of the buyer.

First, we show that in the pooling equilibrium, the transaction cost is increasing in the extent of the mis-selling problem. However, in a semi-separating equilibrium, we have the *opposite* result that the higher the extent of mis-selling, the smaller the transaction cost. Hence, the transaction cost is increasing in the extent of mis-selling problem as long as the extent of mis-selling is small as in many developed countries, and is decreasing thereafter as in some less-developed countries.

Second, increasing the effect of the mis-selling problem raises the transaction cost in the pooling equilibrium, whereas the impact is ambiguous in the semi-separating equilibrium.

Lastly, we find that increasing the transfer does not influence the transaction cost in the pooling equilibrium, but strictly reduces the transaction cost in the separating equilibrium.

Note that only in a separating equilibrium the transaction cost vanishes, since, in this case, there is no mis-selling and the buyer therefore does not think. However, the separating equilibrium does not exist. Thus our ideal society where there is worthy trust everywhere and there is no wasteful cognition is an impossible world in the one-short interaction setting. As "the economic institutions of capitalism have the main purpose and effect of economizing on transaction costs," (Williamson, 1985, p. 17), we then study whether the particular transaction cost of pre-contractual cognition can be saved by some market institutions.

First, we show that reputation may induce a separating equilibrium in each period, which shatters the mis-selling problem, if both buyer and seller are sufficiently patient and the probability of detecting the past cheating behavior is sufficiently high. In the separating equilibrium, the buyer rewards the seller's truthful report of the novel product by paying a higher price, or a "tip". However, we further find that whenever mis-selling occurs in some period in the separating equilibrium, the economy cannot go back to the outcome where no pre-contractual cognition of the buyer is exerted no matter how long the policy of anti-mis-selling campaigns has been exercised. But the out of equilibrium amnesty, which destroys the evidence of this mis-selling spot, can let the economy return immediately to the outcome where the transaction cost vanishes. Moreover, if the seller may be impossible to know the product-appropriateness in some period, we cannot save the pre-contractual cognition completely. Nonetheless, a smaller probability of unawareness of the seller reduces the transaction cost.

Second, in the one-shot interaction setting, if two sellers compete for the buyer simultaneously, there is always a pure-strategy equilibrium where both sellers truthfully report the appropriate product. By contrast to Tirole (2009), in the context of

asymmetric information, competition between sellers plays a role of reducing transaction costs, as two seller may simultaneously reveal the novel product to the buyer. Hence, reputation or competition may induce a separating equilibrium and minimize the transaction cost.

The remainder of the paper is organized as follows: Section 2 reviews the related literature. Section 3 presents the basic model. Section 4 and 5 discuss the role of reputation and competition, respectively. We conclude in section 6.

2 Related literature

2.1 Economics of Information

The paper considers a novel contracting problem with asymmetric information.[5] First, at the contracting stage, the uninformed party, namely the buyer, proposes the price (in each bargaining period, and uses delay as a screening device as in Appendix A.2). This problem belongs to the standard screening problem, which is first formally developed by Mirrlees (1971). Second, our model is close to the price-quality-signaling literature especially by Bester and Ritzberger (2001), which endogenizes the buyer's information on the product quality by the information acquisition approach introduced by Hirshleifer (1971), and Crémer, Khalil and Rochet (1998a, b). The precontractual cognition in our model is a special kind of information acquisition in the unawareness context. However, the buyer has the full bargaining power in our model. Thus we abstract from the signaling problem, and yet focus on the cognition-saving mechanisms. Furthermore, in our model, the seller may announce some awareness-inducing information that opens the buyer's eyes, which is absent in the standard literature of asymmetric information.

2.2 Incomplete Contracts

We have several rationales for incomplete contracts so far: verifiability (Williamson (1985), Grossman and Hart (1986), Hart and Moore (1990), Aghion and Tirole (1997), Maskin and Tirole (1999)), signaling (Aghion and Bolton (1987), Spier (1992), Hermalin (2002)), explicit writing costs (Dye (1985), Anderlini and Felli (1999), Battigalli and Maggi (2002)).

Recent approaches endogenize incompleteness of contracts from bounded rationality introduced by Simon (1957). Bolton and Faure-Grimaud (2009) and Tirole (2009) endogenize incomplete contracts from the parties' insufficient cognition. In contrast, when one party is fully rational and the other party is boundedly rational, contractual incompleteness can be as a result of strategic shrouding by the rational party. (Filiz-Ozbay (2008), Gabaix and Laibson (2006), von Thadden and Zhao (2009)) In our paper, the incomplete contract, which leads to mis-selling, stems from both the buyer's inadequate cognition and the seller's strategic shrouding.

[5]See, e.g., Bolton and Dewatripont (2005) and Laffont and Martimort (2002) for the comprehensive discussion on the literature of economics of asymmetric information.

2.3 Unawareness and Contract Design

In psychology, Kahneman and Tversky (1973, 1974) argue that people use an availability heuristic to judge probabilities. In economics, the corresponding notion of unavailability is unawareness.

Modica and Rustichini (1994) first discuss unawareness formally. Later, Heifetz, Meier and Schipper (2006), Li (2008), and Galanis (2007) model unawareness, which circumvent the impossibility result of non-trivial unawareness by Dekel, Lipman and Rustichini (1998). From then on, unawareness is possible to express. Its economic implications in contracting problems are discussed in the following papers. Gabaix and Laibson (2006) model consumers' unawareness of add-ons. Eliaz and Spiegler (2006) study screening consumers' awareness of future changing tastes. von Thadden and Zhao (2009) design the incentive for agents who are possibly unaware of their own choice possibilities. Applying Ozbay (2008), Filiz-Ozbay (2008) examines an insuree's unawareness of future contingencies.

Considerable progress has been made in Board and Chung (2006), which makes awareness of unawareness possible to be expressed. Awareness of unawareness plays an important role particularly in contracting problems. Although contracting parities are unaware, they are aware that they might be unaware of something. For example, Chung and Fortnow (2008) model the interaction between a contract writer and an interpreter. In equilibrium, the writer who is aware that she is unaware of something writes a simple contract to signal her low awareness. In addition, Tirole (2009) and the present paper also provide models where awareness of unawareness is addressed.

3 The Basic Model

3.1 The Setup

There are two risk-neutral contracting parties: a buyer (B, she) and a seller (S, he). The buyer wants to buy one unit indivisible product (good or service) from the seller. There is a *status quo* product A available from the seller. A can be interpreted as a displayed good on sale or a standard form contract for a service. If A is appropriate, A delivers utility $v > 0$ to the buyer. If A is not appropriate, however, the buyer's utility from A reduces to $v - h$ with $h > 0$. In the latter case, we assume that there always exists a *novel* product A', which is appropriate, (meaning it delivers utility v to the buyer,) but is unforeseen by the buyer.

If A is not appropriate, mis-selling may come in many guises. First, in a *low-cost-low-quality* interpretation, the buyer may be unaware of some utility-relevant features of the status quo product before contracting. For example, after using a computer monitor with a severe radiation problem (A), the buyer is hurt by h, but this monitor is h-cheaper to produce than a LCD monitor (A') for the seller. Second, in an *add-ons* interpretation, as in the example in Gabaix and Laibson (2006), the buyer may be unaware of the future cost of cartridge when buying a printer. If the seller sells a status quo printer with high future cartridge costs, and shrouds the attribute of cartridge to the buyer, the seller saves a cost h for the ink-saving technique. But the buyer has to pay h for the cartridge in the future. By these two interpretations, we normalize only the cost of producing the appropriate product to zero, whereas

the seller's cost of producing A is $-h$ if A is not appropriate. Finally, in a *hold-up* interpretation in the style of Tirole (2009), the unforeseen features of the product, say a design, are not costly for the seller to adjust ex post. That is, if A' is appropriate, the seller could convert A into A' at zero cost. However, at the post-contractual stage, the buyer is locked in, so the seller can hold her up by asking for more payment h. In other words, the seller blackmails the unaware buyer ex post. By this interpretation, the seller's cost of producing any product is normalized to zero.

Hence, the *effect* of mis-selling problem is modeled by a constant h. If A is not appropriate, and the buyer consumes A, the magnitude h is not only the buyer's loss from mis-selling but also the rent for the seller who mis-sells. By mis-selling, there is a redistribution of payoff from the buyer to the seller.[6]

The time line is in Figure 1, and the game structure is depicted Appendix A.1.

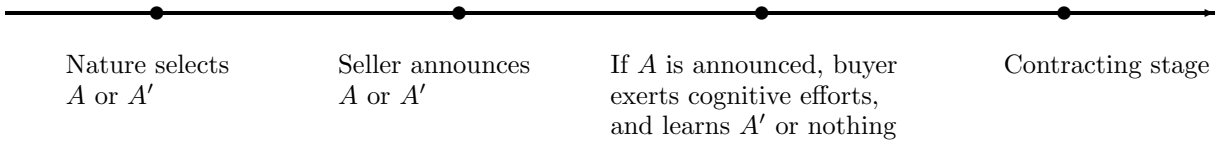


Figure 1: Timeline

The detailed timing is as follows:

• Stage 1: Nature moves.

Nature N chooses A to be *not* appropriate with probability ρ. In other words, with probability ρ, something of the status quo product goes wrong for the buyer. We call ρ the *extent* of the mis-selling problem, since, with probability ρ, the status quo product is inappropriate, which leads to the potential mis-selling problem.

In contrast to Tirole (2009), we assume that the seller knows the nature's move, while the buyer does not.[7] Facing the known product A, the buyer is aware that A might be not appropriate for her. In other words, the buyer is aware that something may go wrong with A. Here, we assume common knowledge of the game and rationality. Since two parties have a common prior ρ, the problem is a classical one of asymmetric information between the buyer and the seller. If A is appropriate, we call the seller type-A, otherwise, we call him type-A'.

• Stage 2: Seller's announcing stage.

[6]In general, the gain of the seller in the case of mis-selling h' may be different from the loss of the buyer h. Particularly, it is quite plausible to assume a deadweight loss of mis-selling ($h' < h$). This extension is straightforward without changing the qualitative results. Our motivation of this simplification compared to Tirole (2009) is that since the seller has been already informed about the product-appropriateness, the buyer's pre-contractual cognition is purely rent-seeking. Therefore we focus only on this more important transaction cost in the mis-selling context, and rule out the possibility of insufficient cognition of the buyer as a free riding problem in Tirole (2009) which needs the assumption of a deadweight loss of hold-up.

[7]The seller's information advantage is common in situations where the seller is a specialized firm who has the capacity to design the product and thus gains the detailed knowledge of the product-appropriateness, whereas the buyer who demands something and has no ability to produce it is therefore relatively unfamiliar with product. Nevertheless, we get back to the case where the seller may be uninformed as well in section 4.3.

At this stage, the seller can announce that the status quo product A is appropriate, or points out that A does not deliver v to the buyer and shows a novel product A', which is appropriate.

If the seller is type-A, then he can only announce that A is appropriate, since A is indeed appropriate, and the buyer cannot be harmfully surprised ex post. However, type-A' seller contemplates two options: falsely saying that the status quo product A is appropriate (mis-selling) on the one hand and unveiling A' on the other hand. Here, announcing A provides only a soft information, since the buyer may remain uncertain of the appropriateness of A (if the seller may mis-sell in equilibrium). However, announcing A' immediately reveals A', and is an eye-opener for the buyer, because the seller can report it to the buyer only if A' is de facto appropriate. Intuitively, the seller can announce something surprising only if the buyer is indeed unaware of something. For example, if the buyer is unaware of the future cartridge when buying a printer, the seller may hide the cost of cartridge or mention it to the buyer. Let q be the probability that type-A' seller mis-sells, which is endogenous.[8]

• Stage 3: Buyer's cognition stage.

If $q > 0$ and the seller says A is appropriate, the buyer still does not know whether or not A is appropriate. However, the buyer can think, namely make an effort to contemplate the situation in this case. The buyer chooses her *cognition* level b, which maps bijectively to the probability that the buyer learns that A' is appropriate given that A' is in fact the appropriate product. The buyer bears a cognition cost, or thinking cost, $C(b)$ that is a smooth, strictly increasing and strictly convex function with the properties $C(0) = C'(0) = 0$ and $C(1) = \infty$.

• Stage 4: Contracting stage.

We assume for simplicity that the buyer has full bargaining power at the contracting stage and thus can make a take-it-or-leave-it offer to the seller. Nevertheless, Appendix A.2 shows that the result is robust to a more general bargaining protocol where the buyer makes all the offers in an infinite-horizon setting. We also assume the outside options of both parties yield zero payoffs.

If the seller reveals A' to the buyer, the buyer is suddenly aware of A' and proposes a contract that consists of a price p and a full specification of the product A'. Facing the contract, the seller decides whether to accept it.

If the buyer is told that A is appropriate, and after the buyer has thought about it at stage 3, there are two possibilities.

(1) The buyer learns that A is not appropriate by pre-contractual cognition, thus she knows the seller has cheated her. We assume that whenever the buyer knows that the seller mis-reports the product, the buyer can sue the seller for a monetary transfer $t \in (0, h)$. Then the buyer demands A' and proposes a price p subject to the seller's participation.[9]

[8]The transmission of awareness-inducing information here is thus different from cheap-talk games (See, e.g., Crawford and Sobel, 1982) where information is always soft and persuasion games (See, e.g., Milgrom (1981) and Milgrom and Roberts (1986)) where information is always hard.

[9]Introducing the possibility that the buyer may demand A does not change our results. In equilibrium, the buyer will gain the same social surplus in trading both A' and A, but the equilibrium price p is lower in the latter case.

We assume that the buyer receives the transfer even without consuming the product in order to shed light on the mere transaction cost of pre-contractual cognition. In fact, what is crucial in the model is punishing the cheating type-A' seller so as to deter mis-selling even if the buyer has not consumed the product yet. To avoid the welfare loss from punishing the seller, the monetary punishment should be returned to the society, namely the buyer, as she is the only rest player in the game. We consider the case of multiple buyers in Appendix A.3 where an individual buyer's cognition may be reduced as a free-riding result.

Since we have assumed that there is common knowledge that the seller knows the product-appropriateness, the buyer knows that mis-selling happens not by chance but occurs only if the seller has an intent of doing it. Hence, the buyer will sue the seller's willful mis-selling. Even if it is possible that the seller does not know the product-appropriateness, due to the seller's specialization in the industry, we assume that the seller can acquire the information with zero cost. Hence, liability of the seller requires the seller to take an appropriate care to report the product.[10] As Milgrom (2008) argues that

> "... what is needed ... is to hold the seller liable for failures to reveal promptly not only the verifiable information that the seller knew, but also the information that it *should have* known under the circumstances."

Now one might consider to increase the transfer t arbitrarily in the constitution so as to deter mis-selling. However, we assume the judicial system is imperfect. When the seller mis-sells, the court will judge it correctly with probability z. Because of the seller's limited liability W, it is very likely that the *expected* transfer $t \leq zW$.[11]

It is worth noting that a deterministic transfer t in the case of mis-selling can be implemented via a litigation mechanism as shown in Appendix A.4 when only type-A' seller can provide hard evidences of mis-selling to the court of law. When there is symmetric information of mis-selling between the buyer and the seller ex post, the transfer can be realized based on the *spirit* but not the *letter* of their contract, although product-appropriateness is not verifiable by the court of law. We also show in Appendix A.4 that even in this case t cannot be arbitrarily high. Here we content ourselves with a simple analysis in which the transfer is modeled by an exogenous constant t smaller than h whenever the buyer knows the seller's false report.

[10] A similar discussion is in the accident (tort) law literature. Here the buyer is a victim, and the seller is an injurer. Assume that the mis-selling accident is unilateral, namely only the seller's care affects the mis-selling risk. We impose the rule of strict liability, meaning the seller has the liability to pay all the loss for the buyer within the seller's asset requirement. Note that the negligence rule, which says that the seller pays for the buyer's loss only if the seller's care is less than the level the court specifies (due care), is not feasible when the court cannot detect the seller's efforts of care. (See, e.g., Shavell, 2004)

[11] One may wonder whether we can solve the problem by the standard Nash implementation approach by Maskin (1999) or subgame perfect implementation approach by Moore and Repullo (1988). However, both mechanisms cannot provide unique equilibrium, as the preferences of both parties over the transfer decision are state-independent, namely the buyer always prefers a transfer, and the seller always prefers no transfer.

One may also wonder whether we can solve the problem by the standard approach before the buyer's uncertainty is resolved. However, Aghion, Fudenberg and Holden (2007) show that the Moore-Repullo mechanism is not robust to the asymmetric information context as we assume here.

(2) The second possibility is that the buyer remains uncertain of whether A is appropriate. Then the buyer proposes a contract, including a price p and the specification of A, under uncertainty.

Suppose A' is appropriate. The buyer can only demand A, although it is not appropriate. The imperfect description in the contract reflects a misleading contract. If the seller accepts the contract, then, at the post-contractual stage, the buyer receives payoff

$$v - p - h + t - C(b),$$

and the seller receives

$$p + h - t.$$

Ex post, the buyer will find out that A is actually not appropriate, since she is hurt by h. Then the buyer sues the seller for a transfer t.

Suppose A is appropriate. Since there is no mis-selling problem, if the seller accepts the contract, then, at the post-contractual stage, the buyer receives $v - p - C(b)$, and the seller receives p.

3.2 Equilibrium

We now solve the game backwards by using the solution concept of perfect Bayesian equilibrium.

At stage 4, when type-A' seller tells the buyer A' or the buyer finds that A' is appropriate by cognition, the buyer optimally demands A'. Sequential rationality implies that the seller accepts the contract if and only if $p \geq 0$ and the optimal price proposed by the buyer is $p = 0$.

An interesting finding is that when the seller says A is appropriate and the buyer finds nothing after cognition the optimal price remains $p = 0$. To show this point, let

$$\widehat{\rho} \equiv \frac{\rho q(1-b)}{1 - \rho + \rho q(1-b)}$$

be the posterior probability of mis-selling from the buyer's view given that the buyer finds nothing after cognition and the the buyer believes that type-A' seller's probability of mis-selling is q.[12] Here the buyer's belief is updated according to Bayesian rule.

Suppose the buyer proposes some price $p \geq 0$. Then both types of sellers accept it. The buyer therefore receives her expected payoff

$$U_1 \equiv (1 - \widehat{\rho})(v - p) + \widehat{\rho}(v - h + t - p) - C(b).$$

The buyer's best proposal is $p = 0$ given that $p \geq 0$.

Suppose the buyer proposes price $p \in [t - h, 0)$. Then type-A seller will reject it. The buyer receives her expected payoff

$$U_2 \equiv \widehat{\rho}(v - h + t - p) - C(b).$$

The buyer's best proposal is $p = t - h$ given that $p \geq t - h$.

[12] In equilibrium, the buyer has a correct belief of q.

If $p < t - h$, both types of sellers reject it. Thus the buyer receives payoff $-C(b)$.

To focus on the welfare loss of pre-contractual cognition, we abstract from the inefficient contracting result where a mutually beneficial trade may break down. Now we make the following assumption:

Assumption 1 $v - \rho(h - t) > \rho v$.

The interpretation of Assumption 1 is, given that there is no cognition and type-A' seller mis-sells with certainty, the buyer always prefers $p = 0$ and contracting with both types of sellers (where the buyer gets $v - \rho(h - t)$) to $p = t - h$ and contracting with only type-A' seller (where the buyer gets ρv). Hence, we rule out the case in which there are only lemons in the market, and trades break down for type-A seller. (Akerlof, 1970) This assumption holds when the extent and the effect of mis-selling are not too high, namely ρ and h and are sufficiently small, and the gain from trade v is large enough.

Assumption 1 implies

$$(1 - \rho)v - \rho(h - t) > 0$$

that also implies

$$(1 - \widehat{\rho})v - \widehat{\rho}(h - t) > 0, \tag{1}$$

since $\widehat{\rho} < \rho$ holds for all $b > 0$ and q.

Inequation (1) is equivalent to $U_1 > U_2$. Hence, $p = 0$ is better than $p = t - h$ for the buyer. Intuitively, after the buyer exerts cognitive efforts and finds nothing, and type-A' seller does not mis-sell necessarily, the buyer believes that mis-selling is less likely to occur, and is more willing to contract with both types of sellers.

Moreover, Assumption 1 also implies that the price $p < t - h$ is never optimal, as $v > 0$. For the buyer, contracting with both types of sellers is also better than her outside option, since there is a positive gain from trade.

Furthermore, Appendix A.2 shows if Assumption 1 holds, $p = 0$ without delay is also the equilibrium outcome in a general bargaining game where the buyer makes all the offers in an infinite-horizon setting in which delay can work as a screening device for the buyer.[13]

Suppose, at stage 2, $q = 0$, i.e., type-A' seller tells the buyer A' with certainty. Then at stage 3, the buyer's optimal cognition is $b = 0$. Since there is no mis-selling problem anymore, it is not worthwhile for the buyer to spend any resource on thinking. However, if $b = 0$, it turns out that type-A' seller optimally pretends to be type-A, since type-A' seller will get the rent from mis-selling with certainty (and $h - t > 0$). Thus it is impossible to have *separating equilibrium* in which the buyer can tell type-A seller and type-A' seller apart for sure without cognition. The negative result is akin to the Grossman-Stiglitz paradox, which says that there is no pure-strategy equilibrium of pricing when acquiring quality-information is costly for consumers in the market. (See Grossmann and Stiglitz, 1980)

Alternatively, suppose $q = 1$ at stage 2, i.e., type-A' seller mis-sells with certainty. Then at stage 3, given that $p = 0$, the buyer maximizes her payoff in expectation

[13] In Appendix A.5, we show that if this assumption fails, there is even no equilibrium in which the buyer strictly prefers to contracting with only type-A' seller or proposing nothing.

$$\max_b (1-\rho)v + \rho b\,(v+t) + \rho(1-b)(v-h+t) - C(b)$$

where $1-\rho$ is the probability that A is appropriate, ρb is the probability that A' is appropriate and the buyer knows it by cognition, and $\rho(1-b)$ is the probability of mis-selling.

The assumptions on $C(\cdot)$ imply that the optimal cognition is b^* such that

$$C'(b^*) = \rho h. \tag{2}$$

The marginal cost of cognition equals the marginal benefit from avoiding mis-selling. Equation (2) reflects that the equilibrium cognition is increasing in ρh, namely the product of the extent and the effect of mis-selling problem.

When ρ is small, we have that b^* is small. Thus if t is also sufficiently small, we have that

$$(1-b^*)(h-t) + b^*(-t) \geq 0, \tag{3}$$

which means that $q=1$ is indeed optimal for type-A' seller. Therefore, when ρ and t are small, there is a *pooling equilibrium* in the sense that both type-A and type-A' sellers announce that A is appropriate. Intuitively, if the extent and the transfer from type-A' seller are low, the buyer therefore does not exert too much cognition, then type-A' seller has an opportunity to mis-sell.

Formally, if $\rho h \leq C'(1-\frac{t}{h})$ holds, we have such pooling equilibrium.[14] It is straightforward to see that pooling is more likely to occur for smaller ρ and t, yet the role of h is indeterminate. It is so because increasing h raises the benefit of mis-selling for the seller, which enhances the seller's incentive to mis-sell, yet also raises the buyer's cognition, which reduces the seller's incentive to mis-sell. Hence, we cannot judge its impact on the validity of condition (3).

However, when $\rho h > C'(1-\frac{t}{h})$, there is no pure-strategy equilibrium, since in this case we have

$$(1-b^*)(h-t) + b^*(-t) < 0, \tag{4}$$

i.e., a high level of cognition by the buyer in the pooling equilibrium deters type-A' seller from mis-selling.

[14] Pooling equilibrium occurs if and only if

$$(1-b^*)(h-t) + b^*(-t) \geq 0$$

where b^* is characterized by equation (2), which is equivalent to

$$b^* \leq 1 - \frac{t}{h}.$$

By strict convexity of $C(\cdot)$, it is also equivalent to

$$C'(b^*) \leq C'(1-\frac{t}{h}),$$

which is nothing but

$$\rho h \leq C'(1-\frac{t}{h}).$$

For large ρ and t, let us therefore investigate the mixed-strategy equilibrium. We assume all parties have perfect recall, so the concept of behavioral strategies is tantamount to that of mixed strategies. Suppose type-A' seller chooses a behavioral strategy $q \in (0,1)$ at stage 2. Then at stage 3, the buyer solves the following problem upon observing A:

$$\max_b \frac{(1-\rho)\,v + \rho q b\,(v+t) + \rho q(1-b)(v-h+t)}{1-\rho+\rho q} - C(b)$$

where the posterior probability that A is appropriate is $\frac{1-\rho}{1-\rho+\rho q}$, the posterior probability that A' is appropriate and the buyer knows it by cognition is $\frac{\rho q b}{1-\rho+\rho q}$, and the posterior probability of mis-selling is $\frac{\rho q(1-b)}{1-\rho+\rho q}$.

Similarly, our assumptions on $C(\cdot)$ guarantee that the optimal cognition is b^* such that

$$C'(b^*) = \frac{\rho q h}{1-\rho+\rho q}. \tag{5}$$

Since type-A' seller plays a non-degenerate behavioral strategy, at stage 2, he is indifferent between announcing A and A', i.e., the following equation is satisfied.

$$(1-b^*)(h-t) + b^*(-t) = 0.$$

Therefore, the equilibrium cognition is

$$b^* = 1 - \frac{t}{h}, \tag{6}$$

so the equilibrium cognition level is determined by h and t and independent of ρ. In particular, b^* is increasing in h and decreasing in t. If h is higher, type-A' seller has a higher incentive to mis-sell. To keep the seller still indifferent between announcing A and A', the buyer has to think more carefully to reduce type-A' seller's incentive to mis-sell. We have the opposite and yet analogous intuition for a higher t.

Plug b^* in (6) into equation (5), we have

$$q^* = \frac{(1-\rho)C'(1-\frac{t}{h})}{\rho(h - C'(1-\frac{t}{h}))}. \tag{7}$$

In equilibrium, an appropriate q^* induces the buyer to choose the optimal cognition such that type-A' seller is indeed indifferent between mis-selling and reporting truthfully. Note that if $h-t$ converges to zero, we have that q^* converges to zero. Thus if the difference between the effect of mis-selling and the transfer due to mis-selling is very low, we have *almost* separating equilibrium.

Figure 2 and 3 illustrate the buyer's best response function $b(q)$ and type-A' seller's best response correspondence $q(b)$ in two different equilibria. Here $b(q)$ is strictly increasing in q,[15] $b(0) = 0$, and $b(1) < 1$ by equation (5). Inequation (3)-(4)

[15]By equation (5), we infer that

$$\frac{dC'(b^*)}{dq} = \frac{d\left(\frac{\rho q h}{1-\rho+\rho q}\right)}{dq} = \frac{\rho\,(1-\rho)\,h}{(1-\rho+\rho q)^2} > 0.$$

implies $q(b) = \{1\}$ for small b, $q(b) = \{0\}$ for large b, and $q(b) = [0, 1]$ for some b in-between.

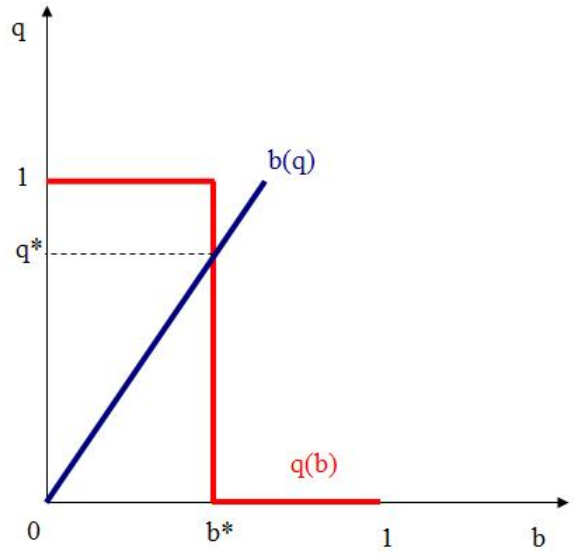


Figure 2: Semi-Separating Equilibrium

Figure 2 shows that if q is too large, the buyer chooses a large $b(q)$ to prevent from being mis-sold. But a large b implies that $q(b)$ is zero, i.e., the seller dare not to mis-sell. Conversely, if q is too small, the buyer has no incentive to think and thus chooses a small b. But a small b implies $q(b)$ is one, i.e., the seller has incentive to mis-sell. Thus the equilibrium q^* has to be not too large and not too small. In the figure, the intersection of $b(q)$ and $q(b)$ is the unique candidate for equilibrium b^* and q^*.

Thus, when ρ and t are large, there is a *semi-separating equilibrium* in the sense that type-A' seller randomizes between mis-selling and telling the truth.[16] This result is in contrast to Tirole (2009). Although the seller has no bargaining power, in the presence of the transfer t, type-A' seller here has no strict incentive to shroud A'. Disclosure of A' by the seller is possible, though not necessary, in equilibrium.

In contrast, when ρ and t are small, the pooling equilibrium is depicted in Figure

[16]The feature of semi-separating equilibrium smacks of an inspection game. The buyer is the counterpart of an inspector, and the seller is the counterpart of an inspectee. (See, e.g., Avenhaus, von Stengel and Zamir, 2002) Nevertheless, there are some substantial differences. First, in our model, there are heterogeneous sellers, and it is impossible for type-A seller to mis-sell. Hence, when the fraction of type-A seller, namely ρ, is high, there exists a pure-strategy equilibrium that is a pooling one. Second, in most inspection games, the inspector has a binary choice: alarm or not alarm. But our buyer here chooses a continuous cognition level b to update her belief. Thus the buyer chooses an appropriate b, which is a pure strategy, in equilibrium. Third, in inspection games, players move simultaneously, yet in our model, the seller moves first. If the seller reveals A', the buyer therefore needs not to think. Fourth, there are two types of errors for the inspector in the statistical parlance. However, our model excludes the buyer's type I error, since describing A' implies that A' is indeed appropriate. Lastly, we abstract from the seller's violation procedure that influences the buyer's cognition.

3. In this case, $b(q)$ and $q(b)$ intersect at $q = 1$, which implies a pure-strategy equilibrium.

However, since $b(q)$ is strictly increasing in q and b is positive in any equilibrium, $b(q)$ and $q(b)$ can never intersect at $q = 0$, thus separating equilibrium does not exist, as the figures show.

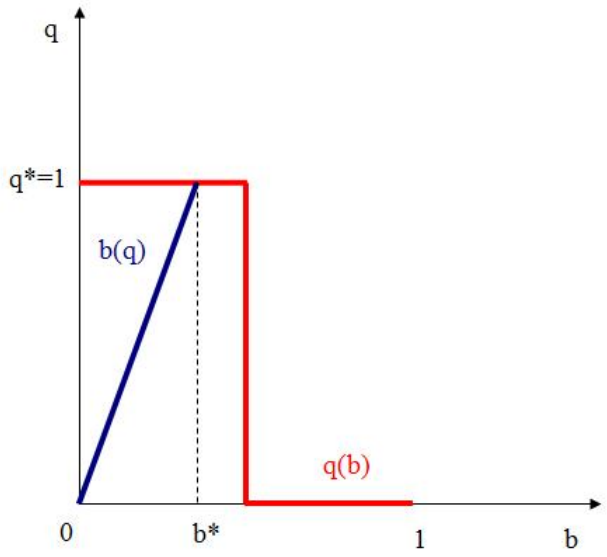


Figure 3: Pooling Equilibrium

We summarize the results we have so far in the following proposition.

Proposition 1 *Under Assumption 1, the equilibrium price is $p = 0$ that is accepted by the seller.*

There is no separating equilibrium where two types of sellers are distinguished by the buyer with certainty.

If $\rho h \leq C'(1 - \frac{t}{h})$, there is a pooling equilibrium where both types of sellers announce that A is appropriate, and the buyer's cognition b^* is characterized by equation (2).

Otherwise, there is a semi-separating equilibrium where type-A' seller randomizes between mis-selling and truthful report with type-A' seller's probability of mis-selling q^* given by equation (7), and the buyer's cognition level b^* is given by equation (6).

Pooling equilibrium happens in many developed countries where unforeseen contingencies are not so likely to occur. In these countries, the consumers are "simple" men in the sense that they do not acquire much information on the product-appropriateness. Although the seller mis-sells with certainty whenever he has an opportunity, the consumers are not afraid of it, since it is a small-probability event. However, in less-developed countries, as the extent of mis-selling is high, the consumers have to be alert. Thus the consumers in less-developed countries are relatively less simple. Nevertheless, the consumers need not to acquire too much information like a "know-it-all" in the semi-separating equilibrium.

3.3 Robustness

The results so far are robust to a number of extensions.

Heterogeneous Buyers: We assume only partially unaware buyers, meaning the buyers are aware of their potential unawareness. In reality, a number of buyers are completely unaware, i.e., they are naive in the sense that they always believe what the seller says, and do not exert any cognition. If we allow diversely unaware buyers, the results are qualitatively similar. The main change is that the pooling equilibrium is more likely to occur, because type-A' seller has a higher incentive to mis-sell due to the opportunity to exploit more completely unaware buyers in the population.[17]

Furthermore, if we allow that a fraction of buyers have the same information as the seller has, that is, some buyers know A' without the need of costly cognition when A' occurs, the qualitative results remain as well, except that the pooling equilibrium is less likely to occur. More informed buyers in population increase type-A' seller's probability of being punished when he mis-sells.

Note that the buyer has full bargaining power in our model. This softens the problem of externality of the existence of a different type of buyers on the buyers we have in the model.

Heterogeneous Sellers: The model assumes that all sellers are immoral in the sense that they mis-sell whenever it is worthwhile for them. Suppose a fraction of sellers are honest. That is, they always truthfully report the appropriate product. It only reduces the buyer's incentive to think, which therefore makes the pooling equilibrium more likely to occur. In addition, we discuss the case where the seller may not be informed in section 4.3.

More than Two States of Nature: Suppose there are not only the appropriate and non-appropriate products, but an order of appropriate products. Simplifying a bit, we have three states of nature: A, A' and A''. After A' is revealed, the buyer may think further to look for the more appropriate A''.

If the seller only knows A', then our analysis is not modified before the buyer's cognition for A'', because there is asymmetric information only on A' between them. After A' is revealed, we are back to the model by Tirole (2009), since both parties are uninformed about A''. However, if the seller is fully informed, type-A'' seller can pretend to be A or A'. Nevertheless, our qualitative results still hold. That is, when t is small, we also have pooling equilibrium. Conversely, we have semi-separating equilibrium where type-A' seller or type-A'' seller (or both) randomizes their choices.

3.4 Welfare Comparatives

We view social surplus of the buyer and the seller as our welfare criterion. In any outcome of the game, we have only one source for a welfare loss: the cognition cost $C(b)$ for the buyer. The mis-selling behavior per se does not reduce social surplus, since the rent simply goes from the buyer to the seller. Thus we define the *transaction*

[17] Alternatively, we can reinterpret it as heterogeneous cognitive cost functions. One is C_1 as assumed before. The other is C_2 such that $C_2(0) = 0$ and $C_2(b) = \overline{C}$ for $b > 0$ where $\overline{C}$ is a sufficiently large constant. The buyer with the later function will never think and always contracts with the seller as long as Assumption 1 is satisfied. Hence, there is no behavioral difference between these two interpretations, although the beliefs of the buyers in two interpretations are different.

cost as the expected cognition cost

$$L \equiv (1 - \rho(1 - q))C(b)$$

where $\rho(1-q)$ is the probability that type-A' seller opens the buyer's eyes, which is the mere situation in which no cognition of the buyer is involved. Otherwise, the buyer has to bear the cognition cost $C(b)$. In the model, there are three free parameters: ρ, h and t. The comparative statics of the transaction cost with respect to these parameters is in the following proposition.

Proposition 2 *If* $\rho h \leq C'(1 - \frac{t}{h})$, *we have* $\frac{dL}{d\rho} > 0$, $\frac{dL}{dh} > 0$ *and* $\frac{dL}{dt} = 0$. *Otherwise, we have that* $\frac{dL}{d\rho} < 0$, *the sign of* $\frac{dL}{dh}$ *is ambiguous, and* $\frac{dL}{dt} < 0$.

Proof. See Appendix A.6. ■

When $\rho h \leq C'(1 - \frac{t}{h})$, there is a pooling equilibrium where type-A' seller mis-sells with certainty. Thus the buyer exerts her cognition with certainty. The transaction cost is therefore $L = C(b)$. The higher ρ, the higher the cognition level b the buyer exerts in order to avoid being mis-sold, and thus the higher L. By the same token, L is increasing in h. However, in the pooling equilibrium, the buyer's cognition level b is independent of the transfer t, because changing t does not influence the buyer's marginal payoff of cognition, although the buyer prefers a higher t.

When $\rho h > C'(1 - \frac{t}{h})$, there is a semi-separating equilibrium. Since q is endogenous, the welfare comparative statics is not so straightforward as above.

Particularly striking is that we have the opposite result that L is *decreasing* in ρ here. Since, in the semi-separating equilibrium, what determines the cognition of the buyer is only type-A' seller's indifference condition, that is equation (6), more type-A' sellers in the population does not alter the buyer's cognition. However, when ρ is large, to keep the buyer employing the same cognition as before, type-A' seller has to reduce q. Equation (7) implies q decreases at a higher rate than ρ. Thus, the overall probability that the buyer exerts cognition is lower. Although ρ is higher, there is much higher probability of information disclosure. Hence, L is reduced for a higher ρ.

In a nutshell, *there is a cutoff value* $\overline{\rho}$ *such that* L *is increasing in* ρ *as long as* $\rho < \overline{\rho}$ *(as in many developed countries) and is decreasing thereafter (as in some less-developed countries).*

However, in the semi-separating equilibrium, it is ambiguous whether or not L increases as h increases. Since raising h has an ambiguous impact on equilibrium q, we cannot judge the welfare consequence of it.

Lastly, a higher t reduces L in the semi-separating equilibrium. For a higher t, to guarantee type-A' seller's indifference condition, the buyer's cognition level b is lower. The only way to maintain the buyer's low cognition is to reduce type-A' seller's probability of mis-selling q. Since both b and q are reduced, L is reduced.

The welfare comparatives suggests that a benevolent court of law should increase t to the largest extent.[18] However, t is bounded above by limited liabilities of the

[18]Although, in the pooling equilibrium, t plays no role in the transaction cost, the court of law may choose the highest t in order to enhance the buyer's welfare as a tie-breaking rule.

parties (as shown in Appendix A.4). Therefore, t can be interpreted as the highest possible transfer, depending on the wealth of the parties in the litigation process.[19]

Notice that suppose there were a separating equilibrium in which $q = 0$. Then $b = 0$, since it is not worthwhile for the buyer to think any more. Thus $L = 0$, that is, the transaction cost vanishes. However, the separating equilibrium does not exist as shown in Proposition 1. Roughly speaking, our ideal society where trust is everywhere, and no wasteful cognition is spent is an impossible world. Nevertheless, we can improve our world by some market institutions in the following sections.

4 Reputation

In section 3, we have the negative result that there is no separating equilibrium, which would be the ideal outcome. However, our discussion so far has focused only on one-shot interaction, we now consider a large economy with a continuum of buyers and sellers in repeated relationships.

Assume that time is discrete and infinite. Buyers and sellers are matched randomly in each period. Assume that the state of nature (A or A') is drawn randomly in each period, and *independently* across periods. In different periods, different products are traded. Both buyers and sellers are uncertain about the state of nature in the future periods. The buyer does not know the appropriateness of the future product, and the seller does not know what product the buyer demands. For example, a buyer bought a laptop yesterday may buy a mouse (A) today or a status quo printer with high add-on costs of inks (A') tomorrow.

We assume the Poisson death process, i.e., the parties alive at a period remain in the economy in the next period with probability $\lambda \in (0, 1)$. Each party who quits at a period is offset by a new party in the period. Let δ_0 be the parties' discount factor. Thus two parties share the same *relevant* discount factor $\delta \equiv \delta_0 \lambda$. To simplify the exposition, we assume in this section that the transfer is $t = 0$. Ignoring the positive transfer only simplifies the presentation. Thus the unique equilibrium in the stage game is the pooling one. Since there is no punishment cost for type-A' seller, he mis-sells with certainty in equilibrium in the stage game.

4.1 Existence of Separating Equilibrium

We now check if a separating equilibrium in each period is possible in equilibrium dynamics.

Consider the following trigger strategies of the parties. Type-A' seller always unveils A', but the buyer pays some price $\widetilde{p} > 0$ *only* after the novel A' is reported, and the buyer does not think at all ($b = 0$). The high price $\widetilde{p}$ can be interpreted as a tip for the seller for bringing the payoff-relevant unforeseen message to the buyer. One may consider the possibility of rewarding the seller in the case where A is indeed appropriate at the post-contractual stage. But, as shown in Appendix A.7, the strategy with zero-rewarding at state A creates the highest possibility for the separating equilibrium in each period. The actions in the other nodes in the stage game are the

[19] The results in Proposition 2 are robust to the situation where we assume a deadweight loss of mis-selling.

same as in Proposition 1. However, if some party deviates from it, the new partner can detect this cheating behavior with probability x in each future period. A high x represents a transparent society in which, say, the media can broadly transmit the complaints from some parties, although the contents of those complaints are not verifiable. Detection leads to the outcome that two parties play the pooling equilibrium in this period.[20] The buyer does not pay the tip any more, and type-A' seller does not reveal A'. It is clear that if they play the reciprocal action profile in each period described as above, the transaction cost reduces to $L = 0$.

Now we check the condition under which the trigger strategy profile is sustainable.

First, we check type-A' seller's incentive for a deviation. If he deviates from revealing A', his *net* gain in the current period is $h - \widetilde{p}$. Since the buyer has no cognition, he can successfully mis-sell, but he loses the tip $\widetilde{p}$.

However, the seller has the risk of losing his individual reputation later. The net loss in the future is

$$\frac{\delta\rho}{1-\delta}\left(\widetilde{p} - (1-x)h - x\left(1-b^*\right)h\right)$$

where b^* is the equilibrium cognition level given by equation (2). In each future period, if A occurs, which happens with probability $1-\rho$, the seller gains zero payoff, irrespective of whether or not he is detected. If the state is A', which happens with probability ρ, the seller loses the tip $\widetilde{p}$ and yet gains the expected rent $(1-x)h + x\left(1-b^*\right)h$ from mis-selling. Here, the seller mis-sells with certainty in each future period by virtue of the stationarity of the game.

Hence, type-A' seller has no incentive to mis-sell if

$$h - \widetilde{p} \leq \frac{\delta\rho}{1-\delta}\left(\widetilde{p} - (1-x)h - x\left(1-b^*\right)h\right),$$

which can be written as,

$$\widetilde{p} \geq \frac{1-\delta+\delta\rho\left(1-xb^*\right)}{1-\delta+\delta\rho}h,$$

which reflects a minimal level of the tip. Thus the buyer has to commit to remunerate at least $\widetilde{p}^* = \frac{1-\delta+\delta\rho(1-xb^*)}{1-\delta+\delta\rho}h$ to type-A' seller in order to enhance his truthful report. Note that $\widetilde{p}^* < h$, that is, the minimal tip is smaller than the effect of mis-selling. Thus it may be worthwhile for the buyer to pay the tip.

Second, we check the buyer's incentive for a deviation. If she deviates from paying $\widetilde{p}^*$ for type-A' seller with a truthful report, her net gain in the current period is $\widetilde{p}^*$, where the buyer only pays price zero so as to guarantee the seller's acceptance of the contract in this period.

However, the buyer loses her reputation in expectation, and the net loss in the future is

$$\frac{\delta}{1-\delta}\left(xC(b^*) + \rho x\left(1-b^*\right)h - \rho\widetilde{p}^*\right).$$

[20]One may wonder the possibility of using no trade as the harshest punishment to enhance cooperation between the buyer and the seller in the spirit of Abreu (1986). But the optimality is not robust to the case with a small probability that the seller is uninformed as well, as discussed in section 4.3.

In each future period, if the buyer's misbehavior is detected, which occurs with probability x, two parties play the strategies of the pooling equilibrium in the stage game. The buyer therefore has to bear the cognition cost $C(b^*)$. With probability $\rho x\left(1-b^*\right)$, she is mis-sold. But she has not to pay $\widetilde{p}^*$ in the future anyway due to the stationarity of the game.

Hence, the buyer has no incentive to misbehave if

$$\widetilde{p}^* \leq \frac{\delta}{1-\delta}\left(xC(b^*)+\rho x\left(1-b^*\right)h-\rho\widetilde{p}^*\right). \tag{8}$$

Substituting for $\widetilde{p}^*$, we conclude that the buyer has no incentive to misbehave if

$$C(b^*) \geq \frac{1-\delta\left(1-\rho\left(1-x\right)\right)}{\delta x}h. \tag{9}$$

Proposition 3 *If the cognition level $C(b^*)$ in the pooling equilibrium in the stage game is high, both parties are patient (δ is high), the detection probability x is high, and the extent ρ and the effect h of the mis-selling problem are low, then separating equilibrium in each period is likely to exist.*

Since the right hand side of inequation (9) is strictly decreasing in δ and x, and converges to zero when δ and x converge to 1, the analysis yields:

Proposition 4 *There exist some cutoff values $\overline{\delta}$ and $\overline{x}<1$ such that for all $\delta \geq \overline{\delta}$ and $x \geq \overline{x}$ separating equilibrium in each period exists.*

In words, if both buyer and seller are sufficiently patient and the probability of detection is sufficiently high, there exists an equilibrium where the mis-selling problem vanishes. Since no cognition is involved, reputation minimizes the transaction cost.[21]

In this equilibrium dynamics, the buyer commits to give the seller a "tip" if and only if the seller brings the surprising news to her before contracting. The tip promotes the seller's incentive to reveal the novel product to the buyer. However, since "surprise" is not contractible, this tip-institution does not work in the one-shot interaction due to sequential rationality in the stage game. Hence, the cultural phenomena of tips in an economy is an instrument of reducing the mis-selling behaviors and pre-contractual cognition.

4.2 Persistence of Pre-Contractual Cognition

We now use the history-dependence approach initiated by Tirole (1996) to investigate the effect of a one-time shock of mis-selling on the separating equilibrium.

[21]The alternative way of modeling reputation is assuming finite time horizon and yet two types of sellers: an opportunistic one as we assume throughout the paper and a honest one who always reports the appropriate product. (See, e.g., Kreps et al., 1982) In the sequential equilibrium, the opportunistic seller may still truthfully report the product in the beginning periods in order to gain the buyer's trust in the later periods. However, the opportunistic seller must mis-sell at least in the last period. Therefore the buyer has to exert cognitive efforts in the last period. Thus the assumption of infinite time horizon is crucial for shattering the transaction cost of pre-contractual cognition. But introducing two types of sellers does not alter our results qualitatively.

Suppose, at period 0, the state is A' and the economy has a shock such that the seller mis-sells. The thought experiment is as follows. Suppose all sellers truthfully report the appropriate product from period 1 to $T\,(>0)$ in order to gain the buyer's trust at period T, and all sellers born at and before period 0 are locked into mis-selling. At period T, if the seller says A is appropriate, the probability that A is indeed appropriate before the buyer's cognition is

$$\frac{1-\rho}{1-\rho+\rho\,(1-x)\,(1-\lambda)\,(\lambda^T+\lambda^{T+1}+\lambda^{T+2}+\cdots)}$$
$$=\frac{1-\rho}{1-\rho+\rho\,(1-x)\,\lambda^T}$$

which is strictly less than one for all $T<+\infty$. Thus after period 0, the probability of mis-selling given that A is announced to be appropriate is always positive, no matter how long the sellers truthfully report the appropriate product. Since the buyer's cognition cost function C is continuous, the pre-contractual cognition cannot be completely saved, although in the limit where T converges to $+\infty$ the buyer does not exert any cognitive efforts. Whenever mis-selling occurs in some period, for any finite periods of *anti-mis-selling campaigns*, the economy cannot go back to the equilibrium outcome where no pre-contractual cognition of the buyer is exerted. However, as in Tirole (1996), the out of equilibrium *amnesty*, which destroys the evidence of this mis-selling spot, can let the economy return immediately to the separating equilibrium outcome where the transaction cost vanishes. In words, the Big-Bang reform is more effective than the gradualist one. We summarize the results in the following proposition:

Proposition 5 *The policy of anti-mis-selling campaigns cannot shatter pre-contractual cognition, but amnesty saves the pre-contractual cognition completely.*

4.3 Secret Awareness of the Seller

The analysis in the last subsection focuses on the effect of a one-time *generation-specific* shock of mis-selling. Here we consider the possibility that mis-selling may come from an infinite cost of acquiring the product-appropriateness information for some seller in some period (whereas we assumed that the seller is always informed about the product appropriateness, or equivalently the cost of acquiring the information is zero in the baseline model.)

Based on Green and Porter (1984), we assume that when A' occurs, in each period, the seller is not aware of A' with probability α. The buyer cannot observe whether or not the seller is aware of A'. Now it is not optimal for the buyer to punish the seller forever in the case of mis-selling, because mis-selling may be unavoidable in some situation, and is therefore not the seller's liability. Suppose that the seller who sells an inappropriate product in period 0 is punished from period 1 to T whenever the seller is detected in these periods.

Let V^+ (respectively, V^-) denote the present discounted value of the seller's payoff beginning from a cooperative phase (respectively, non-cooperative phase). Formally, we define them recursively:

$$V^+=(1-\alpha)\left(\rho\widetilde{p}+\delta V^+\right)+\alpha\left(\rho h+\delta V^-\right)$$

and

$$V^- = \frac{1-\delta^T}{1-\delta}\rho\theta h + \delta^T V^+$$

where $\theta \equiv (1-x) + x(1-b^*) \in (0,1)$ for notational simplicity. Starting from the cooperative phase, with probability $1-\alpha$, the seller receives the expected tip $\rho\widetilde{p}$, and two parties continue to cooperate in the next period. With probability α, the seller is uninformed, and therefore gains the expected rent ρh by chance. Then they switch to the non-cooperative phase. In the beginning T periods of the non-cooperative phase, they play the pooling equilibrium in the stage game where the seller receives the expected rent $\rho\theta h$. Thus the inefficient cognition occurs in these T periods. After these T periods, they switch to the cooperative phase.

On the seller's side, informed type-A' seller's incentive constraint for not deviating is

$$\widetilde{p} + \delta V^+ \geq h + \delta V^-$$

which can be written as,

$$\widetilde{p} \geq \widetilde{p}^*(T) \equiv \frac{1-\delta+\delta\left(1-\delta^T\right)\left(\left(\theta-\alpha\right)\rho+\alpha\right)}{1-\delta+\delta\left(1-\delta^T\right)\left(\left(1-\alpha\right)\rho+\alpha\right)}h, \tag{10}$$

which implies that

$$\frac{d\widetilde{p}^*(T)}{dT} = \frac{\rho\delta^{T+1}(1-\theta)(1-\delta)\ln\delta}{\left(1-\delta+\delta\left(1-\delta^T\right)\left(\left(1-\alpha\right)\rho+\alpha\right)\right)^2}h < 0.$$

Proposition 6 *The minimal tip $\widetilde{p}^*(T)$ that the buyer has to reward the seller for not deviating is decreasing in the length of punishing the seller T.*

Intuitively, the tip $\widetilde{p}$ as a carrot and punishment length T as a stick are substitutes for the buyer to incentivize the seller's cooperative behavior.

Since mis-selling may occur by chance, our social goal is to minimize the punishment periods T in which the cognition costs of the buyer are involved. However, reducing T raises $\widetilde{p}^*(T)$. On the buyer's side, the buyer's incentive constraint for not deviating is the same as before. Thus $\widetilde{p}^*(T)$ is bounded above by the buyer's incentive constraint (8). Inequation (8) implies $\widetilde{p}$ cannot exceed

$$\frac{\delta x\left(\rho h\left(1-b^*\right)+C\left(b^*\right)\right)}{1-\delta+\rho\delta}.$$

Plug it into equation (10), we have that in the equilibrium dynamics, the smallest punishment periods T^* has the property that $\frac{dT^*}{d\alpha} > 0$. Therefore, we obtain the following proposition:

Proposition 7 *In the equilibrium dynamics, the pre-contractual cognition is strictly increasing in α which is the probability that type-A' seller is unaware of A'.*

In words, the lack of knowledge of the seller that is unavoidable raises the transaction cost.

5 Competition

In this section, we extend the model in section 3 to a setting with two sellers (S_1 and S_2) who simultaneously report the product in stage 2. The product-appropriateness is industry-specific, thus two sellers belong to the same type. If A is appropriate, they can only report A. But if A' is appropriate, the payoff matrix of their interaction situation is described in Table 1.

S_1, S_2	A	A'
A	$(1-b^*)(\frac{h}{2}-t)+b^*(-t)$, $(1-b^*)(\frac{h}{2}-t)+b^*(-t)$	$-t$, 0
A'	0, $-t$	0, 0

Table 1: Payoff Matrix of Competition for two type-A' Sellers

In the payoff matrix, b^* is the buyer's equilibrium cognition in this competition context. If both sellers choose A', they obtain payoff zero, no matter whose product is chosen by the buyer in the end. It is due to the buyer's full bargaining power. If, say, S_1 chooses A and S_2 chooses A', the buyer is immediately aware of A'. Then the buyer sues S_1 for a transfer t. But S_2 gets zero payoff. If they both choose A, they obtain their expected payoff. We assume that two sellers have equal probability to be chosen. The gain under mis-selling is therefore $\frac{h}{2}-t$, since only one of their products can be chosen by the buyer, and the buyer can sue both sellers at the post-contractual stage.

In the case of competition, we have the following proposition.

Proposition 8 *Suppose A' occurs. If $\frac{h}{2}-t<0$ or $\rho h > C'(1-\frac{2t}{h})$, ($A'$, A') is the unique equilibrium. Otherwise, we have multiple equilibria (A', A'), (A, A) and the totally-mixed-strategy one. In the latter case, the disclosure decisions of A' are strategically complementary for two sellers.*

Proof. See Appendix A.8. ■

As one would expect, truthfully reporting (A', A') by two type-A' sellers is an equilibrium in the Nash implementation fashion (Maskin, 1999). Given that one seller unveils A', the other seller has no incentive to mis-sell due to the punishment t for mis-selling. Furthermore, if $\frac{h}{2}-t<0$, announcing A' is also a strictly dominant strategy. In this case, the equilibrium (A', A') is therefore unique. Competition reduces the rent of mis-selling for the seller, and yet does not alter his cost of the transfer. Thus no seller has an incentive to mis-sell.[22] Therefore, when competition is present, there exists separating equilibrium in the sense that both types of sellers truthfully report the appropriate product. It reduces the transaction cost to zero.

Nevertheless, competition is by no means a panacea. When $\frac{h}{2}-t\geq 0$ and $\rho h \leq C'(1-\frac{2t}{h})$, there are multiple equilibria. In essence, two type-A' sellers' disclosure

[22]It implies here that the number of sellers and the transfer t are substitutes. Hence, introducing a sufficient number of sellers can always achieve the unique equilibrium (A', A') even though t is bounded above. However, in reality, only a limited number of sellers enter the market due to some entry barrier. Thus, without loss of generality, we assume there are only two such sellers.

decisions of A' are strategically complementary. That is, they reveal their private information hand in hand here.[23]

To sum up, competition *may* induce separating equilibrium, which minimizes the transaction cost. This result is by contrast to Tirole (2009). In the context of asymmetric information and the transfer cost for type-A' seller, competition between sellers plays a role of reducing the transaction cost.

6 Concluding Remarks

6.1 Policy Recommendations

Atkinson et el. (2000) suggest ex ante solutions to the mis-selling problem mainly via promoting public awareness, say providing independent advice to consumers, and educating consumers through mass media, schools and so on. Korobkin (2003) also recommends ex ante intervention by legislatures. However, the ex ante mechanism of mandatory information disclosure is valid only if the regulator knows the product-appropriateness in each industry.[24]

When the regulator also lacks the knowledge of product-appropriateness, some scholars suggest the ex post judicial mechanism, say by using the Unconscionability doctrine to interpret contracts, which refuses to enforce the contracts with unconscionable terms.[25] However, this doctrine as applied by common law courts is not defined by status, and thus is too vague. By contrast, we suggest a mechanism in Appendix A.4, which may reduce the transaction cost. But, this judicial mechanism is still imperfect in our model.

In contrast, our analysis shows that, without an omniscient legislator and a perfect judicial system, we can still achieve the ideal separating equilibrium in which the transaction cost vanishes via the market institution, namely reputation or competition.

First, in order to assure the separating equilibrium by the reputation mechanism, we require that both buyer and seller are sufficiently patient and the probability of detecting the past cheating behavior is sufficiently high, that is, x and δ are high enough. A high δ can be realized through some effort to reduce the mortality rate $1-\lambda$. A high x can be achieved through freedom of press, which means journalists have the opportunity to move frictionless and report scandals without any interference. In the case where the seller is well-informed about the product-appropriateness is commonly known, if the out of equilibrium shock of mis-selling occurs, amnesty can let the economy go back to the outcome where the pre-contractual cognition is completely saved. Lastly, we should promote the specialization of the sellers in any industry to

[23]Notice that we can design the competition mechanism differently to let equilibrium (A', A') more likely to be unique. If, say, S_1 announces A and S_2 announces A', we transfer the punishment t for S_1 to S_2, then a weaker condition $\frac{h}{4} - t < 0$ guarantees the equilibrium uniqueness.

[24]One may consider the possibility of using catch-all clauses in the law. For example, the legislator can require that the seller should disclose all the add-ons without the need of describing the names of the particular add-ons. However, catch-all clauses are always vague, and therefore not likely to be perfectly enforced.

[25]See Korobkin (2003), and Becher (2008).

increase the probability of the seller's awareness α in order to reduce the transaction cost if the seller may be unaware as well.

Second, in order to promote information disclosure of the buyer-unforeseen features of the product voluntarily by the sellers, we should reduce the entry barrier in the industry so as to induce competition among sellers.

It is worth noting that in the separating equilibrium neither mis-selling nor litigation occurs. Thus, even in a world where the transaction cost from direct mis-selling and litigation are non-negligible, these two market institutions still achieve the first best outcome.

6.2 Applications

The analytic framework can be applied to numerous problems.

In financial market, investors may be uncertain whether or not the firm has false statements, but they can employ some accountant to audit the firm. Audit here can be interpreted as cognition. By contrast to the conventional audit literature, if the accountant finds that the firm is cheating, it must provide hard evidences. Otherwise, the investors remain uncertain, since finding nothing provides only soft information. In addition, the firm can also provide hard evidences of its own flaw. It would be interesting to study the strategic statements of the firm.

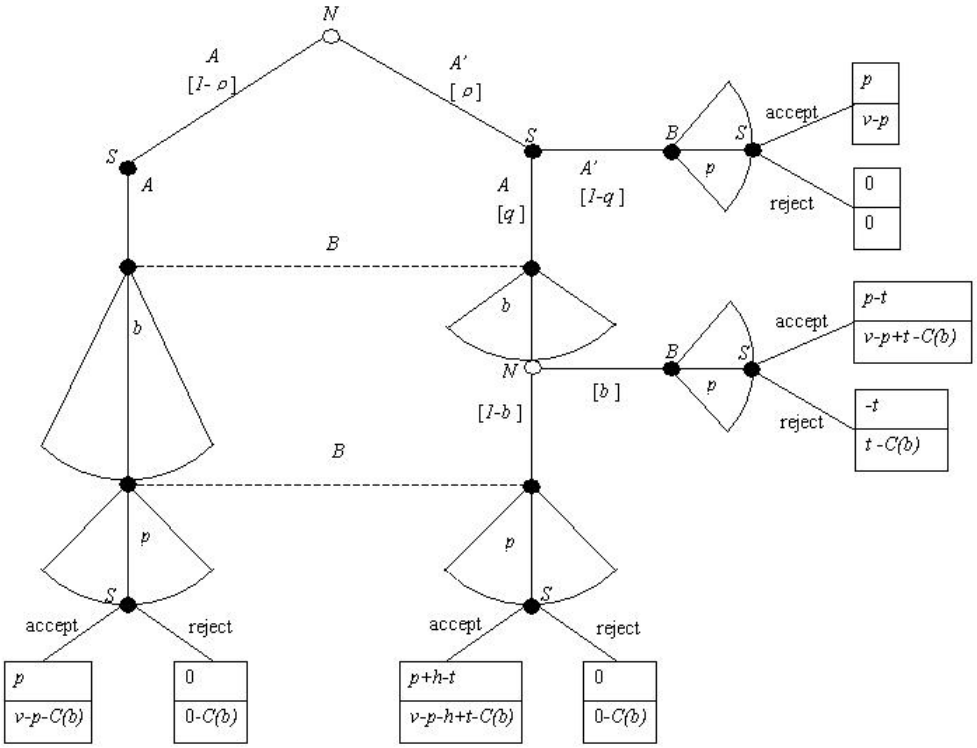
Particularly, consider the recent subprime crisis, when bank 1 decides whether to buy a complex structured product, say a CDO (collateralized debt obligation) or CDO^2, from bank 2, band 1 does not know whether the money eventually goes to the subprime borrowers or not. After exerting costly investigation, bank 1 may find out that the product involves the subprimes or find nothing.

In politics, there is also asymmetric information on the appropriateness of platforms between the politicians and voters. It would be also interesting to study the strategic disclosure of flaws in competitors' platforms in political competition, given that the voters can make efforts to contemplate on the platforms.

Hence, our model of strategic mis-selling is merely a starting point. These further issues give us a rich outline for the future research in asymmetric awareness and pre-contractual cognition in social problems.

A Appendix

A.1 Game Tree



A.2 An Infinite-Horizon Bargaining Game where the Buyer makes All the Offers

Instead of assuming the take-it-or-leave-it offer of the buyer in the contracting stage, we consider here a general bargaining protocol where the buyer makes all the offers in an infinite-horizon bargaining game, which is based on Deneckere and Liang (2006). The buyer here can use delay as a screening device to separate the sellers' types.

The buyer's final equilibrium offer must be $p_0 = 0$ where the subscript 0 denotes the last period. It is because any lower offer would not be accepted by type-A seller, whereas any higher offer would be accepted, and therefore dominated. We suppose now there are $n(\geq 0)$ periods that remain before the last period with $p_0 = 0$ in equilibrium. In order to minimize information rent for type-A' seller, type-A' seller should be indifferent between accepting the current offer p_n and waiting n more periods to receive p_0, i.e.,

$$h - t + p_n = \delta^n (h - t + p_0)$$

where δ is the discount factor. Hence, the buyer optimally chooses $p_n = (\delta^n - 1)(h - t)$

in the current period. The buyer's expected payoff is therefore

$$\begin{aligned}&(1-\widehat{\rho})\delta^n(v-p_0)+\widehat{\rho}(v-h+t-p_n)-C(b)\\&=(1-\widehat{\rho})\delta^n v+\widehat{\rho}[v-\delta^n(h-t)]-C(b).\end{aligned}$$

It is left to determine the optimal periods of delay n. Assumption 1 implies

$$(1-\rho)v>\rho(h-t)$$

that also implies

$$(1-\widehat{\rho})v>\widehat{\rho}(h-t),$$

or equivalently

$$(1-\delta^n)(1-\widehat{\rho})v>(1-\delta^n)\widehat{\rho}(h-t)\ \text{ for all } n>0,$$

or, after some manipulations,

$$(1-\widehat{\rho})v+\widehat{\rho}(v-(h-t))-C(b)>(1-\widehat{\rho})\delta^n v+\widehat{\rho}[v-\delta^n(h-t)]-C(b)\text{ for all } n>0.$$

Hence $n=0$ is optimal for the buyer. That is, the buyer optimally chooses $p_0=0$ in the first period, which leads to pooling equilibrium.

Note that since we have implicitly assumed perfect commitment of strategies ex ante, we have ignored the renegotiation problem after the buyer observes one period of delay. Nevertheless, the pooling equilibrium is per se renegotiation-proof. Hence, the result $p_0=0$ in the first period is also robust to the possibility of renegotiation.

A.3 Multiple Buyers in the Pooling Equilibrium

We assume two buyers (B_1 and B_2) here. In order to illustrate the idea, we discuss only the pooling equilibrium.

Given buyer 2's cognition level b_2, buyer 1 chooses b_1 to maximize

$$(1-\rho)v+\rho(b_1b_2+b_1(1-b_2)+(1-b_1)b_2)\left(v+\frac{t}{2}\right)+\rho(1-b_1)(1-b_2)\left(v-h+\frac{t}{2}\right)-C(b_1).$$

Here t is maximal transfer from the seller. When mis-selling is detected, each buyer shares half of the transfer.

Given the symmetric problem of buyer 2, the equilibrium cognitions of two buyers are $b_1=b_2=b^*$ such that

$$(1-b^*)\rho h=C'(b^*).$$

Thus the equilibrium cognition in the pooling equilibrium is lower compared to the single-buyer case, as each buyer can free ride the other buyer's cognition. However, because there are two buyers here, it is still ambiguous whether the total transaction cost is lower or not.

Note that the analysis above assumes away the possibility of collusion between one buyer and the seller. (Tirole, 1986) When one buyer finds mis-selling and the other does not, the informed buyer can be silent on the information of mis-selling and ask the seller for a secrete transfer up to t. Thus unique informed buyer has to be rewarded by the total transfer in the collusion-proof equilibrium.

Thus buyer 1 chooses b_1 to maximize

$$(1-\rho)v+\rho b_1 b_2\left(v+\frac{t}{2}\right)+\rho b_1\left(1-b_2\right)(v+t)+\rho\left(1-b_1\right)b_2 v+\rho\left(1-b_1\right)\left(1-b_2\right)\left(v-h+\frac{t}{2}\right)-C(b_1).$$

The equilibrium cognitions of two buyers are $b_1 = b_2 = b^{**}$ such that

$$(1-b^{**})\rho h+\frac{\rho t}{2}=C'(b^{**}).$$

Each buyer is therefore incentivized to choose a higher cognition b^{**} compared to the one in the collusion-free case.

Note that it is ambiguous whether each buyer's cognition in the collusion-proof equilibrium is higher or lower than that in the pooling equilibrium in the single-buyer case. The buyer is more likely to choose a higher cognition in the two-buyer case if the problem of collusion dominates the free riding problem, i.e., t is relatively high.

A similar discussion on the free riding and collusion problems of patent challenges with multiple buyers is in Chiou (2007).

A.4 A Litigation Process to Punish type-A' seller and Reward the Buyer

Assume the goal of the benevolent court of law is to transfer t units of money from the seller to the buyer if and only if A' is appropriate and the seller mis-sells. Note that both parties' preferences over the transfer decision are state-independent, i.e., the seller always prefers no transfer, and the buyer always prefers a transfer. Hence, the standard implementation approach cannot provide unique equilibrium that implements the court's goal. However, in contrast to the standard implementation problem, we assume here that type-A' seller can provide hard evidences of his mis-selling, where as type-A seller and the buyer can only make the cheap talk. The litigation process is based on a mechanism by Ben-Porath and Lipman (2008).

The mechanism is as follows. The seller chooses between providing the evidence of A' or nothing. If A' is provided, the game ends, and the transfer is realized. If nothing is provided, which is interpreted as the seller's claim of A, the buyer then chooses between saying A and not A. The former is interpreted as the buyer's agreement with the seller, whereas the later is interpreted as her challenge to him. If the buyer says not A, the game ends, and the transfer is realized. But the buyer is punished by $f_1(>t)$, and the seller is punished by $\varepsilon(>0)$. If the buyer says A, then the seller has another chance to provide the evidence. If the evidence A' is provided, the transfer is realized. Now the buyer is punished by $f_2(>f_1)$, and the seller is rewarded by $r_2(>t)$. If nothing is provided again, the game ends without any transfer of money.

We now prove that this mechanism implements the court's goal.

Suppose A occurs. The seller can provide nothing in each stage. If the buyer says A, she receives 0. If not, the buyer receives $t-f_1$. Thus the buyer will not challenge, and the transfer is not made.

Suppose A' occurs. In the last stage, the seller receives r_2-t for providing the evidence and 0 otherwise. Thus the seller will provide the evidence. Taking it into account, the buyer knows that she receives $t-f_2$ for saying A and $t-f_1$ otherwise.

Thus the buyer will challenge the seller's mis-report. Lastly, in the first stage, the seller will provide the hard evidence A', since $\varepsilon > 0$.

Hence, in either A or A', there is a *unique* subgame perfect equilibrium where the court's goal is implemented.

It is worth mentioning that most buyers cannot be punished arbitrarily off the equilibrium path, due to limited liabilities of the parties. Since the mechanism requires that $f_2 > f_1 > t$, the court cannot raise t arbitrarily to deter mis-selling here.

Although the mechanism is only one possible litigation process, along the lines of Ben-Porath and Lipman (2008), we can further show that there is no perfect information mechanism[26] with punishment bounded below $\frac{t}{2}$ that implements the court's goal. Suppose by contradiction there is one. Suppose A occurs. Let (σ_B^*, σ_S^*) be a subgame perfect equilibrium. Then, for all σ_B, when (σ_B, σ_S^*) is played, the probability that the transfer is realized is strictly less than $1/2$. To see it, suppose not. For some σ_B', when (σ_B', σ_S^*) is played, the probability that the transfer is realized is greater or equal than $1/2$. Then the buyer has an incentive to deviate to σ_B', because her expected payoff is strictly positive, since the punishment is strictly less than $\frac{t}{2}$. So (σ_B^*, σ_S^*) is not an equilibrium, a contradiction. Thus, by playing σ_S^*, the seller receives an expected payoff strictly greater than $-t$, since the probability of being punished is less than $1/2$, and the punishment is strictly less than $\frac{t}{2}$. Now suppose A' occurs. The strategy sets of the buyer and the seller are the same as in A. Then the seller can σ_S^* to guarantee an expected payoff strictly greater than $-t$. Hence, the transfer cannot be realized in A', a contradiction.

A.5 The Case where Assumption 1 fails

When Assumption 1 fails, the buyer contemplates three alternatives.

First, the buyer exerts b^*, and contracts with both types of sellers. The result is described in Proposition 1.

Second, the buyer exerts b', and contracts with only type-A' seller. Under this plan, the buyer proposes $p = h - t$, and therefore solves the following problem upon observing A:

$$\max_b \frac{(1-\rho)\,0 + \rho q b\,(v+t) + \rho q(1-b)v}{1-\rho+\rho q} - C(b).$$

Compared to the first plan, the buyer loses utility v form contracting with type-A seller, but gains additional utility $h - t$ from type-A' seller in the case where mis-selling is not detected. Since the price $h - t$ is so low that it is common knowledge that the trade occurs only if A' happens, there is no transfer ex post in the latter case.

The optimal cognition is b' is characterized by

$$C'(b') = \frac{\rho q t}{1-\rho+\rho q}. \tag{11}$$

Suppose the second plan is strictly better than the first one for the buyer, which is possible only for a positive q. Equation (11) implies b' is also positive. However,

[26] A perfect information mechanism is a sequential-move game where the past actions are perfectly observed. Here the actions are providing hard evidences or cheap talks.

because type-A' seller's expected net payoff from mis-selling is

$$(1-b')0+b'(-t)<0$$

for any $b'>0$, type-A' seller's optimal q is zero, a contradiction.

Hence, there is no equilibrium in which the buyer strictly prefers the second plan.

Third, the buyer may exert some cognition effort, and contracts with no sellers. Under this plan, the buyer proposes any price $p>h-t$, and therefore solves the following problem upon observing A:

$$\max_b \frac{(1-\rho)\,0+\rho q b\,(v+t)+\rho q(1-b)0}{1-\rho+\rho q}-C(b).$$

Along similar lines of the arguments in the second plan, there is no equilibrium in which the buyer strictly prefers the third plan.

A.6 Proof of Proposition 2

When $\rho h \le C'(1-\frac{t}{h})$, there is a pooling equilibrium, so $q=1$. The transaction cost is therefore $L=C(b)$. By (2), we have that

$$\frac{dL}{d\rho}>0,\ \frac{dL}{dh}>0,\ \text{and}\ \frac{dL}{dt}=0.$$

When $\rho h > C'(1-\frac{t}{h})$, there is a semi-separating equilibrium.

First, we show $\frac{dL}{d\rho}<0$.

To see this, by equation (6), we have $\frac{dC(b)}{d\rho}=0$. Thus

$$\frac{dL}{d\rho}=C(b)\frac{d\,(1-\rho(1-q))}{d\rho}.$$

Equation (7) implies

$$\frac{d\rho q}{d\rho}=\frac{d\left(\frac{(1-\rho)C'(1-\frac{t}{h})}{h-C'(1-\frac{t}{h})}\right)}{d\rho}=-\frac{C'(1-\frac{t}{h})}{h-C'(1-\frac{t}{h})}.$$

Since $h-C'(1-\frac{t}{h})>0$ (otherwise, $q<0$ by equation (7)), we have $\frac{d\rho q}{d\rho}<0$. Furthermore, we have

$$\frac{d\,(1-\rho(1-q))}{d\rho}=-1+\frac{d\rho q}{d\rho}<0.$$

We therefore obtain $\frac{dL}{d\rho}<0$.

Second, we judge the sign of $\frac{dL}{dh}$.

By definition,

$$\frac{dL}{dh}=(1-\rho(1-q))C'(b)\frac{db}{dh}+C(b)\frac{d\,(1-\rho(1-q))}{dh}.$$

Equation (6) and (7) imply

$$\frac{dL}{dh} = (1-\rho(1-q^*))\,C'(b^*)\frac{t}{h^2} + C(b^*)(1-\rho)\frac{tC''(b^*)-hC'(b^*)}{h\left(h-C'(b^*)\right)^2}$$
$$= \frac{1-\rho}{h\left(C'(b^*)-h\right)^2}\left[tC'(b^*)\left(h-C'(b^*)\right)+C(b^*)\left(tC''(b^*)-hC'(b^*)\right)\right]$$

of which the sign is ambiguous. If $tC''(b^*)$ is sufficiently low compared to $hC'(b^*)$, we have $\frac{dL}{dh}<0$, although we have $h-C'(b^*)>0$ here. Otherwise, we have $\frac{dL}{dh}>0$.

Lastly, we show $\frac{dL}{dt}<0$.

To show this, we first have

$$\frac{dL}{dt} = (1-\rho(1-q))C'(b)\frac{db}{dt} + C(b)\frac{d\left(1-\rho(1-q)\right)}{dt}.$$

By equation (6) and (7), we have

$$\frac{dL}{dt} = -\frac{(1-\rho(1-q^*))C'(b^*)}{h} - \frac{C(b^*)(1-\rho)C''(b^*)}{h\left(h-C'(b^*)\right)^2} < 0.$$

A.7 Proof of zero-rewarding at state A at the post-contractual stage in Section 4

We now introduce the possibility that a tip is also given to type-A seller.

Consider the following strategy profile in the stage game.

Type-A' seller always unveils A', but the buyer pays some price $\widetilde{p}'>0$ for A' after A' is reported and pays some price $\widetilde{p}>0$ for A if A is de facto appropriate at the post contractual stage, and the buyer does not think at all ($b=0$). The actions in the other nodes in the stage game are the same as in Proposition 1.

Detection of deviation in the past leads to the outcome that two parties play the pooling equilibrium in this period.

First, we check type-A' seller's incentive for a deviation. If he deviates from revealing A', his *net* gain in the current period is $h-\widetilde{p}'$.

However, the seller' loss in the future is

$$\frac{\delta}{1-\delta}\left(\rho\left(\widetilde{p}'-(1-x)h-x\left(1-b^*\right)h\right)+(1-\rho)\,x\widetilde{p}\right).$$

where b^* is given by equation (2). In each period, if A occurs, which happens with probability $1-\rho$, the seller loses utility $\widetilde{p}$ given that he is detected. If the state is A', which happens with probability ρ, the seller loses the tip $\widetilde{p}'$ and yet gains the expected rent $(1-x)h+x\left(1-b^*\right)h$ from mis-selling.

Hence, type-A' seller has no incentive to mis-sell if

$$\widetilde{p}' \geq \frac{\left(1-\delta+\delta\rho\left(1-xb^*\right)\right)h-\widetilde{p}x\delta\left(1-\rho\right)}{1-\delta+\rho\delta}.$$

Thus the buyer has to commit to remunerate at least $\widetilde{p}'(\widetilde{p}) \equiv \frac{(1-\delta+\delta\rho(1-xb^*))h-\widetilde{p}x\delta(1-\rho)}{1-\delta+\rho\delta}$ to type-A' seller in order to enhance his truthful report. Note that $\widetilde{p}'$ and $\widetilde{p}$ are *substitutes* for the seller's truthful report.

Second, we check the buyer's incentive for a deviation.

Suppose A' occurs. If she deviates from paying $\widetilde{p}'(\widetilde{p})$ for type-A' seller with a truthful report, her net gain in the current period is $\widetilde{p}'(\widetilde{p})$, where the buyer only pays price zero so as to guarantee the seller's acceptance of the contract.

However, the buyer loses her reputation in expectation and the loss in the future is

$$\frac{\delta}{1-\delta}\left(xC(b^*)+\rho x\left(1-b^*\right)h-\rho\widetilde{p}'(\widetilde{p})-(1-\rho)\,\widetilde{p}\right).$$

In each future period, if the buyer's misbehavior is detected, which occurs with probability x, the buyer has to bear the cognition cost $C(b^*)$. With probability $\rho x\left(1-b^*\right)$, she is mis-sold. But she has not to pay $\widetilde{p}'(\widetilde{p})$ with probability ρ and $\widetilde{p}$ with probability $1-\rho$.

Hence, substituting for $\widetilde{p}'(\widetilde{p})$ and after some manipulation, the buyer has no incentive to misbehave if

$$\widetilde{p}\leq\frac{\delta xC(b^*)-\left(1-\delta\left(1-\rho\left(1-x\right)\right)\right)h}{\delta\left(1-x\right)\left(1-\rho\right)} \tag{12}$$

Thus a smaller $\widetilde{p}$ enhances the buyer's incentive for giving a tip to the seller for his truthful report at state A'.

Suppose A occurs. If she deviates from paying $\widetilde{p}$ for type-A seller at the post-contractual stage, her net gain in the current period is $\widetilde{p}$.

The buyer's loss in the future is also

$$\frac{\delta}{1-\delta}\left(xC(b^*)+\rho x\left(1-b^*\right)h-\rho\widetilde{p}'(\widetilde{p})-(1-\rho)\,\widetilde{p}\right).$$

Similarly, the buyer has no incentive to misbehave if

$$\widetilde{p}\leq\frac{\delta\left((1-\delta+\rho\delta)xC(b^*)+\rho h\left(x+\delta-bx-x\delta-\rho\delta+bx\delta+x\rho\delta-1\right)\right)}{1-\delta+\delta^2\rho\left(1-x\right)\left(1-\rho\right)} \tag{13}$$

Hence, by inequation (12) and (13), we find that $\widetilde{p}=0$ makes separating equilibrium in each period most likely to occur.

Furthermore, when $\widetilde{p}=0$, condition (12), which turns to be equivalent to condition (9), implies condition (13).

To show it, condition (13) is equivalent to

$$(1-\delta+\rho\delta)xC(b^*)+\rho h\left(x+\delta-bx-x\delta-\rho\delta+bx\delta+x\rho\delta-1\right)>0,$$

that is,

$$C(b^*)>\frac{\rho h\left(bx-\delta-x+x\delta+\rho\delta-bx\delta-x\rho\delta+1\right)}{(1-\delta+\rho\delta)x}.$$

Therefore, by condition (9), it is equivalent to show

$$D\equiv\frac{\left(1-\delta\left(1-\rho\left(1-x\right)\right)\right)h}{\delta x}-\frac{\rho h\left(bx-\delta-x+x\delta+\rho\delta-bx\delta-x\rho\delta+1\right)}{(1-\delta+\rho\delta)x}>0,$$

which always holds, since

$$D=\frac{\left(1-\delta\right)\left(1-\delta+\rho\delta\left(1-bx\right)\right)h}{\delta x\left(1-\delta+\rho\delta\right)}>0.$$

A.8 Proof of Proposition 8

Obviously, (A', A') is an equilibrium, since $t > 0$.

If $\frac{h}{2} - t < 0$, announcing A' is also a strictly dominant strategy. Thus (A', A') is the unique equilibrium.

If $\frac{h}{2} - t \geq 0$, by a similar reasoning in section 3, there are two cases.

The first case is $\rho h \leq C'(1 - \frac{2t}{h})$.

In this case, (A, A) is also an equilibrium, because in this case we have

$$(1 - b^*)(\frac{h}{2} - t) + b^*(-t) \geq 0. \tag{14}$$

where b^* is given by equation (2). For the buyer, after she chooses one the sellers while facing (A, A), the game is the same as that in section 3, except that t in the buyer's payoff is doubled, because she may ex post sue both type-A' sellers. However, this does not change the equilibrium cognition b^*, as b^* is independent of t.

We now look for a mixed-strategy equilibrium. Let q_i be the probability that seller S_i chooses A for $i = 1, 2$. Since b is determined by q_1 and q_2, in any equilibrium, we have

$$C'(b) = \frac{\rho q_1 q_2 h}{1 - \rho + \rho q_1 q_2}. \tag{15}$$

Note that if $q_1 = 0$, then S_2 chooses A' with certainty since $t > 0$, which leads to equilibrium (A', A'). If $q_1 = 1$, then S_2 chooses A with certainty by inequation (14), which leads to equilibrium (A, A). Thus we look for the totally-mixed-strategy equilibrium. Hence, two sellers must be both indifferent between A and A'. The following two conditions therefore hold.

$$q_1 \left[(1 - b)(\frac{h}{2} - t) + b(-t)\right] - (1 - q_1)\, t = 0. \tag{16}$$

$$q_2 \left[(1 - b)(\frac{h}{2} - t) + b(-t)\right] - (1 - q_2)\, t = 0. \tag{17}$$

So the mixed-strategy equilibrium is characterized by equation (15)-(17).

Obviously, in equilibrium, we have $q_1 = q_2$. Otherwise, equation (16)-(17) cannot hold. Hence, the disclosure decisions of A' are strategically complementary for two type-A' sellers in this case.

Furthermore, the totally-mixed-strategy equilibrium exists, because of inequation (14) and $t > 0$.

The second case to consider is $\rho h > C'(1 - \frac{2t}{h})$.

Then (A, A) is not an equilibrium because in this case we have

$$(1 - b^*)(\frac{h}{2} - t) + b^*(-t) < 0.$$

Furthermore, the totally-mixed-strategy equilibrium does not exist as well, since inequation (14) fails and yet $t > 0$.

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