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Abstract

This paper studies a selling mechanism where the seller first charges a fee for advice (information structure) then sells a product. When the buyer has no private information, the seller can extract full surplus, both when the seller has private information and when he doesn't. If only the buyer has private information, the seller cannot extract full surplus. When both the seller and the buyer have private information, selling advice can strictly increase the probability of trade, and it is welfare-improving for both parties. In the private-value setting, Myerson-Satterthwaite no-trade theorem can be overcome by this mechanism. If the seller's valuation doesn't depend on the buyer type, then commitment power doesn't change results, but with interdependent values, the limited-commitment solution cannot replicate the full-commitment solution.

Keywords: information design, dynamic informed-principal problem, interdependent values, limited commitment, Myerson-Satterthwaite.

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1 Introduction

Many financial institutions offer advisory services. Sometimes, clients only pay for advice, but typically these institutions also offer financial products that they recommend at the end of an advisory service. The client's willingness to pay for a financial product or whether he is going to purchase any financial product in the first place depends on the advice he gets. This paper studies how to price when a seller charges for complementary goods sequentially, and particularly, what happens if the first product is information about the value of the second product.

In the benchmark, I model this problem as designing a selling mechanism where the seller commits to the information structure in the first period and the pricing strategy in the second period. The buyer doesn't have to commit to both periods. The buyer can choose whether to participate in the first period then chooses an information structure; after observing the signal, the buyer decides whether to purchase in the second period. The buyer can also choose only to participate in the second period without purchasing an information structure. Then I consider the limited commitment case in section 3.2.

Apart from prices the seller charges, ex-post payoffs of the seller and the buyer depend on the payoff-relevant state (state of the world) and whether trade happens in the second period. I allow both the seller and the buyer to have private information, and this allows for interdependent values. For example, the payoff-relevant state could be the pair of (seller type, buyer type); the seller's private information is his type, and the buyer's private information is his type. This includes private values as in Myerson-Satterthwaite no-trade theorem. Alternatively, both the seller and the buyer can have informative signals about the payoff-relevant state which is the buyer's valuation of the product. This maps into the informed-principal problem, and the typical assumption in any monopoly setting is that the seller's payoff doesn't depend on the payoff-relevant state.

Allowing for interdependent values and informed-principal problem leads to many real-world applications. As mentioned already, financial advisory services or private banking industry offer advices as a core part of their business. Many skincare brands offer some type of analysis or advice, and sometimes these are for a fixed fee, but sometimes the advice is offered for free; however, the advice consists of which products would be helpful for the client's problem which implies that the advice is most likely only relevant for their own products. There are also educational advisory services in many different countries including the US which help students prepare for college entrance exams or college applications. In this case, one could think of the seller offering consultation then preparation for college. Whenever the buyer or the client has to first get an estimate for the service, the seller offers the information for a fee then the product or the service if the buyer decides to purchase. The information disclosure literature has focused on the case where this information is offered for free, and there is a significant difference if the seller can charge for information and the buyer can choose which period to participate in the mechanism if he is going to participate at all.

When the seller provides an information structure, the seller first charges a price, then a signal is realized. The probability of each signal is known when the buyer decides whether to purchase the information structure. In the main part of the paper, I assume the seller doesn't observe the signal realization, but I also discuss what happens if the seller observes the signal realization or the seller sells a particular signal instead of an information structure. An information structure can depend both on the seller's type and the payoff-relevant state. If the seller has no private information and the information structure is a mapping from the set of payoff-relevant states to the set of signals, this allows for experiments as in the Bayesian persuasion literature.

By offering an information structure, the buyer in most cases won't have complete information even after purchasing the information structure. However, by allowing information structures to be conditional both on the seller's type and the payoff-relevant state, the seller can sell a signal informative about his own private information and also informative about the payoff-relevant state that he doesn't know himself.

Since the seller can have private information and sells both an information structure and a product, there are a few branches of literature this paper can be related to in principle; however, there are very few papers on these. The related literature includes (i) dynamic informed-principal problem, (ii) informed-principal selling information, (iii) selling both the information and the product, or more generally, (iv) selling complementary products. It is also related to (v) mechanism with limited commitment. Complementarity between the information structure and the product is related to common agency, but in my model, the single seller sells both. In terms of a single seller selling complementary products, this generally involves multi-dimensional screening, and there are very few papers both in the simultaneous pricing case and the sequential pricing case.[1] I will first describe the results then list the few existing related papers.

The most important, or the most interesting, case is when both the seller and the buyer have private information. I show that if the seller is allowed to sell an information structure and can commit to both the information structure and the pricing strategy in the beginning of the first period, then the seller can strictly increase the probability of trade by providing information in the first period. My result holds with interdependent values, but an important benchmark is the private values as in Myerson-Satterthwaite no-trade theorem; selling information leads to a strictly positive ex-ante probability of trade, and the no-trade theorem can be overcome. Suppose the buyer doesn't have complete information about his own valuation. Essentially, any information structure the seller can provide in the first period makes the buyer's posterior a martingale of his prior. The set of buyer's posteriors can be partitioned into two, one in which the buyer purchases the product in the second period and the other in which the buyer doesn't purchase in the second period. Any information structure that increases the probability of buyer's posterior being in the first partition is welfare improving, since the seller can then choose appropriate prices. In Myerson-Satterthwaite (1983), both the seller and the buyer commit to trade once they participate in the mechanism and the reported valuations are for trade; in my case, the buyer can choose to participate after observing the price offered by the seller, but one could model the second period of my mechanism in the exactly same way as in Myerson-Satterthwaite, and this highlights that the result is driven by selling information in the first period. In the complete information case, the seller can also provide whether his valuation is below or above the cutoff.

When neither the seller nor the buyer has private information and the seller can offer an experiment on the payoff-relevant state, it is well-known in the information-disclosure literature that the seller can extract full surplus by charging the expected surplus in the first period. I show that this intuition is robust to informed-principal problem if the buyer has no private information. Whether the seller has private information or not doesn't matter if the buyer has no private information. The seller can extract full surplus anyway, so different types of seller have no incentives to deviate.

[1]Daskalakis et al (2017) has additively separable utility.

However, if the buyer is the only one with private information, then the seller can no longer extract full surplus. This follows straightforwardly from the standard adverse selection problem in the second period. The seller cannot extract full surplus in the second period except in the degenerate case of selling only to the highest type, and the seller has to extract the surplus in the first period by charging for information structures. But the buyer already has private information in the first period, and under the usual regularity conditions, the seller cannot extract full surplus and let every type report truthfully (choose the information structure for their own type).

Many assumptions can be relaxed. Particularly, in the benchmark case where the seller doesn't value the good himself, the commitment power of the seller doesn't change results, and whether the seller observes the signal realization or sells a single signal also doesn't change results. However, if the seller's utility from keeping the good himself depends on the buyer type, then whether the seller can commit to both the menu of information structures and the pricing strategy in the beginning of first period or not matters. The limited-commitment solution cannot replicate the full-commitment solution. However, whether the seller observes the signal realization or sells a single signal doesn't make a big difference in this case either. Comparing the two cases, one in which the seller's valuation doesn't depend on the buyer type and the other in which the seller's valuation depends on the buyer type, shows that in this class of models where the seller first sells information then sells a product, commitment power interacts with interdependent values, but it doesn't interact with informed-principal problems. In the usual setting as in the information disclosure literature, commitment power doesn't matter.

[detailed literature review]

When the buyer has no private information, my results show that the seller can extract full surplus by selling information in the first period. Full-surplus extraction by itself doesn't affect total welfare if we take both the buyer and the seller together. The case when only the buyer has private information can be taken in the similar light. The most significant welfare implication or policy implication is when both the buyer and the seller have private information. The price that the buyer pays to the seller is just the transfer between the two parties, and strictly increasing the probability of trade, when there is ex-ante gains from trade, is always welfare-improving. Selling information or advice could be a commitment device for communication where cheap talk or non-verifiable information is not sufficient. However, for consumer protection, if one were to take the perspective that buyers could potentially be exploited, then selling an information structure should be conditional on the buyer having private information himself.

The rest of the paper is organized as follows. Section 2 describes the model, and results are in section 3 including extensions in section 3.2. Section 4 concludes.

2 Model

There are one seller and one buyer. The seller has a product, and both the seller's type, θ_s, and the buyer's type, θ_b, are private information. The payoff-relevant state is ω. The seller and the buyer first learn their types then the seller offers a mechanism; the mechanism charges for an information structure in the first period and for a product in the second period. In the second period, the seller can offer a price-quantity schedule or a price-quality schedule. In the benchmark, the seller commits to both periods, but the buyer can choose whether to participate in each period. The commitment assumption is relaxed in section 3.2. Both the seller and the buyer have quasilinear utilities. Let p_1, p_2 be prices in the first and the second period, respectively. If the buyer doesn't participate in period t, denote $p_t = 0$. The seller's payoff is $u_s(\omega) + p_1$ if he doesn't sell the product in the second period, and $p_1 + p_2$ if he sells the product. The buyer's payoff is $u_b(\omega) - p_1 - p_2$ if he buys the product and $-p_1$ if he doesn't buy the product.

This setup allows for different types of private information. If the payoff-relevant state is the pair of (seller type, buyer type), we have $\omega = (\theta_s, \theta_b)$. A special case is $u_s(\omega) = \theta_s,\ u_b(\omega) = \theta_b$; the seller and the buyer know their own valuations of the product, and this maps into Myerson-Satterthwaite (1983). Alternatively, we can have $u_s(\omega) = 0$ as in the usual seller-buyer setting, and both the seller and the buyer have informative signals about the buyer's valuation of the good which is the payoff-relevant state ω. This setup is related to information disclosure literature as in Bergemann-Pesendorfer (2007), Eso-Szentes (2007) and Li-Shi (2017). Or both $u_s(\omega)$ and $u_b(\omega)$ depend on the payoff-relevant state, and this allows for interdependent values. It is without loss of generality to define the utility function as a function of signals, but once the buyer acquires information, we need to make more assumptions to define how it changes the expected utility of buyer from purchasing the good in the second period.

$\theta_s \in \Theta_s$, $\theta_b \in \Theta_b$, $\omega \in \Omega$ and $\Theta_s, \Theta_b, \Omega$ are metric spaces. The common prior on the joint distribution at the beginning of the game is π. Since θ_s, θ_b are not necessarily real numbers, I don't make any assumptions on u_s, u_b for now. The type of information structure the seller can offer in the first period is a signal structure $s : \Theta_s \times \Omega \to \Delta(S)$ where S is a metric space and $\Delta(S)$ is the set of distributions on S. Since the seller learns his type before offering a mechanism, the seller can charge different prices conditional on his type. When Θ_b is not a singleton, the buyer has private information, and the seller offers a menu of information structures that the buyer can choose from; by revelation principle, each buyer type has an information structure intended for his type. If the buyer chooses an information structure, the buyer observes the signal privately. Afterwards, the seller offers a price-quantity schedule or a price-quality schedule in the second period. Section 3.2 discusses what happens if the seller observes the signal realization or offers a single signal.

The following assumption is for theorem 3. Other theorems don't depend on assumption 1.

Assumption 1. *The buyer's valuation from the second period is* $u_b(\omega) = U(\omega)V(q) - T$ *where* $V(0) = 0$, $V'(\cdot) > 0 > V''(\cdot)$, $q \in \mathbb{R}_+$ *is the quantity or quality, and* $T \in \mathbb{R}_+$ *is the price. Further assume* $U : \Omega \to \mathbb{R}_+$, *and define* $\mathbb{R}_+ = \{x | x \in \mathbb{R}, x \geq 0\}$.

Assumption 1 is a standard assumption for static adverse selection problems, and this could be generalized to the usual Spence-Mirrlees condition. I don't need strict multiplicative separability in ω and q.

The signal structure the seller can offer in the first period can depend both on the seller's private information and the payoff-relevant state. A special case of this signal structure is Bayesian persuasion where the seller has no private information and offers an experiment without knowing the signal realization nor the payoff-relevant state. More precisely, if the signal structure is a mapping $s : \Omega \to \Delta(S)$, then the seller can provide an additional signal about the payoff-relevant state that is independent of his own signal. This implies that the seller can offer information that he doesn't know himself. I assume the signal realization of the information structure is independent of the buyer's private information.

3 Results

I first present results when the seller offers a menu of information structures and doesn't observe the signal realization. I also assume that the seller doesn't value the good in the second period as in the usual monopoly setting, i.e., $u_s(\omega) = 0$. Section 3.2 discusses what happens when $u_s(\omega) \neq 0$ which maps into interdependent values and also private values as in Myerson-Satterthwaite (1983). $u_s(\omega) \neq 0$ makes the seller's commitment power relevant; I also discuss what happens if the seller cannot commit to both periods and will choose a price-quantity schedule or a price-quality schedule based on the participation decision and the information structure the buyer purchases in the first period. Then I discuss what happens if the seller observes the signal or he sells one signal.

3.1 Main Results

When $u_s(\omega) = 0$, the seller doesn't value keeping the good to himself and wants to maximize the revenue from trade. The main difference between this section and the extension $u_s(\omega) \neq 0$ is that when the seller's valuation from keeping the good himself depends on the payoff-relevant state, the seller might not always want to trade, and the buyer's private information is informative about whether the seller prefers to trade; otherwise, the seller always prefers to sell and maximize the revenue.

When $u_s(\omega) = 0$, the seller wants to maximize revenue which implies that it's the buyer's willingness to pay that depends on private information of the seller and the buyer; this section is closely related to the informed-principal problem.

The first benchmark is already known in the information disclosure literature, but I include it here formally as a benchmark.

Theorem 1. *Suppose Θ_s, Θ_b are singleton. The seller can extract full surplus, but the total surplus the seller can extract depends on the information structure.*

Proof. When Θ_s, Θ_b are singleton, there is no private information, and since the parties start with common prior, the expected utility of the buyer from purchasing the good after purchasing a particular signal structure is common knowledge. The seller can extract full surplus by charging the expected utility of the buyer as the price of the information structure. The buyer can choose not to purchase any information structure in the first period, but since the seller and the buyer have common prior, the seller can then extract the expected utility of the buyer from purchasing the good in the second period. Therefore, the buyer's expected utility is the same as his outside option under the optimal mechanism, but the seller can provide more information in the first period and maximize the gains from trade. □

The next theorem shows that the common wisdom in theorem 1 no longer holds when the buyer has private information.

Theorem 2. *Suppose Θ_s is singleton and Θ_b has more than one element. Suppose Θ_b are ordered in the sense of first-order stochastic dominance with respect to $U(\omega)$. The seller can no longer extract full surplus.*

Proof. Since the seller knows whether the buyer purchases any information structure and which one he buys if he does, the seller can offer a different menu of contracts in the second period conditional on the information structure the buyer purchased in the first period. The buyer privately observes the signal realization, and the seller has a prior on the pair of (buyer type, signal realization). The buyer jointly updates his belief about the seller's type and the payoff-relevant state using his type and the additional signal he observes. This turns the second-period problem into a standard adverse selection problem. Even in the usual adverse selection problem, the buyer is left with rent unless the seller only serves the highest type. The rest of the argument follows from the buyer's incentives in the first period. If the seller were to extract all the surplus, he has to extract it in the first period, and in particular, the seller has to extract the rent of the buyer in the second period by the price of the information structure in the first period. However, the buyer can always deviate and purchase another signal structure. □

Comparing theorems 1 and 2 shows that whether the buyer has private information or not matters for surplus extraction. Theorem 2 might not seem too surprising given standard adverse selection models, but theorem 1 shows that contrary to information disclosure literature, charging for information structure changes the payoff of the seller drastically.

The next theorem shows that the intuition from theorem 1 only depends on the buyer not having private information. Whether the seller has any private information doesn't matter, since even with an informed principal, if pooling all types is the maximum surplus the seller can ever extract, the seller has no incentives to reveal his type. This crucially depends on the set of information structures the seller can offer which is discussed after theorem 3. If one were to say that theorems 1 and 2 follow existing literature relatively closely, theorem 3 shows the interaction between the informed-principal problem and the set of information structures; things change even more once there is private information on both sides (the seller and the buyer), and this is another illustration that interdependent values can bring in a huge difference.

Theorem 3. *Suppose Θ_b is singleton and Θ_s has more than one element. The seller can extract full surplus.*

Proof. When Θ_b is singleton, the buyer has no private information, and only the seller has information about the value of the good to the buyer, i.e., the payoff-relevant state which matters for $u_b(\omega)$. The buyer's expected utility from purchasing a particular signal structure is known to the seller, and the seller can extract full surplus by the price in the first period.

The seller with a different private information could in principle offer a different information structure, but given that the seller can extract maximum surplus by offering one information structure for all types, he has no incentives to deviate. □

Proof of theorem 3 crucially depends on the assumption that the seller can offer any information structure, and in particular, it can be any mapping from the set of payoff-relevant states, Ω, independent of the private information of the seller himself. This is the usual assumption in the Bayesian persuasion literature, but as one can see from the proof, it is a very strong assumption. If we were to take away this assumption and restrict the set of information structures the seller can offer, then the seller cannot offer any experiment, and results might change. However, following the Bayesian persuasion and information disclosure literature, when the seller can offer any experiment, results must hold.

An alternative interpretation of the set of information structures is to consider the posterior belief of the buyer. I assumed that the set of information structures is the set of all mappings from (seller type, payoff-relevant state) to some metric space. Results hold as long as this metric space is fixed for all seller types and payoff-relevant states, and this is equivalent to saying that the set of buyer's posterior beliefs is the set of any belief that can be updated by Bayesian updating from the buyer's type, i.e., if the buyer initially assigns a zero probability to some seller type or the payoff-relevant state, it can't be updated, but any other posterior can be generated by some information structure.

Theorem 4. *Suppose both the seller and the buyer have private information. Except in the degenerate case, the optimal mechanism strictly increases the probability of trade and welfare-improving for both parties.*

Proof. When the buyer learns his type, he can update his belief about the joint distribution of (seller type, payoff-relevant state), (θ_s, ω), from common prior π. Denote the marginal by $\pi|_{\theta_b}$. When the seller designs an information structure, it is without loss of generality to consider the posterior belief of the buyer on (θ_s, ω) conditional on each signal realization. In particular, the posterior belief of the buyer is always a martingale, and the seller can always design an information structure that puts the maximum probability on the buyer willing to purchase in the second period and increase the probability of trade. The seller still needs to choose optimal prices in both periods, but the seller can always strictly increase the probability of trade except in the degenerate case when the buyer's initial type already maximizes the probability of trade across all martingales that can be generated. □

Theorem 4 shows that the seller can strictly increase the probability of trade by selling an information structure in the first period. In light of Myerson-Satterthwaite (1983), it already suggests that the no-trade theorem can be overcome by the seller offering information before the trade takes place. Compared to the original no-trade theorem, I assumed in this section that the seller doesn't value the good himself and $u_s(\omega) = 0$ for all $\omega \in \Omega$. The following section considers the extension when $u_s(\omega) \neq 0$, but the intuition follows along the same line. I also allow the buyer to choose whether to purchase after observing the price in this section, but this doesn't matter for the result, and the second period can be modelled exactly the same way as in Myerson-Satterthwaite (1983).

3.2 Extensions

This section discusses which assumptions of the model can be relaxed and theorems 1-4 still hold. The key assumptions that matter for results are (i) Spence-Mirrlees condition, (ii) the set of information structures the seller can offer, and (iii) whether $u_s(\omega) = 0$ or $u_s(\omega) \neq 0$.

The most important case is when the seller values keeping the good to himself, i.e., $u_s(\omega) \neq 0$. In this case, the seller doesn't always want to trade, and one needs to take care of willingness to trade on both the seller side and the buyer side. In particular, with interdependent values, the buyer still cares about the seller's information as it is informative about the buyer's valuation from the good, but the seller also cares about the buyer's information and the seller might not want to trade depending on the buyer's type. And this is when the commitment assumption on the seller side matters; in section 3.1, theorems 1-4 all generalize to limited commitment. The seller doesn't need to commit to the price schedule in the second period, and the mechanism can be designed with limited commitment for both periods for both the seller and the buyer. Before discussing results for $u_s(\omega) \neq 0$, I will briefly discuss what happens if the seller observes the signal realization or if he sells only one signal. Again, theorems 1-4 don't change. When the seller doesn't value the good himself, theorems 1-4 are robust as long as the payoffs of the buyer and the seller are as in the static adverse selection satisfying the Spence-Mirrlees condition and the set of information structures are not restricted as in Bayesian persuasion.

When the seller observes the signal realization that the buyer purchases, theorems 1 and 3 don't change. The seller after observing the signal realization knows the buyer's utility from purchasing the good in the second period. The seller can extract full surplus in the second period, and the seller can even offer the information structure for free in the first period. In theorem 2, if the buyer has private information, then even if the seller observes the signal realization, the seller doesn't learn the buyer's type from the signal realization unless the signal is perfectly informative. Therefore, in the second period, the buyer still has private information, and the seller cannot extract full surplus unless he only sells to the highest type. In theorem 4, the same argument as for theorem 2 shows that unless the signal the buyer purchased is perfectly informative about the buyer's valuation, the buyer still has private information in the second period, and the seller cannot extract full surplus except when the seller only sells to the highest type. Furthermore, in light of trade, as long as the probability that the buyer is ex-post willing to trade increases as a result of purchasing an information structure, then total welfare increases.

If the seller sells a single signal, then the effect of the signal on the buyer's information is the same as when the seller observes the signal realization of the information structure, and the discussion in the above paragraph goes through.

Suppose $u_s(\omega) \neq 0$ for all $\omega \in \Omega$ and the seller commits to both periods. By the revelation principle, the seller can offer a menu of information structures for each buyer type in the first period and then a price-quantity schedule for each (buyer type, signal realization). In the second period, given the seller's posterior on the buyer type after the first period, the seller might not want to trade with some (buyer type, signal realization). However, since the seller has commitment power, he can commit to trade with (buyer type, signal realization) who are ex-post inefficient. Therefore, the seller can design the information structure in the first period and the price-quantity schedule in the second period together at the beginning of the first period, given his private information. (Myersonian approach) Furthermore, when the seller doesn't observe the signal realization, the seller can just offer a pair of (information structure, price-quantity schedule). As before, if the seller knows the signal realization or sells a single signal, then the seller can condition the price-quantity schedule on the signal realization, but results don't change qualitatively.

When the seller doesn't have the commitment power, he offers the second-period price-quantity schedule after observing the information structure the buyer chooses. In particular, the seller updates his belief about the buyer type after the first period, and the seller cannot commit to offering an ex-post inefficient price-quantity schedule.

When the seller has no commitment power, one could compare the monopoly setting with the common agency setting, i.e., one seller provides information for the good sold by another seller. This is another fairly common situation in the real world. When the monopolist can replicate the full-commitment solution with limited commitment, the second seller of the common agency can replicate the monopolist. It still depends on the first seller whether he wants to replicate the monopolist, because the monopolist still takes into account his second-period revenue when he prices for information structures. However, if the full-commitment solution cannot be replicated with limited commitment, which is often the case with $u_s(\omega) \neq 0$, $\forall \omega$, then the optimal mechanism by the monopolist with full commitment can never be replicated by two sellers in common agency.

4 Conclusion

I study a selling mechanism when the seller can first sell information then sells a product. It is a fairly common situation in the real world, but most of existing literature has focused on cases where the seller offers the information for free. I show that when the seller can charge for information, if the buyer doesn't have any private information, then the seller can extract full surplus. The size of full surplus could depend on the information structure, depending on how the payoff-relevant state affects the buyer's willingness to pay, but the buyer's payoff under the optimal mechanism is exactly the same as his outside option. However, once the buyer has private information, then the seller can no longer extract full surplus, and in particular, if both the seller and the buyer have private information, then selling information can increase the probability of trade which is welfare-improving for both parties.

As far as I'm aware, there aren't many papers on monopoly with complementary goods. I have a work in progress on this, but other related papers on multi-dimensional screening are mostly on additively separable utilities. Selling information in the first period is a particular type of complementarity, but this also hasn't been studied much yet. My results show that particularly given that Li-Shi (2017) already has an example showing that the seller can extract full surplus if neither the buyer nor the seller has private information about the payoff-relevant state and the seller can offer any experiment as a function of the payoff-relevant state, whether the buyer and the seller have private information matters crucially for this type of problems. The way I modelled the problem is such that I can incorporate both the buyer's private information and the seller's private information as part of the payoff-relevant state. One could interpret theorems 1-4 in light of private information and informed-principal problem, but more generally, this points to interdependent values in multi-dimensional screening problems which is largely unexplored at the moment.

Another implication of theorems 1-4 is that the set of information structures is very important. Bayesian persuasion or information disclosure literature has assumed that there is no restriction on the set of experiments the seller can offer. If one were to consider that the financial (or any other) advisory services can provide any information about the payoff-relevant state, then most likely, we observe these advisory services in the real world because the buyers have private information. Or it could be that there are restrictions on the type of information that can be provided, for example, by unforeseen contingency type of reasons or government regulations. Given that many clients will likely subscribe to the service for a long term, things could also change if the two periods of my mechanism is repeated over time. Dynamic informed-principal problem is also largely unexplored, and in particular, if the time horizon is infinite, then backloading until the last period type of argument no longer works. Dynamic informed-principal problem over infinite horizon is another interesting area that needs to be explored.

Lastly, my results show that in the informed-principal problem ($u_s(\omega) = 0, \ \forall \omega$), the commitment power of the seller doesn't matter qualitatively, and the seller can replicate the full-commitment solution with limited commitment power if the buyer has no private information. However, once we have interdependent values, $u_s(\omega) \neq 0$, then the seller might not want to trade with a buyer who's private information informs the seller that the net payoff is going to be negative. The informed-principal case is when the seller doesn't value the good himself and always wants to trade; it also says that the seller's valuation is independent of the payoff-relevant state, or more precisely, the buyer's private information only matters for the buyer's willingness to pay and not for the seller's valuation of the good. Taken together, selling information and the good sequentially interacts with the seller's commitment power with interdependent values, but they don't always do if the seller's payoff doesn't depend on the buyer's private information.

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