Contracts with Framing*

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Abstract

We study a model of contracts in which a profit-maximizing seller uses framing to influence buyers’ purchase behavior. Framing temporarily affects how buyers evaluate different products, and buyers can renege on their purchases after the framing effect wears off. We characterize the optimal contracts with framing and their welfare properties in several settings. Framing that is not too strong reduces total welfare in regulated markets with homogenous buyers, but increases total welfare in markets with heterogenous buyers when the proportion of buyers with low willingness to pay is small.

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1 Introduction

Sellers commonly use framing to influence buyers’ purchase behavior. When presenting a product menu to buyers, for example, sellers often visually highlight a particular product by placing it in a prominent position, by coloring it differently from other products, or by other means. Sellers also tend to present information about products in a way that buyers find desirable, such as indicating the percentage of a dairy product that is “fat-free” rather than the actual fat content of the product. More subtle cues like the type of background music played in a store also influence buyers’ behavior. For example, classical music has been shown to trigger buyers to purchase higher quality items. In all these cases, framing seems to influence buyers’ behavior by increasing the attractiveness of some product or product attribute.

This increased attractiveness is likely temporary. According to leading theories of cognition, the effect of various inputs on decision making depends on their relevance and frequency. Inputs that are less relevant or less frequent decay faster than other more relevant or more frequent ones. Frames are often payoff-irrelevant inputs that buyers encounter only at the point of sale, so their effect likely decays faster than that of more relevant inputs that enter decision making frequently. For example, the effect of music played in a store likely decays quickly after the buyer exits the store, because the buyer is no longer exposed to the music. The music is also probably less relevant than other inputs such as the purchased product characteristics.

After the framing effect decays, the buyer may wish to, and often can, renege on his purchase. Many US retailers, for example, allow buyers to return products for a full refund within a certain time period, and require their franchisees to adopt the same policy. In other cases, the law mandates such return policies in order to protect buyers. In the European Union, for example, online and purchases other than in shops can be returned for any reason within a “cooling off”

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1 For an illustration, see the brochures in Appendix A.

2 This is similar to the positive versus negative framing of information in Tversky and Kahneman’s (1981) Asian disease problem.

3 The effect of background music on purchasing behavior has been studied extensively in the marketing literature. Some examples include Areni and Kim (1993), who showed that classical music led to more expensive wine purchases relative to top-40 music, North and Hargreaves (1998), who showed that classical music increased students’ purchase intentions in a cafeteria by approximately 20 percent, and North, Shilcock, and Hargreaves (2003), who showed that spending in a restaurant increased in the presence of classical music relative to pop music or no music.

4 One class of leading theories, developed by Anderson and colleagues (see e.g. Anderson (1993)), is the class of Adaptive Character of Thought (ACT) theories. A simplistic description of ACT is that the momentary activation level of a particular memory “chunk” is the sum of the base-level general usefulness of the “chunk” and the weighted average of inputs, which decay over time. Thus, the effect of a particular input declines if it is not repeated and as other inputs appear.
period of 14 days. Similarly, the US Department of Transportation requires airlines to allow
buyers to renege on their flight ticket purchase within 24 hours. In all these environments,
the ability of buyers to return products makes the temporary nature of framing economically
relevant because it naturally limits the ability of sellers to use framing to increase profit.

We study the optimal design of product menus with frames in such environments. Our two
main postulates are that (1) frames temporarily increase the attractiveness of some product
or product attribute, and (2) after the framing effect fades away, buyers who overpaid for the
product return it to the seller.

In our model, a seller chooses a product menu and a frame in order to maximize profit. The
different ways in which the seller can influence buyers’ behavior at the point of sale are captured
by a collection of functions \( \{U^f\} \). Each function \( U^f \) describes how buyers evaluate products in
the frame \( f \). Buyers’ preferences are captured by an additional function \( U \) that reflects how
they evaluate products absent framing or, alternatively, their true willingness to pay.

When making a choice among bundles in the frame \( f \) (a bundle is a product and its price),
the buyer maximizes \( U^f \). That is, the frame influences the buyer at the point of sale. The
buyer keeps his chosen product if doing so is \( U \)-superior to not buying anything, and otherwise
returns it. That is, the framing effect is temporary, and after it wears off the buyer returns the
purchased product if he overpaid for it.

There is, of course, more than one way to model what the buyer does after returning a
product. One possibility is that the buyer walks away without making another purchase. This
may be the case when it is not clear to the buyer why he overpaid and he does not want to
overpay again, or when the buyer believes the product he just returned is the best among the
available ones and so there is no point in making another purchase. Another possibility, which
reflects more sophistication on the part of the buyer, is that after returning the product the buyer
makes another purchase according to his \( U \) preferences. This may be the case when the buyer
internalizes ex-post how the frame affected his behavior, and is able to resist similar framing
effects from that point on. There is also an intermediate possibility, in which the buyer makes
another purchase according to the same choice procedure, ignoring the product he just returned.

Because in all these post-return specifications the seller’s optimal contract in many of the
settings we consider does not involve returns, it is robust to the exact post-return specification.
We therefore focus on the post-return specification in which the buyer walks away after returning
the product. We also discuss settings in which the optimal contract involves returns, and
demonstrate in Section 6 how increased sophistication of buyers in their post-return behavior
may actually increase the seller’s profit.

Welfare in the model is evaluated with respect to buyers’ preferences. This follows the view
that frames are details that are irrelevant to buyers’ intrinsic valuation of goods, and their effect
is not persistent.\(^5\)

The first part of our analysis focuses on the profit and welfare implications of frames that increase the attractiveness of a particular product attribute. Presenting information about products in a way that buyers find desirable and background classical music may have this effect. We consider two environments in which the seller offers buyers a menu with more than one bundle, so framing has the potential to affect purchasing behavior by influencing how buyers compare bundles.

The first environment is a regulated market in which the seller is required to offer buyers a specific basic bundle, in addition to offering them other bundles of his choice. This is often the case in the cable-TV market, where regional cable providers have to offer customers a basic package of channels at a low rate, in addition to other packages of their choice.\(^6\) One rationale for this regulation in the absence of framing is that with homogenous buyers it shifts surplus from the seller to buyers without creating efficiency distortions. This is because by offering an additional bundle, the seller can extract from buyers the entire social surplus from this bundle, up to an amount that makes them \(U\)-indifferent to the basic bundle. The seller therefore offers buyers the socially efficient product at a lower price than without the regulation.

The seller in such a market will choose to use framing that increase attractiveness. This is because such framing enables the seller to charge for the socially efficient product a higher price than without framing, and he can obtain an even higher profit in the optimal contract. The optimal use of framing by the seller leads to non-trivial distortions: either the additional product offered by the seller and purchased by buyers is socially inefficient and buyers’ surplus is reduced, or the regulation fails to shift any surplus from the seller to buyers. This result hints at the potential of framing to undo the effect of regulations that aim to increase consumer welfare in monopolistic settings.

The second environment that we study is a market with heterogenous buyers. Framing is not necessarily profit-enhancing in this case. This is because framing triggers buyers with low willingness to pay to perceive premium products, which are targeted at buyers with high willingness to pay, as more attractive than without framing. Since premium products may be priced above low-type buyers’ willingness to pay for them, framing may cause these buyers to forgo purchasing altogether, leading to an overall decrease in profit. Of course, the seller will take this effect into account when designing the optimal menu, but when framing is “sufficiently strong” his overall profit will nevertheless be lower than in the optimal contract without framing.\(^7\)

When framing is not too strong, it is profit-enhancing in this environment as well. The welfare

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\(^5\)See Rubinstein and Salant (2008, 2012) for a detailed discussion of this approach to welfare analysis in the presence of framing, and Benkart and Netzer (2015) for an application of this approach to nudging.

\(^6\)See, for example, http://www.fcc.gov/guides/regulation-cable-tv-rates for cable-TV regulation in the US.

\(^7\)This is one of the few results that depend on the specification of the buyer’s post-return behavior.
implications of framing in this case are different for high- and low-type buyers. The product purchased by high-type buyers is always less efficient than in the optimal contract without framing, while the product purchased by low-type buyers is more efficient than in the optimal contract without framing when the proportion of these buyers is not large. Overall, framing increases total welfare when the proportion of low-type buyers is not large. This result hints at the potential of framing to mitigate the social inefficiencies created by profit maximization in the presence of private information.

The second part of our analysis studies the optimal design of frames that highlight a particular product. Such highlighting is frequently done in real life by coloring one product differently than other products, by putting it in a separate box, by presenting it as the default product, and so on. For example, Sam’s Club highlights its premium “sam’s plus” membership by putting it in a separate box and by indicating that it is the “best value,” and the insurance provider “Insure My Rental Car” highlights its premium insurance policy by coloring it in a darker color and by adding a “check” mark to it (see appendix A for visual illustrations of these and another example of highlighting). In the spirit of Tversky and Kahneman’s (1991) model of reference-dependent choice, we postulate is that highlighting triggers buyers to anticipate regret in case they will need a feature that is included in the highlighted product but not in the product they purchased. In the context of insurance, for example, buyers may anticipate regret if they are involved in an accident and have less coverage than in the highlighted insurance policy.

To study optimal highlighting, we consider an insurance setting a-la Stiglitz (1977), in which a risk neutral insurance provider offers a menu of insurance bundles to a population of risk-averse buyers, and can choose to highlight one of them. We show that the highlighted bundle optimally coincides with the premium insurance policy targeted at high-risk buyers. This is in line with the real-world phenomenon, including the above examples, that sellers tend to highlight premium bundles. We also show that in the optimal contract low-risk buyers are always partially insured, while high-risk buyers are either over-insured or do not purchase any insurance. Insuring low-risk buyers but not high-risk buyers is impossible in the optimal contract without framing, and is in line with the phenomenon of advantageous selection identified in the empirical literature (See Einav, Finkelstein, and Levin (2012) for a recent survey).

The paper proceeds as follows. Section 1.1 discusses the related literature. Section 2 introduces the framework. Section 3 analyzes regulated markets with homogenous buyers. Section 4 studies markets with heterogenous buyers. Section 5 studies the insurance setting. Section 6 concludes by discussing an alternative post-return specification. Appendix A contains visual illustrations of framing that highlights a product, and Appendix B contains proofs that do not appear in the main text.
1.1 Related literature

The paper is related to several growing literatures. The first is the literature on individual choice with frames. Our specification of the buyer builds on Salant and Rubinstein (2008). The primitives that describe the buyer in our model correspond to their framework, but our specification of the buyer’s two-stage choice procedure is different. Other two-stage choice procedures were studied in the context of individual choice without framing. See, for example, Manzini and Mariotti (2007). Our approach to welfare analysis is based on Rubinstein and Salant (2008, 2012) who advocate evaluating welfare with respect to preferences rather than frame-dependent behavior. A related application of their approach is Benkart and Netzer (2015) who study the conditions under which a planner can identify from frame-dependent behavior an optimal nudge, i.e., a frame that triggers an individual to choose similarly to his preferences. In contrast to all these papers, we study the effect of frame-dependent behavior on the outcomes of strategic interactions.

In the context of strategic interactions with frame-dependent behavior, Piccione and Spiegler (2012) and Spiegler (2014) study competition between two firms in a complete-information setting in which frames influence consumers’ ability to compare the firms’ actions, such as prices. Firms choose “marketing messages,” in addition to actions, and these messages jointly determine the frame. The frame and the actions determine how the market is split between the firms. We study a different question, namely the optimal design of product menus with frames by a monopolistic seller in a regulated market or a market with incomplete information. Our model of consumer behavior is also different, since framing is not persistent and buyers can renge on their purchases.

Another related literature is the literature on behavioral contract theory (see K˝oszegi (2013) for an excellent survey), and in particular the literature on screening agents with non-standard preferences. In this literature, the agent has at the outset some private information, either on his degree of inconsistency (see Eliaz and Spiegler (2006), Esteban and Miyagawa (2006), Esteban, Miyagawa, and Shum (2007), and Galperti (2015)), or on some payoff-relevant parameter, such as his willingness to pay (see Esteban and Miyagawa (2006) and Carbajal and Ely (forthcoming)). The focus is on the design of an optimal product menu or menus from which the agent makes choices. In our framework the principal has an additional tool, frames, which he uses to temporarily influence how consumers evaluate different products. Our focus is on the optimal use of profit-enhancing frames, and product menus that complement them, to screen agents with payoff-relevant private information.

There are also papers that study implementation with boundedly-rational agents. De Clippel (2013) studies implementation with general choice functions. Glazer and Rubinstein (2012) study a persuasion model in which agents are limited in their ability to find arguments that satisfy a set of rules specified by a principal in order to screen agents. We focus on framing as the cause
for boundedly-rational behavior, and study the effect of frame-dependent behavior on the design of profit-maximizing contracts.

2 Framework

A profit-maximizing seller offers a contract \((M, f)\) to buyers. The menu \(M\) includes bundles \((x, t)\), where \(x \in [0, d] \subset \mathbb{R}\) is a product and \(t \in \mathbb{R}_+\) is a price. The frame \(f\) belongs to a set \(F\) of feasible frames.

Buyers. Frames affect how buyers compare bundles in the menu, and buyers can renege on their purchases after the framing effect wears off. To capture this formally, let \(U(x, t, \theta) = u(x, \theta) - t\) describe the quasi-linear preferences of a type \(\theta\) buyer over bundles, where \(\theta \in \Theta\) is the buyer’s “taste” parameter, and let \(U^f(x, t, \theta) = u^f(x, \theta) - t\) describe how the buyer evaluates bundles in the frame \(f\). The functions \(u\) and \(u^f\) are differentiable and strictly increasing in \(x\).

Let \(stayout = (0, 0)\) denote the buyer’s bundle if he does not purchase anything.

Given a contract \((M, f)\), the set \(C^\theta(M, f)\) of possible choices of a type \(\theta\) buyer consists of:

1. all the \(U^f\)-maximal bundles in \(M\) that are weakly \(U\)-superior to \(stayout\), and
2. \(stayout\) if it is weakly \(U\)-superior to some \(U^f\)-maximal bundle in \(M\).

The correspondence \(C^\theta\) summarizes a two-stage choice procedure that includes a maximization stage and a verification stage. In the maximization stage, the buyer identifies a \(U^f\)-maximal bundle in the menu \(M\). In the verification stage, the buyer keeps this \(U^f\)-maximal bundle only if it is superior, according to his \(U\)-preferences, to not buying anything; otherwise, he does not buy anything as (2) indicates.

The main interpretation of this procedure is that the frame influences the buyer at the point of sale, where he evaluates bundles according to \(U^f\). This is captured by the maximization stage. The buyer, however, reassesses his purchase according to his \(U\)-preferences after a “cooling off” period, and if he is unsatisfied with his purchase, he returns the product and walks away.\(^8\) This is captured by the verification stage.

As discussed in the Introduction, there are other natural ways to model what the buyer does after returning a product. For example, a more sophisticated buyer who internalizes ex-post how the frame influenced his behavior, and is able to resist the framing effect from that point on, may make another purchase according to his \(U\) preferences. We discuss this alternative specification of the buyer’s post-return behavior in Section 6 and show that many of our results extend to the alternative specification.

There are also other interpretations of the buyer’s choice procedure. One interpretation is that frames influence how buyers perceive relative differences between bundles but cannot

\(^8\)Note that the buyer does not incur a return cost. We discuss the effect of a return cost below.
influence willingness to pay for each particular product. They therefore influence how the buyer chooses from the menu (according to $U_f$) but not whether he actually buys the chosen product (which is done according to $U$). Another interpretation is learning. When buyers are involved in similar interactions or communicate with other buyers, they may learn to anticipate the effect of framing on their behavior, while still not being able to resist this effect at the point of sale. Understanding this, buyers may choose not to interact with the seller if they anticipate they will overpay.

**Seller.** The seller has a convex, differentiable, and strictly increasing cost $c(x)$ of providing the product $x$, with $c(0) = 0$. His full-information profit maximization problem subject to type $\theta$ buyers obtaining a $U$-utility of $U(0, 0, \theta)$ is strictly concave in $x$ and has a unique “first-best” solution $(x_\theta^*, t_\theta^*)$. Note that the product $x_\theta^*$ is socially efficient in the sense that it maximizes the social surplus with respect to type $\theta$ buyers, $u(x, \theta) - c(x)$.

The seller can offer a frameless contract to buyers by choosing the “null” frame $\phi \in F$. In the null frame $U^\phi = U$, so for any frameless contract $(M, \phi)$ the set $C^\phi(M, \phi)$ is the set of $U$-maximal bundles.

**Implementation.** An allocation rule $g$ assigns to each $\theta \in \Theta$ a bundle $g(\theta)$. A contract $(M, f)$ (partially) implements $g$ if $g(\theta) \in C^\theta(M, f)$ for every $\theta \in \Theta$. In this case, we say that $g$ is implementable with the frame $f$. An allocation rule is implementable if it is implementable with some feasible frame. Finally, a contract is profit maximizing (or optimal) if it implements an allocation rule that maximizes the seller’s profit among all implementable allocation rules.

**Frames increase attractiveness.** Our main assumption on the seller’s framing technology is that frames increase the attractiveness of any increase in the product. For example, if products vary in quality, then the frame increases how much buyers are willing to pay for an increase in quality. Background classical music and presenting information on product attributes in a way that buyers consider desirable seem to have this effect.

**Assumption A1.** Increased attractiveness: For every frame $f \neq \phi$ and every product $x$, $u'_f(x, \theta) > u_x(x, \theta)$.

## 2.1 Benchmark analysis

We begin by examining a simple benchmark in which buyers are homogenous, i.e., have the same type $\theta$. The seller knows buyers’ type and has full discretion over the menu he offers.

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9 Section 5 studies the implications of type-dependent cost.

10 We relax this assumption in Section 5.
Framing is not profit-enhancing in this case because it cannot trigger buyers to overpay. That is, if buyers choose the bundle \((x, t)\) with framing, then this bundle is weakly \(U\)-superior to not buying anything, so buyers will also choose it without framing if it is the only available bundle. Thus, whether the seller uses framing or not, he will offer buyers the first-best bundle \((x^*_θ, t^*_θ)\) and capture the entire surplus in excess of \(U(0, 0, θ)\).

**Observation 1** Framing is not profit-enhancing in a complete information setting in which the seller has full discretion over the menu.

Observation 1 relies on returns being costless to buyers. When returns are costly, frames that increase attractiveness are profit enhancing. This is because the seller can charge more than \(t^*_θ\) for the first-best product \(x^*_θ\), so his profit in the optimal contract is higher than without framing. Note, however, that the seller may not be able to extract the entire return cost from buyers when it is large relative to the increased attractiveness of the frames.\(^{11}\)

We proceed to discuss two other settings in which the conclusion of Observation 1 may fail. Section 3 studies a regulated market with homogenous buyers in which the seller is required to offer buyers a specific bundle in the menu addition to other bundles of his choice. Section 4 studies a market with heterogenous buyers who have private information about their type. In both cases, the seller offers buyers a menu with more than one bundle, so framing has the potential to increase the seller’s profit.

### 3 Regulated market with homogenous buyers

Monopolistic sellers are sometimes required by a regulator to offer consumers a specific bundle in the menu in addition to other bundles of their choice. This is the case, for example, in the cable-TV market, in which cable providers often have to offer customers a basic package of channels at a low rate in addition to other packages of their choice. This section studies how framing changes the effectiveness of this regulation in markets with homogenous buyers, all of whom have the same known type \(θ\).

Consider a regulation that requires the seller to include in the menu the bundle \((\bar{x}, \bar{t})\), which buyers strictly \(U\)-prefer to \((x^*_θ, t^*_θ)\). The product \(\bar{x}\) is basic in the sense that \(\bar{x} < x^*_θ\). The seller can add to the menu other bundles of his choice.

In the absence of framing, this regulation is appealing because it changes the division of surplus between the seller and buyers without reducing social surplus. This is because the

\(^{11}\) This is because buyers cannot be convinced to pay \(t^*_θ + c\) for the first-best product, where \(c\) is the return cost, when framing is not sufficiently strong, and producing above the first-best level to extract additional surplus from buyers may at some point be too costly for the seller relative to buyer’s increased willingness to pay in the frame.
seller can charge for any product \( x \) the entire surplus \( u(x, \theta) \) up to the amount \( u(\bar{x}, \theta) - \bar{t} \). This makes buyers \( U \)-indifferent between \((x, t)\) and \((\bar{x}, \bar{t})\). He therefore chooses \( x \) to maximize \( u(x, \theta) - (u(\bar{x}, \theta) - \bar{t}) - c(x) \), and optimally offers the socially efficient product \( x^*_\theta \) at the price \( t = u(x^*_\theta, \theta) - (u(\bar{x}, \theta) - \bar{t}) \). Thus, the regulation increases consumer surplus at the expense of producer surplus without reducing social surplus.

The same regulation is less effective when the seller can use framing that increase attractiveness.

**Proposition 1** Suppose it is feasible to produce above the socially efficient level, i.e., \( x^*_\theta < d \). Then, in every optimal contract, either buyers have a surplus of zero or the product they purchase is strictly above the socially efficient level.

Thus, when the seller can use framing, the regulation either fails to redistribute surplus from the seller to buyers or creates efficiency distortions.

To see why this is the case, we first observe that frames that increase attractiveness are profit-enhancing in this setting because the seller can charge more for the product \( x^*_\theta \) than in the optimal frameless contract. He can obtain an even higher profit in the optimal contract.

The regulation fails to redistribute surplus from the seller to buyers when there is a frame \( f \) that is sufficiently strong so that buyers \( U^f \)-prefer the first-best bundle \((x^*_\theta, t^*_\theta)\) to \((\bar{x}, \bar{t})\). This is because in this case the seller will offer buyers the first-best bundle with the frame \( f \), and buyers will choose it over \((\bar{x}, \bar{t})\).

If no frame is sufficiently strong, the seller will offer buyers a product above the socially efficient level. The intuition for this upward distortion is that similarly to the optimal frameless contract, the seller will not offer buyers a product below the socially efficient level \( x^*_\theta \). And at \( x^*_\theta \), the seller’s marginal production cost is equal to buyers’ marginal \( U \)-willingness to pay, which in turn is strictly smaller than their marginal \( U^f \)-willingness to pay, by increased attractiveness. Thus, the seller can increase his profit by increasing \( x \) slightly above \( x^*_\theta \) and increasing the price by the marginal \( U^f \)-willingness to pay.

This implies that when framing is not too strong, it leads to a reduction in social surplus relative to the optimal frameless contract. Consumer surplus also goes down, because the seller’s profit goes up while the social surplus goes down, so redistribution of surplus is less effective than without framing.

In summary, the presence of framing in this setting either completely undoes the effect of regulation (when framing is sufficiently strong) or leads to inefficiencies (when framing is not too strong). In both cases, framing reduces the regulation’s effectiveness in shifting surplus to buyers.
4 Market with heterogenous buyers

When there is more than one type of buyer, in the absence of framing the seller often optimally offers buyers a menu with more than one product. Framing that increases attractiveness is not necessarily profit-enhancing in this case, because it may cause buyers with low willingness to pay to perceive products for which they are not willing to pay, targeted at buyers with high willingness to pay, as more attractive than products they would have bought without framing. This section demonstrates that profit reduction indeed happens when framing is sufficiently strong, and then characterizes the optimal contract and its welfare properties when framing is not too strong.

We consider a setting with two types of buyers, Low and High, with the interpretation that high-type buyers are U-willing to pay more than low-type buyers for an increase in the product, i.e., \( u_x(x, H) > u_x(x, L) \). A buyer’s type is his private information. The proportion of buyers of type \( \theta \in \{L, H\} \) is \( \pi_\theta \) with \( \pi_L + \pi_H = 1 \).

In addition to increasing attractiveness (Assumption (A1)), we also assume that framing does not reverse the ranking of types: with framing high-type buyers still perceive increases in the product as more desirable than low-type buyers.

**Assumption A2.** Non-reversal: For any frame \( f \) and any product \( x \), \( u_f(x, H) > u_f(x, L) \).

Assumption (A2) implies that when buyers of both types make a purchase, high-type buyers purchase a weakly larger product than low-type buyers.

4.1 Profit reduction

A frame that increases attractiveness (Assumption (A1)) without reversing the ranking of types (Assumption (A2)) has two effects on the seller’s profit. First, if a buyer chooses a product \( x \) from a menu \( M \) without the frame, then with the frame this product becomes more attractive relative to smaller products. Thus, with the frame the buyer will continue to choose \( x \) over smaller products in the menu even if the price of \( x \) is increased slightly (and the prices of the smaller products are not decreased). This is why framing was profit-enhancing in the regulated market setting of the previous section.

Second, the product \( x \) becomes less attractive relative to larger products in the menu, whose prices may exceed the buyer’s willingness to pay. This implies that a buyer who made a purchase without the frame may not make a purchase with the frame because the bundle he finds most attractive is over-priced. This effect was irrelevant in the regulated market setting because the bundle intended for buyers was optimally larger than the regulator’s bundle. But with more than one type of buyer, the bundle intended for low-type buyers is often optimally smaller than the bundle intended for high-type buyers.

The potential adverse impact of this effect on the seller’s profit does not arise in a contract
$(M, f)$, where $M$ is part of a profit-maximizing frameless contract $(M, \phi)$ and $f$ increases attractiveness, if each buyer weakly $U^I$-prefers his chosen bundle in the frameless contract to larger bundles in $(M, f)$. Intuitively, this reflects a situation in which the frame is not “too strong.” In this case, every profit-maximizing contract involves framing. This is because the first effect above implies that, similarly to the complete information setting, the seller can increase the price of the largest chosen product in $M$ slightly so that every buyer will continue to purchase from the modified menu with the frame $f$ the same product he purchased in $(M, \phi)$.

On the other hand, when some buyers strictly $U^I$-prefer larger bundles in $(M, f)$ to their chosen bundle in $(M, \phi)$, an optimal contract with the frame $f$ may generate strictly lower profit than the optimal frameless contract, despite the increased attractiveness.

Such profit reduction may arise when the seller’s ability to vary the products in the menu is limited, e.g., due to regulatory or technological constraints. In this case, the optimal frameless contract may involve selling a “basic” product to low-type buyers and a “premium” product to high-type buyers. With the frame, the seller may be forced to reduce the price of the basic product to make sure that low-type buyers do not find the premium product more attractive than the basic product. The following example illustrates this.\(^{12}\)

**Example 1 (Price discrimination with linear frames)** There are only two available products, a basic product $x_L$ and a premium product $x_H > x_L$, whose production is costless. Buyers’ utility $u(x, \theta)$ satisfies $u(0, \theta) = 0$. There is a single frame $f \in \mathbb{R}_+$ that increases attractiveness with $u^f(x, \theta) = u(x, \theta) + xf$, i.e., the frame interacts linearly with the product and does not interact with the type.

Suppose that $\pi_H \in (\frac{u(x_H, L) - u(x_L, L)}{u(x_H, H) - u(x_L, H)}, \frac{u(x_L, L)}{u(x_H, H)})$, so the optimal frameless contract offers both products.\(^{13}\) The basic product in this contract is bought by low-type buyers, and its price $u(x_L, L)$ is determined by their binding participation constraint. The premium product is bought by high-type buyers and its price $u(x_H, H) - (u(x_L, H) - u(x_L, L))$ is determined by their binding incentive compatibility constraint.

For the optimal contract with the frame $f$ to generate more profit than the optimal frameless contract, it has to be a separating contract in which low-type buyers buy the basic product and high-type buyers buy the premium product. The maximal price the seller can charge for the premium product is $t_H = u(x_H, H)$, which is the high-type buyers’ willingness to pay for this product. Therefore, the maximal price that the seller can charge for the basic product so that in the frame $f$ low type buyers will find this product more attractive than the premium product is $t_L = u(x_H, H) - (u(x_H, L) - u(x_L, L)) - f(x_H - x_L)$. This price should not exceed the

\(^{12}\)We thank Andrew Rhodes for developing this example.

\(^{13}\)The condition on $\pi_H$ is derived by comparing the profit in the optimal contract in which both products are bought to the optimal pooling contract and to the optimal contract in which low-type buyers do not purchase anything.
low type buyers’ willingness to pay for the basic product \( u(x_L, L) \), which is guaranteed when 
\[
f \geq \frac{u(x_H, H) - u(x_H, L)}{x_H - x_L},
\]
so the optimal contract with frame \( f \) is pinned down in this case.

In this optimal contract, the seller gains 
\[
\pi_H(u(x_H, H) - (u(x_H, H) - (u(x_L, H) - u(x_L, L)))) = \pi_H(u(x_L, H) - u(x_L, L))
\]
on high type buyers relative to the optimal frameless contract, but loses 
\[
(1 - \pi_H)(u(x_L, L) - (u(x_H, H) - (u(x_L, H) - u(x_L, L)) - f(x_H - x_L)) on low-type buyers. For a large enough \( f \), the loss is larger than the gain.
\]

Profit reduction may also arise when the seller is able to change the products he offers. In this case, with framing he will offer low-type buyers better products than in the optimal frameless contract, rather than reducing prices as in Example 1. The prices of these better products will be relatively low, because the \( U \)-willingness to pay of low-type buyers is low. In a setting similar to that of Example 1, this will imply that framing increases the seller’s profit, because production is costless. But when producing better products is costly, offering them at relatively low prices may decrease the seller’s profit more than the gain due to increased attractiveness. Example 3 in the Appendix illustrates this channel for profit reduction. To summarize,

**Observation 2** If there exists an optimal frameless contract \((M, \phi)\) and a frame \( f \) that increases attractiveness such that every type weakly \( U \)-prefers in \((M, f)\) the product he chooses in \((M, \phi)\) to larger products, then every optimal contract involves framing. If this is not the case, then it may be that every optimal contract is frameless.

To focus on situations in which framing increases profit, our third assumption on framing limits the distortion that framing creates. It states that, similarly to the standard model with incomplete information, high-type buyers want to mimic low-type buyers in the first-best solution to the seller’s profit maximization problem.

**Assumption A3.** Limited distortion: For any frame \( f \), 
\[U^f(x_L^*, t_L^*, H) > U^f(x_H^*, t_H^*, H).\]

### 4.2 Characterization of the optimal contract

We now characterize the set of optimal contracts and their welfare properties under Assumptions (A1)-(A3). The set of optimal contracts may include pooling and separating contracts. If some optimal contract is pooling, then it implements the allocation rule 
\[g(\theta) = (x_L^*, t_L^*),\]
because the bundle \((x_L^*, t_L^*)\) is the profit-maximizing bundle subject to low-type buyers being \( U \)-indifferent between making and not making a purchase. In particular, framing does not influence the seller’s profit in this case. On the other hand,

**Proposition 2** Any optimal contract that is separating involves framing.

An immediate implication of Proposition 2 is that framing is profit-enhancing whenever the optimal pooling contract is dominated by some separating contract. This happens when \( x_L^* < d \),
or when \( x^*_L = d \) and there is a frame \( f \) such that \( u_x(d, L) < \pi_L c_x(d) + \pi_H u^f_x(d, H) \). In both cases, the optimal pooling contract is dominated by a separating contract in which low-type buyers are offered a product that is slightly lower than \( x^*_L \) at a price that equals their \( U \)-willingness to pay, and high-type buyers are offered the product \( x^*_L \) at a price that makes them \( U^f \)-indifferent to the low-type buyers’ bundle. Every optimal contract is therefore separating, so by Proposition 2 framing is profit-enhancing.

Another implication of Proposition 2 relates to participation.

**Corollary 1** Both types of buyers purchase positive products in any optimal contract.

This result contrasts with the model without framing, in which the optimal frameless contract excludes low-type buyers when their proportion in the population is small in order to eliminate the information rents of high-type buyers.

To see why such exclusion is never optimal with framing, consider a frameless contract that excludes low-type buyers and extracts the maximum surplus from high-type buyers by offering them the first-best bundle \( (x^*_H, t^*_H) \). By Proposition 2, this contract generates strictly less profit than any optimal contract with framing, which must therefore offer a positive product to low-type buyers.\(^\text{14}\)

Because buyers of both types purchase positive products in an optimal contract, it suffices to focus on contracts with two-product menus \( \{(x_L, t_L), (x_H, t_H)\} \), where \( (x_\theta, t_\theta) \) is the bundle purchased by type \( \theta \). By Assumption (A2), we have that \( (x_H, t_H) \geq (x_L, t_L) \), so we refer to \( (x_L, t_L) \) as the basic bundle and to \( (x_H, t_H) \) as the premium bundle. Our next proposition identifies the binding constraints in the seller’s profit maximization problem.

**Proposition 3** In an optimal contract with a frame \( f \), low-type buyers are \( U \)-indifferent between buying the basic bundle and not buying anything, and high-type buyers are \( U^f \)-indifferent between buying the premium bundle and the basic bundle.

The binding constraints in Proposition 3 are similar to the binding constraints in the optimal frameless contract. But in contrast to the optimal frameless contract, the constraints do not imply that whenever the basic product is positive high-type buyers strictly \( U \)-prefer the premium bundle to not making a purchase, so they do not necessarily obtain information rents in the form of positive surplus.

\(^\text{14}\) The seller can also exclude high-type buyers in the model with framing by offering them a bundle that is \( U^f \)-superior to the other bundles in the menu but is \( U \)-inferior to stayout, but this is dominated by the optimal pooling contract, because the production cost is type-independent.
4.3 Welfare properties

Framing that is profit-enhancing has several welfare implications. The first relates to the efficiency of the basic product. When the proportion of low-type buyers $\pi_L$ is small, the basic product with framing is more efficient than without framing, in the sense that it generates a larger social surplus with respect to low-type buyers, $\pi_L(u(x_L, L) - c(x_L))$. This is because the optimal frameless contract excludes low-type buyers when $\pi_L$ is small in order to eliminate the information rents of high-type buyers, while the optimal contract with framing always offers low-type buyers a positive product. This positive product is smaller than $x_L^*$, and thus generates positive social surplus. By Proposition 3, the entire surplus gain goes to the seller.

A second welfare difference relates to the efficiency of the premium product. Without framing, this product is efficient in the sense that it maximizes the social surplus with respect to high-type buyers, $\pi_H(u(x, H) - c(x))$. This is because for any basic bundle, the seller can extract from high-type buyers the entire social surplus generated from the premium bundle, up to an amount that makes high-type buyers $U$-indifferent between the premium bundle and the basic bundle. In contrast,

Proposition 4 The premium product in an optimal separating contract is strictly above the efficient level $x_H^*$ when $x_H^* < d$, and is efficient when $x_H^* = d$.

The reason for this efficiency distortion is that for any basic bundle $(0, 0) < (x_L, t_L) < (x_L^*, t_L^*)$ such that low-type buyers are $U$-indifferent between this bundle and not purchasing anything, increasing the premium product slightly above the efficient level along the high-type’s $U$-indifference curve does not decrease the seller’s profit to a first-order. But such an increase makes the premium product strictly more $U^f$-attractive to high-type buyers relative to the basic bundle, so the basic bundle can be increased along the low-type’s $U$-indifference curve through it without reducing the price of the premium product, which results in a first-order gain to the seller.15

A third difference relates to the information rents of high-type buyers. Without framing, high-type buyers always obtain a strictly positive surplus whenever the basic product is positive. This is because they can mimic low-type buyers, so by choosing the premium bundle they must obtain the surplus they would obtain from choosing the basic bundle. The most the seller can therefore charge for the premium product is the high-type buyer’s $U$-willingness to pay for it minus the difference between the high type’s $U$-willingness to pay for the basic product and the basic product’s price. But with framing, the seller can charge for the premium product the high-type buyer’s $U^f$-willingness to pay for it minus the difference between his $U^f$-willingness to pay for the basic product and its price, subject to not exceeding high-type buyers’ $U$-willingness to pay for the premium product. When this last constraint binds, high-type buyers do not obtain

15 Over-consumption arises for other reasons in Carbajal and Ely (forthcoming) and Galperti (2015).
any surplus. In fact, even a frame that creates a small distortion can eliminate the entire surplus of high-type buyers, as the following example illustrates.

Example 2 (Price discrimination with linear utility) Suppose that production is costless, that \( L < H \in \mathbb{R}_+ \), that \( u^f(x, \theta) = u(x, \theta) + xf \) as in the previous example, and that \( u(x, \theta) = x\theta \). The first-best product is then \( x^* = d \) independently of buyers’ types. Fix some frame \( f > 0 \) and assume that \( \pi_H \in (\frac{1}{f+T}, \frac{1}{H}) \).

Using well-known properties of the optimal contract without framing,\(^{16}\) one can show that because \( \pi_H < \frac{1}{H} \), the optimal frameless contract is a pooling contract with the bundle \((d, dL)\). The surplus of high-type buyers in this contract is \( d(H - L) > 0 \).

In the optimal contract with framing, we have that \( x_H = d \), because the optimal pooling contract includes the bundle \((d, dL)\) and Proposition 4 implies that \( x_H = x_H^* = d \) in an optimal separating contract. By Proposition 3, the price of the basic product is \( x_L L \), and the price of the premium product satisfies \( d(H + f) - t_H = x_L(H + f) - t_L \), so \( t_H = d(H + f) - x_L(H + f - L) \).

In addition, the price of the premium bundle cannot exceed the \( U \)-willingness to pay of high-type buyers, i.e., \( t_H \leq dH \). The minimal \( x_L \) that satisfies these conditions is \( \frac{df}{H+f-L} \), and it is straightforward to verify that because \( \pi_H > \frac{1}{f+T} \), this \( x_L \) is profit-maximizing.

We thus obtain that the uniquely optimal contract is \( ((\frac{df}{H+f-L}, \frac{df}{H+f-L}), (d, dH)), f) \). In contrast to the optimal frameless contract, the surplus of high type buyers in this contract is 0.\( \checkmark \)

A fourth welfare difference is that framing increases total surplus, i.e., \( \pi_L(u(x_H, L) - c(x_L)) + \pi_H(u(x_H, H) - c(x_H)) \), relative to the standard model when the proportion of low-type buyers is small. To see why, suppose that the proportion of low-type buyers is small, so that the optimal frameless contract excludes them and offers the first-best bundle \((x_H^*, t_H^*)\) to high-type buyers. Fix a frame \( f \), and let \((x_L, t_L)\) denote a basic bundle such that high-type buyers are \( U^f \)-indifferent between this bundle and \((x_H^*, t_H^*)\) and low-type buyers are \( U \)-indifferent between this basic bundle and not making a purchase. By increased attractiveness for high-type buyers, \((x_L, t_L) > (0, 0)\), and by assumptions (A2) and (A3), \((x_L, t_L) < (x_L^*, t_L^*)\).\(^{17}\) The total welfare in the contract \( ((x_L, t_L), (x_H^*, t_H^*)) \) is higher than in the optimal frameless contract, because the premium product is unchanged and the basic product is more efficient. The profit-maximizing contract with framing further increases welfare: it weakly increases the seller’s profit by definition, and it gives buyers of both types a weakly higher \( U \)-utility than what they get in the above contract, in which they are \( U \)-indifferent to not buying anything.

\(^{16}\)See, for example, Fudenberg and Tirole (1992, Chapter 7.1.1).

\(^{17}\)If \((x_L, t_L) \geq (x_L^*, t_L^*)\), then low-type buyers \( U^f \)-prefer \((x_L, t_L)\) to \((x_L^*, t_L^*)\) because they are \( U \)-indifferent between these two bundles. Because high-type buyers have the same \( U^f \)-ranking of these two bundles, and because they are \( U^f \)-indifferent between \((x_H^*, t_H^*)\) and \((x_L, t_L)\), we obtain that they \( U^f \)-prefer \((x_H^*, t_H^*)\) to \((x_L^*, t_L^*)\), contradicting Assumption (A3).
5 Monopolistic insurance with a highlighted bundle

Sellers often highlight a particular product in the menu, and the highlighted product frequently includes premium features that are not included in other products. For example, Figure 1 in Appendix A illustrates that Sam’s Club highlights its premium “sam’s plus” membership by putting it in a separate box and by indicating that it is the “best value”. The premium membership includes a 2% annual rebate and early shopping hours, which are not included in the basic membership. Similarly, Figure 2 illustrates that the online insurance provider “Insure My Rental Car” highlights its premium policy over the basic one by coloring it in a darker color and adding a “check” mark to it. The premium policy covers personal property and hotel burglary, which are not included in the basic policy. In the spirit of Tversky and Kahneman’s (1991) model of reference-dependent choice, highlighting may trigger buyers to anticipate regret in case they will need a feature that is included in the highlighted product but not in the product they purchased.

This section studies the optimal highlighting of a product in the menu in the context of Stiglitz’s (1977) insurance setting. There are two key departures from the framing we considered so far. First, the highlighted product has to be offered in the menu, so there is a dependency between the menu and the frame. Second, highlighting a product affects buyers’ behavior differently than increased attractiveness, so we have to modify assumption (A1).

Stiglitz’s monopolistic insurance. A risk-neutral profit-maximizing insurance provider offers a menu of insurance bundles to a population of risk-averse individuals. Each individual has initial wealth $w$, and may suffer an accident of size $A > 0$. An individual’s privately-known probability of an accident is $\theta \in \{L,H\}$, with $0 < L < H < 1$. The proportion of Low-risk individuals in the population is $\pi_L > 0$ and of High-risk individuals is $\pi_H = 1 - \pi_L > 0$. Each individual’s preferences over wealth are summarized by a strictly increasing, strictly concave, and continuously differentiable function $u$.

An insurance bundle is a pair $(x,t)$, where $t$ is the premium paid by the individual to the insurance provider upfront and $x \geq 0$ is the amount paid by the provider to the individual if the accident occurs. The expected utility of an individual with risk level $\theta$ from the bundle $(x,t)$ is

$$U(x,t,\theta) = \theta u(w - t - A + x) + (1 - \theta)u(w - t).$$

Because buyers are risk averse and the insurance provider is risk neutral, the first-best bundles involve full coverage, i.e., $x^*_H = x^*_L = A$.

Stiglitz’s setting departs from the environments we considered so far in two ways. First, the seller’s cost $c(x,\theta) = x\theta$ is type-dependent, because high-risk individuals are more costly to serve than low-risk individuals. Second, buyers’ $U$-preferences are not quasi-linear. They nonetheless satisfy the natural extension of Assumption (A2), in that high-risk individuals value
an additional unit of coverage more than low-risk individuals.\textsuperscript{18}

**Frames that highlight a bundle.** We enrich Stiglitz’s setting by assuming that in addition to offering a menu of insurance bundles the provider can also highlight one bundle in the menu. The highlighting changes the “reference point” to which buyers compare insurance bundles, so that instead of evaluating bundles relative to the outside option, buyers evaluate them relative to the highlighted bundle. This leads buyers to anticipate a mental loss in case of an accident if they buy less coverage than in the highlighted bundle. After the highlighting effect fades away, buyers return to evaluate bundles relative to the outside option, i.e., according to $U$.

Formally, let $f = (x_f, t_f)$ denote the highlighted bundle. A contract is a pair $(M, f)$ where $f \in M$. That is, the highlighted bundle has to be offered in the menu. The set $F$ of frames is the set of all possible bundles.

A buyer anticipates that if he purchases an insurance bundle $(x, t)$ with coverage $x \leq x_f$, he will experience a mental loss or regret of $r(x_f - x)$ in case an accident occurs, in addition to the material effect of the accident on his wealth. That is, in the frame $f$ an individual chooses from the menu a bundle $(x, t)$ that maximizes

$$U^f(x, t, \theta) = \theta \left( u(w - t - A + x) - 1_{x \leq x_f}r(x_f - x) \right) + (1 - \theta) u(w - t).$$

In line with Tversky and Kahneman (1991), the regret function $r$ satisfies the following properties:

- $r'(\Delta) > 0$ for $\Delta \geq 0$: Regret is increasing in the difference in coverage $\Delta = x_f - x$ between the highlighted coverage and the chosen coverage,
- $r''(\Delta) < 0$ for $\Delta > 0$: Marginal regret is decreasing, and
- $r(0) = 0$: There is no regret if the chosen coverage is equal to the highlighted coverage.\textsuperscript{19}

As mentioned earlier, highlighting departs from the framing we considered so far in two ways. First, frames do not increase the attractiveness of every marginal increase in coverage as Assumption (A1) postulates. Rather, they increase the attractiveness of additional coverage as long as the total coverage is less than the reference coverage.\textsuperscript{20}

Second, there is a dependency between the menu and the frame, because the reference bundle has to be offered in the menu. Thus, an optimal contract may in principal require three bundles:

\textsuperscript{18}Formally, $\frac{\partial U(x,t,H)}{\partial x} > \frac{\partial U(x,t,L)}{\partial x}$.

\textsuperscript{19}Note that $r$ does not depend on the premium in the reference bundle. Our characterization of the optimal contract extends to cases in which $r$ decreases in the reference premium, as long as $r$’s dependency on the premium satisfies conditions that parallel those in the first two bullet points.

\textsuperscript{20}Formally, $\frac{\partial U^f(x,t,\theta)}{\partial x} > \frac{\partial U(x,t,\theta)}{\partial x}$ for any $f \neq (0,0)$ and $x < x_f$. 

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a basic one targeted at low-risk individuals, a premium one targeted at high-risk individuals, and a highlighted bundle. The seller’s profit-maximization problem then has the additional constraints that type-θ buyers $U^f$-prefer the bundle $(x_\theta, t_\theta)$ to the highlighted bundle.

**Optimal contract.** In solving for the optimal contract and the optimal highlighted bundle, three complications arise relative to the setting of Section 4. First, the highlighted bundle has to be part of the menu, which adds additional constraints to the seller’s profit-maximization problem. We omit these constraints in solving for the optimal contract and verify that the resulting optimal highlighted bundle coincides with one of the menu’s bundles.

Second, the seller’s cost is type-dependent. This changes the analysis of the optimal contract because the seller may wish to exclude high-risk individuals, who are more costly to serve. This is impossible in the standard model, but can be done (and is sometime optimal) with framing.

Third, the specification of buyers’ preferences and frame-dependent behavior is not quasi-linear, and does not satisfy increased attractiveness. But the weaker version of increased attractiveness mentioned above holds, as well as the natural extension of Assumption (A2) to non quasi-linear environments. These properties suffice to establish Proposition 3 in this setting and characterize the optimal contract when high-risk individuals are not excluded.

We now proceed to characterize the optimal contract. Because the optimal frameless contract is separating (see Stiglitz (1977)) and framing does not increase the profit from pooling contracts, any optimal contract with highlighting is separating. Any optimal contract also has the following properties, which are proved in Appendix B.

**Property 1** The highlighted coverage is identical to the premium coverage in any optimal contract in which high-risk individuals purchase insurance.

Property 1 is in line with the real-world phenomenon that the highlighted product often coincides with the premium product. This property arises because the marginal sensitivity to losses is decreasing, so by setting the highlighted coverage to be equal to the premium coverage, the seller minimizes the attractiveness of the basic insurance bundle to high-risk individuals.

**Property 2** In an optimal contract, low-risk individuals purchase insurance regardless of the distribution of types.

Property 2 implies that framing that highlights a bundle increases the social surplus with respect to low-risk individuals when their proportion in the population is small. This is because in this case the optimal frameless contract excludes low-risk individuals. By Proposition 3, the entire surplus gain goes to the seller.

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21 Formally, $\frac{\partial U^f(x,t,H)}{\partial x} \geq \frac{\partial U^f(x,t,L)}{\partial x} \geq \frac{\partial U^f(x,t,H)}{\partial t}$ for any frame $f$.

22 Assumption (A3) holds, because $x_H^* = x_L^* = A$ and $t_H^* > t_L^*$. 
Property 3 In an optimal contract, high-risk individuals are either strictly over-insured, or do not purchase insurance.

Property 3 implies that framing reduces the social surplus with respect to high-risk individuals. One channel for inefficiency is over-consumption of high-risk individuals, which enables the seller to increase the coverage of low-risk individuals, similarly to Proposition 4. A new channel for inefficiency is exclusion. Because high-risk individuals are more costly to serve than low-risk individuals, the insurance provider may want to exclude them and only serve low-risk individuals. This is impossible without framing, but can be done with framing by offering high-risk individuals a premium insurance bundle that they $U^f$-prefer to the basic bundle but that is $U$-inferior to not purchasing insurance.

Taken together, Properties 2 and 3 imply that with framing the seller may optimally choose to serve only low-risk individuals. This is in line with the phenomenon of advantageous selection identified in the empirical literature. Such advantageous selection will arise in our setting when high-risk individuals are at very high risk of having an accident, so the profit from fully insuring them is low, whereas low-risk individuals are at intermediate risk, so the profit from fully insuring them is high. Insuring both types then generates less profit than excluding high-risk individuals and fully insuring low-risk individuals, because whenever low-risk individuals are substantially insured, any insurance bought by high-risk individuals leads to a loss.

6 Alternative model of buyers’ behavior

The main postulate of our model is that framing is not persistent, in the sense that it influences buyers at the point of sale but fades away afterward. Buyers are partially sophisticated in that they reevaluate their purchase according to their preferences after the framing effect fades away and renege on it in case they overpaid.

There are of course alternative ways to capture buyers’ partial sophistication and how they use their underlying $U$ preferences in making choices. One possibility that reflects greater sophistication on part of the buyers is that after overpaying for a product, buyers internalize how framing influenced them at the point of sale and are able to resist similar framing effects from this point on. Such increased sophistication can be modelled by the choice correspondence that assigns to every contract $(M, f)$ the set of:

1. all the $U^f$-maximal bundles in $M$ that are weakly $U$-superior to stayout, and
2. all the $U$-maximal bundles in $M \cup \{ \text{stayout} \}$ if stayout is weakly $U$-superior to some $U^f$-maximal bundle in $M$.

We conclude with a discussion of how such increased sophistication affects the predictions of our model.
Our first observation is that the increased sophistication of buyers does not change the characterization of the optimal contract in Section 3, in Section 4 when framing is not too strong (as captured by assumption (A3)), and in Section 5 when high-risk individuals purchase insurance. Consider, for example, the optimal allocation rule in Section 4. Any contract that implements this allocation rule in our model also implements it in the model with increased sophistication. And to verify that this allocation rule is profit-maximizing with increased sophistication, note that in the model with increased sophistication, we have that (i) a type-$\theta$ buyer purchases $(x_\theta, t_\theta)$ only if it is $U$-superior to not buying anything, and (ii) if low-type buyers make a purchase, then high-type buyers purchase the premium bundle only if it is $U^I$-superior to the basic bundle. The constraints (i) and (ii) are the only relevant constraints in the original model.

Our second observation is that the increased sophistication may actually increase the seller’s profit in other settings. This can happen when framing is sufficiently strong so that assumption (A3) is violated. In this case, the seller in the original model is worried about low-type buyers not making a purchase because they are attracted to the premium bundle, which is too expensive for them. He therefore has to offer them a basic bundle that is of high quality at a relatively low price to make sure they make a purchase. But in the alternative model, the seller does not have to worry about this. Buyers who overpay will internalize the framing effect, return the premium product and then buy another product according to their $U$-preferences. Thus, increased sophistication may actually hurt buyers because it enables the seller to screen them better, and have high-type buyers make purchases according to $U^I$ and low-type buyers according to $U$. 
A Examples of highlighting

![Sam's Club and The Brookfield Zoo brochures](image1.png)

Figure 1: Sam’s Club (left) and The Brookfield Zoo (right) brochures

![Insurance policies at InsureMyRentalCar.com](image2.png)

Figure 2: Insurance policies at InsureMyRentalCar.com

B Proofs

**Proof of Proposition 1.** We proved in the main text that the optimal contract involves framing, and that if there exists a frame $f$ such that buyers $U_f$-prefer the first-best bundle $(\hat{x}_0^*, \hat{t}_0^*)$ to $(\bar{x}, \bar{t})$, then buyers purchase the first-best bundle in the optimal contract. We now proceed to examine the case in which there is no such frame.
Denote by \((x,t)\) a bundle chosen by a buyer in an optimal contract. It cannot be that \(x < x_\theta^*\), because then replacing \((x,t)\) with the bundle \((x_\theta^*,t+\Delta)\), where \(\Delta = u(x_\theta^*,\theta) - u(x,\theta)\), would increase the seller’s profit (by increased attractiveness and the concavity of the seller’s profit-maximization problem). If \(x = x_\theta^* < d\), then \(t < t_\theta^*\) (otherwise \((x_\theta^*,t^*_\theta)\) is implementable), so \(U(x_\theta^*,t,\theta) > U(x_\theta^*,t^*_\theta,\theta) = U(0,0,\theta)\), and by optimality of the contract \(U^f(x_\theta^*,t,\theta) = U^f(x_\theta^*,t^*_\theta,\theta)\). For small \(\varepsilon > 0\), let \(\Delta = u^f(x_\theta^* + \varepsilon,\theta) - u^f(x_\theta^*,\theta)\). Thus, \(U^f(x_\theta^*,t,\theta) = U^f(x_\theta^* + \varepsilon,t + \Delta,\theta)\). In addition, \(u^f_x(x_\theta^*,\theta) > u_x(x_\theta^*,\theta) = c'(x_\theta^*)\) (the equality follows from the definition of \(x_\theta^* < d\)), so for sufficiently small \(\varepsilon\) we have that \(U^f(x_\theta^* + \varepsilon,t + \Delta,\theta) = U^f(x_\theta^*,t,\theta) > U(x_\theta^*,\theta)\), and \(c(x_\theta^* + \varepsilon) - c(x_\theta^*) < \Delta\). Thus, replacing the bundle \((x,t)\) with \((x + \varepsilon,t + \Delta)\) increases the seller’s profit.

**Example 3.** Consider the price discrimination setting of Example 1, with \(u(x,\theta) = x\theta\), \(c'(x) = x\) for \(x \leq 1\), and \(c'(x) = 1 + (x - 1)/B\) for \(x > 1\), where \(B\) is large.\(^{23}\) Suppose that the seller can only increase attractiveness substantially. Specifically, suppose that \(F = \{\phi, f\}\), where \(f = 9\). Suppose also that high type buyers’ \(U\)-willingness to pay for quality is much higher than that of low type buyers. Specifically, \(L = 1\) and \(H = 2\). Finally, suppose that \(\pi_L > 1/2\).

We now specify two frameless contracts \(D\) and \(E\) by describing their menus \(D\) and \(E\), and show that the profit that any contract with the frame \(f\) generates is strictly lower than the maximum of the profit that these two contracts generate. Let \(D = \{(x_L^*,t_L^*), (x_H^*,t_H^*)\}\), where \(x_L^* = 1\), \(x_H^* = 1 + B\), \(t_L^* = 1\), and \(t_H^* = 2B + 1\). Then, \((x_L^*,t_L^*) \in C^L(D,\phi)\) and \((x_H^*,t_H^*) \in C^H(D,\phi)\). When buyers choose these bundles, \(D\) generates profit \(\pi_H (B + 1)/2\) from high type buyers, which is only \(\pi_H\) less than the first-best profit from selling to high type buyers, and generates the first-best profit from low type buyers. Let \(E = \{(\varepsilon, \varepsilon), (x_H^*,t_H^* - \varepsilon)\}\) for some small \(\varepsilon > 0\). Then, \((\varepsilon, \varepsilon) \in C^L(E,\phi)\) and \((x_H^*,t_H^* - \varepsilon) \in C^H(E,\phi)\). When buyers choose these bundles and \(\varepsilon\) is sufficiently small, the profit that \(E\) generates is strictly higher than the first-best profit from selling to high type buyers, because \(\pi_L > \pi_H\).

Consider a contract with the frame \(f\) that excludes buyers of some type, i.e., these buyers choose *stayout*. If the contract excludes high type buyers, then the profit it generates is bounded above by the first-best profit from selling to low type buyers, which is strictly lower than the profit generated by \(D\). If it excludes low type buyers, then the profit it generates is bounded above by the first-best profit from selling to high type buyers, which is strictly lower than the profit generated by \(E\).

Now consider a non-excluding contract \(G\) with the frame \(f\), denote by \((x_\theta^*,t_\theta^*) \neq stayout\) the bundle that buyers of type \(\theta\) choose, and suppose that \(G\) generates more profit than any excluding contract. To generate more profit than \(D\), the contract \(G\) must generate a profit of at least \(\pi_H (B + 1)/2\) from high type buyers, because \(D\) already generates the first-best profit from

\(^{23}\)The cost of producing \(x\) units is therefore \(c(x) = x^2/2\) for \(x \leq 1\) and \(c(x) = (1 - B + 2(B - 1)x + x^2)/2B\) for \(x > 1\).
follows: Suppose to the contrary that there is an optimal separating contract that is frameless, and denote by \( g(\theta) = (x_\theta, t_\theta) \) the optimal allocation it implements. The standard theory tells us that \( x_L \leq x_L^*, x_H = x_H^* \); low-type buyers are \( U \)-indifferent between \((0,0)\) and \((x_L, t_L)\), and high-type buyers are \( U \)-indifferent between \((x_L, t_L)\) and \((x_H, t_H)\). Consider a modified contract with the menu \( \{(x_L, t_L), (x_H, t_H)\} \) and a frame \( f \neq \phi \). By Assumption (A1), high-type buyers strictly \( U^f \)-prefer \((x_H, t_H)\) to \((x_L, t_L)\), but low-type buyers may also \( U^f \)-prefer \((x_H, t_H)\) to \((x_L, t_L)\). We now modify the bundles in a way that increases profit until \( g(\theta) \) with the modified bundles is implemented. First, increase \( t_H \) until high-type buyers are either \( U^f \)-indifferent between \((x_H, t_H)\) and \((x_L, t_L)\) or are \( U \)-indifferent between \((x_H, t_H)\) and \((0,0)\). If the latter occurs before the former, increase \( x_L \) and \( t_L \) along the \( U \)-indifference curve of low type buyers through \((0,0)\). By Assumption (A3), high-type buyers will be \( U^f \)-indifferent between \((x_H, t_H)\) and \((x_L, t_L)\) before \((x_L, t_L)\) reaches \((x_L^*, t_L^*)\). By Assumption (A2) the modified contract implements \( g \), and by properties of the seller’s problem this generates a strictly higher profit than the original contract, a contradiction.

Proof of Proposition 2. If \( f = \phi \), then we are in the standard setting, in which these properties are well known. Suppose that \( f \neq \phi \). If the contract is a pooling one, then the properties follow immediately. It thus remains to consider a separating contract in which all buyers choose a positive product and \( f \neq \phi \). The seller’s problem (conditional on \( f \)) can therefore be written as follows:

Choose \( ((x_L, t_L), (x_H, t_H)) \) to maximize \( \pi_L(t_L - c(x_L)) + \pi_H(t_H - c(x_H)) \) subject to:

\[
IR^U_\theta : U(x_\theta, t_\theta, \theta) \geq U(0,0, \theta) \text{ for } \theta \in \{L, H\},
\]
\[
IC^f_\theta : U^f(x_\theta, t_\theta, \theta) \geq U^f(x_{\theta'}, t_{\theta'}, \theta) \text{ for } \theta, \theta' \in \{L, H\} \text{ and } \theta' \neq \theta.
\]

Considering an optimal contract, we first note that if \( IC^f_\theta \) holds strictly, then \( IR^U_\theta \) binds, otherwise \( t_\theta \) can be increased slightly without violating any of the constraints. This implies that either \( IC^f_H \) or \( IC^f_L \) bind, otherwise, because by Assumption (A3) \( \{(x_L, t_L), (x_H, t_H)\} \neq \{(x_L^*, t_L^*), (x_H^*, t_H^*)\} \), some \( x_\theta \) can be increased or decreased slightly along the \( U \)-indifference curve of agent \( \theta \) to decrease \( |x_\theta - x_\theta^*| \), which increases the principal’s profit, without violating any of the constraints.
In fact, \( \text{IC}^f_H \) must bind. Indeed, suppose that \( \text{IC}^f_L \) binds. By Assumption (A2), because \( x_L < x_H \), \( \text{IC}^f_H \) holds strictly, so \( \text{IR}^U_H \) binds. We now modify the bundles in a series of steps in a way that increases profit, such that either at some point along the sequence all the constraints are satisfied, so the modified bundles generate more profit than the optimum, a contradiction, or the modified bundles are \((x^*_h, t^*_h)\) and \( \text{IC}^f_H \) holds, which contradicts Assumption (A3). The first step applies if \( x_H > x^*_H \). In this case, decrease \((x_H, t_H)\) continuously along the high type’s \( U \)-indifference curve until either \( \text{IC}^f_H \) binds or \( x_H = x^*_H \). In the former case, Assumption (A2) implies that \( \text{IC}^f_L \) holds, so all the constraints are satisfied and the principal’s profit increases, a contradiction. We therefore have that \( x_H \leq x^*_H \) and \( \text{IC}^f_H \) holds strictly. Now increase \( t_L \) until \( \text{IR}^U_L \) binds. This further relaxes \( \text{IC}^f_H \). Finally, if \( x_L < x^*_L \), increase \((x_L, t_L)\) continuously along the low type’s \( U \)-indifference curve until either \( \text{IC}^f_H \) binds or \( x_L = x^*_L \). In the former case, we obtain a contradiction as in the first step. We have therefore reached a situation in which (i) \( x_L \geq x^*_L \) and \( \text{IR}^U_L \) binds, (ii) \( x_H \leq x^*_H \) and \( \text{IR}^U_H \) binds, and (iii) \( \text{IC}^f_H \) holds strictly. Now, (i), Assumption (A1), and Assumption (A2) imply that

\[
U(x_L, t_L, L) = U(x^*_L, t^*_L, L) \Rightarrow U(x_L, t_L, L) \geq U(x^*_L, t^*_L, H) \Rightarrow U^f(x_L, t_L, H) \geq U^f(x^*_L, t^*_L, H),
\]

and (ii) and Assumption (A1) imply that

\[
U(x^*_H, t^*_H, H) = U(x_H, t_H, H) \Rightarrow U^f(x^*_H, t^*_H, H) \geq U^f(x_H, t_H, H),
\]

so by (iii) we have \( U^f(x^*_H, t^*_H, H) > U^f(x^*_L, t^*_L, H) \), which contradicts Assumption (A3).

Because \( \text{IC}^f_H \) binds, by (A2) we have that \( \text{IC}^f_L \) holds strictly, so \( \text{IR}^U_L \) binds.

**Proof of Proposition 4.** First observe that \( x_L \leq x^*_L \) and \( x_H \geq x^*_H \). Indeed, if \( x_L > x^*_L \), then decrease \((x_L, t_L)\) slightly along low-type buyers’ \( U \)-indifference curve so that \( \text{IC}^f_L \) continues to hold. By Assumption (A1) and (A2) this relaxes \( \text{IC}^f_H \), so all constraints hold and the profit increases, a contradiction. If \( x_H < x^*_H \), then increase \((x_H, t_H)\) slightly along the high type’s \( U \)-indifference curve so that \( \text{IC}^f_H \) continues to hold. By Assumption (A1) this relaxes \( \text{IC}^f_H \), so all constraints hold and the profit increases, a contradiction.

Finally, suppose that \( x^*_H < d \) and \( x_H = x^*_H \). If \( \text{IR}^U_H \) holds strictly, then \( x_L < x^*_L \), similarly to the standard setting.\(^{25}\) And if \( \text{IR}^U_L \) binds, then \( x_L < x^*_L \), because Assumption (A3) implies that \( \{(x_L, t_L), (x_H, t_H)\} \neq \{(x^*_L, t^*_L), (x^*_H, t^*_H)\} \). But \( x_L < x^*_L \) implies that the principal’s marginal

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\(^{24}\)It must be that \( x_H \geq x_L \), because by \( \text{IR}^L_L \) and (A2) \((x_L, t_L)\) lies below the high type’s \( U \)-indifference curve through \((0,0)\), so \( \text{IC}^f_H \) binds before \( x_H \) reaches \( x_L \).

\(^{25}\)If \( x^*_L = x_L \), then \( x^*_L = x_L < x_H = x^*_H < d \), because the contract is separating. That \( x^*_L < d \) implies that the principal’s marginal cost at \( x^*_L \) is equal to low type buyers’ marginal \( u \)-utility, whereas \( x^*_L < x^*_H \) implies that high type buyers’ marginal \( u \)-utility at \( x^*_L \) is strictly higher (because the profit function is concave along each type’s \( U \)-indifference curve). Therefore, by Assumption (A2), decreasing \( x_L \) by some small \( \varepsilon \) along the low type’s \( U \)-indifference curve decreases high type buyers’ \( U \)-utility from the bundle \((x_L, t_L)\) by at least \( \delta \varepsilon \) for some \( \delta > 0 \).
profit at \( x_L \) along the low type’s \( U \)-indifference curve is positive, while \( x_H = x_H^* \) implies that the principal’s marginal profit at \( x_H \) along the high type’s \( U \)-indifference curve is 0. Therefore, the profit can be increased by increasing \( x_H \) slightly along the high type’s \( U \)-indifference curve, which relaxes \( IC_H^f \) and makes it possible to increase \( x_L \) along the low type’s \( U \)-indifference curve.\(^{26}\)

**Proof of Property 1.** Assume to the contrary that there exists an optimal contract in which high-risk individuals buy insurance and in which the reference coverage \( x_f \) differs from the high type’s coverage \( x_H \). By Proposition 3, whose proof applies to the insurance setting as well, \( IC_H^f \) holds with equality in this contract, and because \( x_H > x_L > 0 \), by Assumption (A2) \( IC_L^f \) holds strictly. We now modify this contract by modifying the reference coverage to derive a contradiction to Proposition 3. If \( x_f < x_H \), then increase \( x_f \) slightly to \( x_H \) (or slightly above the low-risk individual’s coverage \( x_L \) if \( x_f < x_L \)) so \( IC_L^f \) still holds. This increases the regret associated with purchasing the low-risk individuals’ bundle (but not with purchasing the high-risk individuals’ bundle), so \( IC_H^f \) holds strictly and all other constraints hold. If \( x_f > x_H \), then decrease \( x_f \) slightly to \( x_H \) so \( IC_L^f \) still holds. This makes low-risk individuals’ bundle less attractive relative to that of high-risk individuals, because \( r \) is concave and \( x_H > x_L \). Again, this implies that \( IC_H^f \) holds strictly and all other constraints hold. In both cases, the new separating contract generates the same profit as the original one, and is therefore optimal, but in contradiction to Proposition 3, the constraint \( IC_H^f \) holds strictly.

**Proof of Property 2.** Letting \( f = (x_H^*, t_H^*) \), we obtain the result using the same arguments for non-exclusion of low type buyers in the discussion following Proposition 2, whose proof applies to the insurance setting as well.

**Proof of Property 3.** Consider an optimal contract in which high-risk individuals buy insurance. As in the proof of Proposition 4, we have that \( x_L \leq A = x_L^* \) and \( x_H \geq A = x_H^* \). Thus, to complete the proof it suffices to verify that any contract in which low-risk individuals are partially insured, high-risk individuals are fully insured, and full coverage is highlighted is not optimal.

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\(^{26}\)More precisely, increasing \( x_H \) by some small \( \varepsilon \) along the high type buyers’ \( U \)-indifference curve increases their \( U^f \)-utility from the bundle \((x_H, t_H)\) by at least \( \delta \varepsilon \) for some \( \delta > 0 \) that is independent of \( \varepsilon \). And increasing \( x_L \) by some small \( \gamma \) along the low type buyers’ \( U \)-indifference curve increases the high type buyers’ \( U^f \)-utility from the bundle \((x_L, t_L)\) by no more than \( \alpha \gamma \) for some \( \alpha > 0 \). Thus, the increase of \( x_H \) by \( \varepsilon \) allows to increase \( x_L \) by at least \( \delta \varepsilon / \alpha \). And because the marginal effect on the profit of such an increase in \( x_H \) is 0, whereas the marginal effect on the profit of the increase in \( x_L \) is positive, for small \( \varepsilon \) the profit increases.
Consider such a contract, and increase the high-risk individuals’ coverage and premium slightly along their $U$-indifference curve. This does not change the provider’s profit to a first order, because when high-risk individuals are fully insured their willingness to pay for an additional unit of insurance is identical to the provider’s cost of providing this unit. Because the new coverage is larger than the reference coverage, $U$-indifference implies that a high-risk individual is also $U^f$-indifferent between his original bundle and the new bundle, so $IC_{H}^{f}$ continues to hold; and $IC_{L}^{f}$ continues to hold because it held strictly before the change. Now increase $x_f$ to equal the new coverage $x_f$ for the high-risk individual. Then $IC_{H}^{f}$ holds strictly, and $IC_{L}^{f}$ continues to hold if the change in coverage is small enough. Finally, increase the low-risk individuals’ coverage and premium slightly along their $U$-indifference curve, which strictly increases profit to a first order and does not violate any of the constraints.

References


