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Optimal pricing scheme for addictive goods

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This article analyses how consumers' habit formation and addiction affect firms' pricing policies. I consider both sophisticated consumers, who realize that their current consumption will affect future tastes, and "naive" consumers, who do not. The optimal contract for sophisticated consumers is a two-part tariff. The main result is that the optimal pricing pattern when the consumer is naive is a "bargain then rip-off" contract, namely a fixed fee, with the first units priced below cost, and then priced above marginal cost. This holds both under symmetric and asymmetric information about the consumers' degree of sophistication.

1. Introduction

■ Over the last few years, a significant increase in the use of smartphones and mobile internet has been documented (Zenith Media, 2019). Recent experimental studies show that their use is habit-forming (Mosquera et al., 2020; Allcott et al. 2020),[1,2] and that they have addictive properties (Allcott et al., 2021).[3,4] This article shows that the naivety about the addictive properties of the good makes the use of the "bargain then rip-off" contracts optimal, which are the pricing contracts we observe in these markets (Lambrecht and Skiera, 2006). These contracts include a

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[1] The use of social media is predominantly facilitated through smartphones, creating a direct link between the marginal pricing of smartphones use and the consumption of social media.

[2] People feel that they use these goods more than they think they should. Recent experimental studies find that reducing the current consumption of social media would reduce future consumption, suggesting some form of learning or habit formation (Mosquera et al., 2020; Allcott et al. 2020).

[3] They find that reducing consumption can increase subjective well-being, suggesting some form of addiction.

[4] See also Tromholt (2016), Sagioglou and Greitemeyer (2014), Hunt et al. (2018), Vanman et al. (2018), Mosquera et al. (2020), Acland and Chow (2018), Allcott et al. (2020) for discussions on digital addiction and its effect on well-being and grades.

fixed fee, an allowance of bargain units, and a positive rip-off price for additional units beyond the allowance.

I study a dynamic pricing model in which a firm sets all the prices at the contractual stage, and the consumers decide whether or not to buy, based on their expectation of the value of their future consumption. The consumers have two consumption opportunities within the contract period: they can buy the good once or twice, depending on their needs and their valuation of the good.

I consider consumers of different levels of sophistication who are not aware of the addictiveness properties of the good that is, they are naive about how today's consumption affects future consumption. Moreover, there are two types of naively addicted consumers of diverse sophistication: first, "mostly habit-forming" consumers, and second "mostly addicted" consumers. In the case of mostly habit-forming consumers, the positive effect of acquiring a habit through past consumption is stronger than the negative effect of becoming addicted to it. The main implication is that this type of consumer *ex ante* undervalues the contract because she underestimates the acquired habit. On the other hand, if mostly addicted, the damage from becoming addicted to the good's consumption is more significant than the increasing pleasure of consuming it over time. Therefore, this consumer mistakenly overvalues the contract at the contractual stage because she cannot foresee, due to her naivety, the magnitude of the damage from addiction.

If the consumers are sophisticated, namely consumers know the exact value of their future consumption, the firm finds it optimal to maximize the consumer surplus by setting marginal prices equal to the marginal cost, and to charge a fixed fee that extracts all the consumer surplus. Thus, it is optimal for the monopolist to charge a two-part tariff.

If the consumer is even slightly naive about her addiction and the monopolist can recognize that she will become addicted, then the optimal contract is a "bargain then rip-off" type of contract. The firm charges a marginal price above the marginal cost for high volumes, a marginal price below marginal cost for low volumes, and a fixed fee.

As an intuition, naive consumers underestimate the probability of having high demand at the contractual stage. They do not expect that they will acquire a habit and thus fail to realize that the probability of consuming the next unit of the good or service will be larger. Given this bias, the firm finds it optimal to distort the marginal cost pricing by charging a marginal price above the marginal cost for this good and, thus, for high volumes.[5]

Naively addicted consumers do not make mistakes about the probability of having low demand at the contractual stage. It is only after consuming the good that they experience an unexpected change in their demand (Pollak, 1975). Moreover, the naively addicted consumer evaluates her consumption decisions sequentially, and she is forward-looking. This means they can foresee that there will be a price change in the future and they internalize this information into their decision as to whether or not to consume in the current period. They can also foresee that they may forego utility if they consume today and expect that the next unit will be charged differently and may be more costly. Thus, the monopolist finds it optimal to charge a price below the marginal cost for low volumes, as the consumers are forward-looking, with the second unit priced above the marginal cost, for the reasons explained above. In this way, the probability of consuming the first unit increases and the cost of the foregone future utility decreases. The firm finds it optimal to increase the probability of consuming the first unit, not only because it will lead to an increased future consumption but also because the firm can fully extract the surplus produced from the first unit. As the consumer makes no mistake at the contractual stage for the first unit, the perceived expected utility is equal to the actual expected utility. Thus, the fixed fee can fully extract the surplus of this unit.

Finally, the third part of the tariff is the fixed fee. This fee is equal to the gross expected surplus of the consumers at the contractual stage. However, the mostly habit-forming consumers

[5] See Armstrong (2016) for a detailed survey on non-linear pricing and markets where contracts with similar characteristics are optimal.

undervalue the contract offered by the monopolist at the contractual stage, because they cannot foresee that they will value the good more highly the more they consume it. They participate in the market and consider themselves to be less habit- forming. For this reason, the firm cannot extract all the consumer surplus actually produced with the fixed fee. The monopolist mitigates the contract undervaluation, and thus extracts as much consumer surplus as possible by distorting marginal prices. The direction of the distortion of the marginal prices is as discussed. The mostly habit-forming consumers are, in turn, left with a positive *misperception rent*, given by the difference between their true expected surplus and the surplus they mistakenly perceive at the contractual period. Consequently, the mostly habit-forming naive consumers cannot be exploited through the pricing scheme.[6] Nonetheless, the underestimation of the value of the contract at the contractual period, causes some consumers not to participate in the market, even if they actually value the good more than its cost, leading to participation distortion (Heidhues and Kőszegi, 2015).

Interestingly, if the good is mostly addictive, the consumer still underestimates high demand but overestimates the value of the contract at the contracting stage. She cannot foresee the magnitude of the loss in the contract's value after consuming. I show in Section 4 that the welfare implications are the opposite, and that the firm can exploit the mostly addicted naive consumer.

In Section 4, I also relax the assumption of the firm being fully informed about the consumer's sophistication and study the pricing strategy of a monopolist when the firm cannot observe the consumer type. I study the optimal screening of mostly habit-forming consumers with differing degrees of sophistication. I contend that frequently observed contract menus, that comprise both two-part tariffs and "bargain then rip-off" types of contracts, can be explained by the presence of consumers of heterogeneous levels of sophistication. In this way, the firm screens between sophisticated and naive consumers. The "bargain then rip-off" contract is still the optimal type of contract for naive consumers.

To understand why, consider that the sophisticated consumers would have an incentive to mimic the naive consumers. Even if they know that they are more likely to consume in the future, they will likely choose a contract that penalizes large consumption levels with high marginal prices. By mimicking the naive consumer, the sophisticated consumers would be left with a positive rent *ex post*, because the contract made for naive consumer charges a fixed fee that does not extract all the surplus. For this reason, the optimal contract for sophisticated consumers charges the same marginal prices as the full information case, but a smaller fixed fee. Consequently, the presence of naive consumers in the market exerts a positive externality on the sophisticated consumers, in the spirit of "rip-off externality" (see Armstrong (2015)).

The optimal contract for naive consumers is still a "bargain then rip-off", as in the full information case because of the same economic forces. The difference now is that the contracts should be incentive compatible and not attractive to the sophisticated consumer. For this reason, I observe an increase in the marginal prices per unit. The firm still cannot exploit the naive consumers who are left with a positive but smaller, in this case, misperception rent. Thus, the naive consumers are worse off when there are sophisticated consumers in the market.

Even if the optimal marginal price for low volumes is smaller than the marginal cost, the naive consumer under-consumes compared to the sophisticated case. The firm does not charge a pricing scheme that induces the efficient probability of consumption, but rather, a smaller probability. On the one hand, a decrease in the low volume marginal price would have only second order efficiency losses because the firm can fully extract consumer surplus on these units. Moreover, it would lead to an increase in the second unit surplus as its consumption becomes more probable. Importantly, however, the firm can only extract a part of the second unit surplus by overcharging it. It cannot fully extract it with the fixed fee, because the consumer does not anticipate *ex ante* its real value. Therefore, the firm bears all the costs of subsidizing low volumes

[6] I use the notion of exploitation according to Eliaz and Spiegler (2006), where "An exploitative contract extracts more than the agent's willingness to pay, from his first-period perspective".

of consumption, but only a fraction of its benefits, which motivates it to under-invest as well in incentivizing its consumption.

In Section 5, I consider a market where there is perfect competition both with informed and uninformed firms. The optimality of a "bargain then rip-off" contract in the presence of naive habit-forming consumers is again confirmed. The only part of the tariff that differs is the fixed fee, which decreases as the market becomes more competitive.

The article proceeds as follows. Section 2 discusses the related literature. Section 3 outlines the model setup, and Section 4 presents the case of full information and asymmetric information with a monopolist in the market. Section 5 considers the case of perfect competition when the firms are both informed and uninformed. Finally, Section 6 concludes.

2. Literature

■ This article has strong connections to different streams of the literature. First, it is related to models that explain the use of the "bargain then rip-off" contract (see Armstrong (2016) for a thorough review). Moreover, it is related to models that explain the use of three-part tariffs, for example, over-confidence about the precision of the prediction when making difficult forecasts (Grubb, 2009), inattention about one's own consumption (Grubb, 2014), or being optimistic, and thinking that the good state is more likely to happen (Eliaz and Spiegler, 2008).[7] I propose a different explanation for this pricing scheme, which does not necessarily rely on such mistakes.

Articles that discuss the optimal pricing of habit goods (Nakamura and Steinsson, 2011; Fethke and Jagannathan, 1996) or addictive goods (Becker et al., 1991; Driskill and McCafferty, 2001) are also linked to my study, however, I consider them within a contract period, where the firm cannot renegotiate the price during the contract period.

Moreover, the discussion of a naive consumer is closely related to articles that consider the optimal nonlinear pricing induced by various types of consumers' biases or nonstandard preferences.[8], [9] On the one hand, some articles discuss biased beliefs (DellaVigna and Malmendier, 2004; Eliaz and Spiegler, 2006), naivety about self-control (Esteban et al., 2007; Heidhues and Köszegi, 2010) and myopia (Gabaix and Laibson, 2006; Miao, 2010). A common consequence of these behavioural biases is an underestimation of the demand, which results in marginal prices above the marginal cost. These models cannot explain why marginal prices are below the marginal cost for low volumes.

On the other hand, there are biases that may explain prices below the marginal cost, but not above; for example, behaviours, such as naive quasi-hyperbolic discounting for investment goods (DellaVigna and Malmendier, 2004) and flat rate bias (Lambrecht and Skiera, 2006) that lead to an overestimation of demand, or non-standard preference, such as loss aversion (Herweg and Mierendorff, 2013).

This article is also related to the literature on exploitative contracting, where firms design their contracts to profit from the agent's mistakes. There are two kinds of consumers' mistakes most often analyzed in the literature. First, the consumer does not understand all of the features of a contract (all prices and fees) (Gabaix and Laibson, 2006; Armstrong and Vickers, 2012). Second, a consumer may mis-predict her own behavior concerning the product (DellaVigna and Malmendier, 2004). The latter type of mistake is closer to the model I study here, and, as in my model, the consumer mispredicts that her valuation for the good will change if she has consumed before.

[7] I assume, however, that the firm cannot observe all the consumption opportunities of the consumer.

[8] See Köszegi (2014) for a survey of behavioral economics research in contract theory.

[9] For rational preferences, see Mussa and Rosen (1978) and Maskin and Riley (1984). Although they explain contracts with high marginal prices for early units and marginal cost pricing for late units consumed, they cannot predict the reverse, which characterizes "bargain then rip-off".

In Section 4, the uninformed monopolist model is related to the behavioral screening literature, where a principal screens the agents with respect to their degree of sophistication. In the literature, there are screening models with respect to loss aversion, (Hahn et al., 2012; Carbajal and Ely, 2012), present bias, temptation disutility (Esteban et al., 2007), or overconfidence (Sandroni and Squintani, 2010; Spinnewijn, 2013). In contrast to this literature, the optimality of the pricing scheme is not the result of a screening mechanism.

This section is also related to the literature on the sequential screening of consumers with standard preferences. In these models, the consumers know the distribution of their valuation for the good at the contracting period and, subsequently, learn their realized valuation (Courty and Li, 2000; Miravete, 2005; Inderst and Peitz, 2012).

Eliaz and Spiegler (2006) show that the principal gains a lot by also contracting the event that the consumer thinks is unlikely to happen. The difference in the prior expectations between the consumers and the principal leaves room for exploitation. In this article, by contrast, the consumer does not know the extent to which her utility function will change after consuming in the first period. This feature becomes important because in all cases the contract is signed before the consumer experiences the change in her utility and cannot be renegotiated afterward.

3. Model setup and consumer behaviour

□ **Model setup.** This section presents the basic structure of the model. A consumer has two consumption opportunities: one per period, and in each period purchases at most one unit of the good. Moreover, the consumer is subject to addiction with differing levels of sophistication, and there is one firm. The consumers are uncertain about their valuation of the good in each period.

The time horizon is $T = 2$. At period 0, the firm offers a menu of contracts:

$$\boldsymbol{\sigma}^{\theta} = \{F^{\theta}, p_1^{\theta}, p_2^{\theta}\}.$$

where θ is the level of sophistication of the consumer. The contract $\boldsymbol{\sigma}^{\theta}$ consists of p_1^{θ} (the price of the first unit consumed), p_2^{θ} (the price of the second unit consumed), and F^{θ} (a fixed payment). The first unit is assumed to have the same price, irrespective of the period t when consumed. Time-dependent pricing would require that the firm observe and record the opportunities to consume, as if the consumer had direct communication with the firm in every opportunity to consume.[10,11] The total payment is:

$$P^{\theta}(\mathbf{q}) = p_1^{\theta} q_1 + p_1^{\theta}(1 - q_1)q_2 + p_2^{\theta} q_1 q_2 + F^{\theta},$$

which is a function of quantity choices $\mathbf{q} = (q_1, q_2)$, the marginal prices $\mathbf{p}^{\theta} = (p_1^{\theta}, p_2^{\theta})$ and the fixed fee F^{θ}.

Consider a consumer who is rationally addicted in the spirit of Becker and Murphy (1988). At each period $t \in \{1, 2\}$, the consumer learns the realization of the taste shock v_t for the good and for its outside option. More specifically, the consumer's value for the first unit is $v_{1,good} \sim F_1$, where $F_1 : [\underline{v}, \overline{v}] \to [0, 1]$ is the cumulative distribution function (CDF). I assume that F_1 is continuous on $\mathbb{R}_+$ and has a density f_1 that take values $f_1(v) > 0$ for all $v > 0$. Moreover, F_1 has a finite mean: $\int v f_1(v) dv < \infty$. Her value for the outside option of the first unit is zero, $v_{1,outside} = 0$ with probability one.

If she consumes the first unit in the first period, $q_1 = 1$, her value for the second unit in the second period is distributed as $v_{2,good} \sim F_2$, with the same properties as $F_1(v)$. To reflect the idea that the good is habit-forming, I assume that $F_2(v) \leq F_1(v)$ for every v.[12] Moreover, the value of

[10] Contrary to Grubb (2014), I assume that the firm cannot observe the period in which the consumption takes place. It is plausible to assume that the firm cannot observe whether or not the consumer decides to consume.

[11] The result of increasing the marginal pricing holds also in the case that the firm could observe it. See Appendix for an analysis of the model with date-dependent pricing.

[12] This is in the spirit of Becker and Murphy (1988), on the complementarity of consumption and capital stock, namely $u_{cs} > 0$, where c is consumption and s consumption stock.

the second unit's outside option is $v_{2,outside} = w < 0$ with probability one. The valuation of the outside option of the second unit is less than that of the first unit, if the consumer has consumed before, in order to reflect the product's addictive properties.

Moreover, if $q_1 = 1$, she anticipates that the second unit surplus is:

$$V_2(p_2^\theta) = \int_{\underline{v}}^{\overline{v}} \max(v - p_2^\theta, w) f_2(v) dv =$$
$$= \int_{p_2^\theta + w}^{\overline{v}} (v - p_2^\theta) f_2(v) dv + \int_{\underline{v}}^{p_2^\theta + w} w f_2(v) dv$$

integrating by parts then,

$$V_2(p_2^\theta) = \int_{p_2^\theta + w}^{\overline{v}} (1 - F_2(v)) dv + (1 - F_2(p_2^\theta + w)) w + F_2(p_2^\theta + w) w$$
$$= \int_{p_2^\theta + w}^{\overline{v}} Q_2(v) dv + w$$

where $Q_2(v)$ is the analogous surplus associated with $1 - F_2(v)$.

If she does not consume the first unit in the first period, $q_1 = 0$, then in the second period, the consumer evaluates the consumption of the first unit again, as in the first unit in the first period $v_{1,good} \sim F_1(v)$ and her value for the outside option of the first unit is zero, $v_{1,outside} = 0$ with probability one. The consumer anticipates surplus $V_1(p_1^\theta)$ for this first unit, where:

$$V_1(p) = \int_p^{\overline{v}} Q_1(v) dv$$

is the surplus function associated with demand function $Q_1(v) = 1 - F_1(v)$.

Let now assume that there are also naive consumers in the market who are unaware of how much the good is habit-forming and addictive. Let $\theta \in [0, 1]$ be the level of sophistication of the consumer as the weight that a naive consumer attributes to her rational expectation beliefs and her mistaken status quo, first unit beliefs. In this case, the naively perceived consumer surplus of the good is the weighted average of the two consumer surpluses:

$$\begin{aligned} \tilde{V}_2(p_2^\theta) &= \theta \int_{\underline{v}}^{\overline{v}} \max(v - p_2^\theta, w) f_2(v) dv + (1 - \theta) \int_{\underline{v}}^{\overline{v}} \max(v - p_2^\theta, 0) f_1(v) dv \\ &= \theta \int_{p_2^\theta + w}^{\overline{v}} Q_2(v) dv + (1 - \theta) \int_{p_2^\theta}^{\overline{v}} Q_1(v) dv + \theta w \end{aligned} \tag{1}$$

A sophisticated consumer, $\theta = 1$, anticipates that the value is likely to rise for the second unit and the value for its outside option will decrease. By contrast, the absolutely naive consumer, $\theta = 0$ mistakenly believes that the second unit has the original CDF, $F_1(v)$, with no change in the outside option.[13] For $\theta \in (0, 1)$, the consumer is partially naive, and she knows that there will be change in both the valuation of the good and its outside option but does not fully foresee the magnitude of this change.

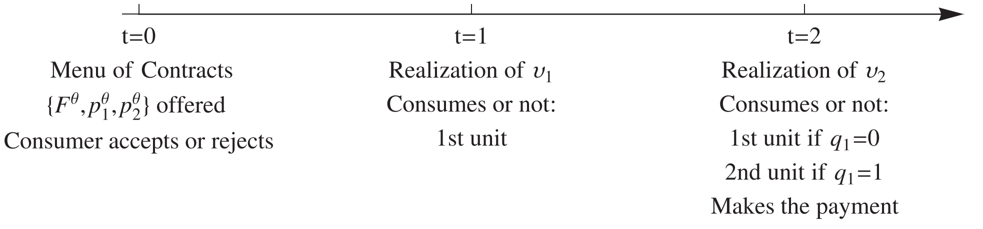
The timing of the game is described in Figure 1 and there is no discounting.

□ **Consumer behaviour.** The consumer decides whether or not to participate in the market by solving backward her problem during the contract period that constructs her expectation for the value of the contract *ex ante*.

[13] Naive habit formation is like having increasing marginal utility the more she consumes in the past, but the naive consumer wrongly believes that her marginal utility is linear.

FIGURE 1

TIMING OF THE GAME, WITH NO DISCOUNTING.



In the second period the consumer's consumption depends on whether or not she has consumed in the first period. If $q_1 = 0$, then she consumes when $v_2 > p_1^\theta$ and the expected surplus is $V_1(p_1^\theta)$. If $q_1 = 1$, the price of the second unit is p_2^θ and she consumes when $v_2 > p_2^\theta + w$, the respective expected surplus is $\tilde{V}_2(p_2^\theta)$.

Given this behaviour in the second period, and going backward in the first period, the consumer will consume when $v_1 - p_1^\theta + \tilde{V}_2(p_2^\theta) > V_1(p_1^\theta) \Rightarrow v_1 > p_1^\theta + V_1(p_1^\theta) - \tilde{V}_2(p_2^\theta)$, where $V_1(p_1^\theta) - \tilde{V}_2(p_2^\theta)$ is the perceived foregone second period consumer surplus if $q_1 = 1$. If $\theta \in [0, 1)$; namely, the consumer is partially naive, let $X_\theta = p_1^\theta + V_1(p_1^\theta) - \tilde{V}_2(p_2^\theta)$ be the optimal first period threshold above which the realization of taste shock should be in order for her to consume the first unit. If the consumer is sophisticated, $\theta = 1$ the respective threshold is $X_1 = p_1^1 + V_1(p_1^1) - V_2(p_2^1)$.

The consumer is forward-looking and is partially aware of having a habit-forming propensity, so she takes into account both the opportunity cost of consuming the first unit (i.e., the price increase from p_1^θ to $p_2^\theta + w$ for the second unit), and the increase in her valuation due to the habit. The habit-forming consumer expects to experience a larger utility in the future if she consumes the first unit, so she finds it optimal to increase the probability of consuming the first unit. Thus, the optimal threshold decreases. Moreover, the first-period threshold increases if the second unit marginal price increases and it decreases the more habit-forming the consumer is.

The naive consumer consumes less often than she would if she were sophisticated when she undervalues the second unit consumption, $\tilde{V}_2(p_2^\theta) < V_2(p_2^\theta)$, and consequently $X_\theta > X_1$. In this case, the consumer is *mostly habit-forming*, in the sense that the difference between the actual and the perceived gain through habit from consuming the first unit is greater than the difference between the actual and perceived cost due to addiction. Interestingly, the more sophisticated the consumer is, that is, the larger the θ, the smaller the X_θ, the result shows:

$$\frac{\partial X_\theta}{\partial \theta} = -\frac{\partial \tilde{V}_2(p_2^\theta)}{\partial \theta} \leq 0 \quad \text{and} \quad \lim_{\theta \to 1} X_\theta = X_1$$

Definition 1. The consumer is *mostly habit-forming* when $\tilde{V}_2(p_2^\theta) < V_2(p_2^\theta)$ for every p_2^θ.

On the other hand, the naive consumer over-consumes relative to the sophisticated one when $X_\theta < X_1$, which happens when she overvalues the second unit consumption, $\tilde{V}_2(p_2^\theta) > V_2(p_2^\theta)$. In that event, the consumer is *mostly addicted* at p_2^θ as the difference between the actual and perceived loss due to the addictive properties is more significant than the relevant gain due to the habit-forming properties.

Definition 2. The consumer is *mostly addicted* when $\tilde{V}_2(p_2^\theta) > V_2(p_2^\theta)$ for every p_2^θ.

Finally, the consumer buys the contract *ex ante* at the contractual stage, before the random value v_1 of the first unit is realized. Then, the *ex ante* expected consumer surplus is:

$$\begin{aligned}\tilde{V}(p_1^\theta, p_2^\theta) =& V_1(p_1^\theta) + \int_{p_1^\theta + V_1(p_1^\theta) - \tilde{V}_2(p_2^\theta)}^{\overline{v}} Q_1(v)dv \\ =& V_1(p_1^\theta) + V_1(p_1^\theta + V_1(p_1^\theta) - \tilde{V}_2(p_2^\theta)) \\ =& V_1(p_1^\theta) + V_1(X_\theta)\end{aligned} \tag{2}$$

Therefore, she believes that her expected surplus is $\tilde{V}(p_1^\theta, p_2^\theta)$, even though her actual expected surplus, and the one that the firm knows she will have, is $V(p_1^\theta, p_2^\theta)$:

$$\begin{aligned}V(p_1^\theta, p_2^\theta) =& V_1(p_1^\theta) + V_1(p_1^\theta + V_1(p_1^\theta) - V_2(p_2^\theta)) \\ =& V_1(p_1^\theta) + V_1(X_1).\end{aligned} \tag{3}$$

In period one, the consumer uses the same threshold as she expected to use when she signed her contract in the contractual stage. More specifically, the probability of consuming in the first period is $Q_1(X_\theta)$, as the consumer expected at period 0. This means that there is no mistake that the firm could take advantage of. The only implication of the consumer's naivety, in the first period, is related to the expected consumer surplus $V_1(X_\theta)$. In the case where the consumer is mostly naively habit forming, the $X_\theta > X_1$ and $V_1(X_\theta)$ is smaller than the one that would be produced if the consumer were sophisticated, $V_1(X_\theta) < V_1(X_1)$. The effect would be the opposite in the case where the consumer is mostly naively addicted and $X_\theta < X_1$ then the consumer surplus is larger than it would be if she were sophisticated, $V_1(X_\theta) > V_1(X_1)$.

In the second period, given that the consumer has not consumed before ($q_1 = 0$), she does not realize that she is habit forming, and thus she consumes as much as she was expecting to consume at the contract period. The probability of consuming is $(1 - Q_1(X_\theta))Q_1(p_1^\theta)$, and it does not differ from what the consumer would expect. The consumer does not overestimate the probability of buying only one unit, and indeed does not make any mistake given that her consumption is low.

On the other hand, given that the consumer has consumed before ($q_1 = 1$), she has a mistaken belief about the probability of consuming two units. She expects that her optimal choice probability, in this case, would be $\tilde{Z}_2(p_2^\theta)$,

$$\tilde{Z}_2(p_2^\theta) = \frac{\partial \tilde{V}_2(p_2^\theta)}{\partial p_2^\theta} = \theta Q_2(p_2^\theta + w) + (1-\theta)Q_1(p_2^\theta) \tag{4}$$

where $\tilde{V}_2$ is (equation (1)). However, she realizes *ex post* in the second period that the probability is $Z_2(p_2^\theta)$, more specifically, $Z_2(p_2^\theta) = Q_2(p_2^\theta + w)$. She underestimates the probability of consumption when $Z_2(p_2^\theta) > \tilde{Z}_2(p_2^\theta)$, which holds regardless of whether the habit or the addiction is stronger.

Thus, the *ex ante* probability of consuming in both periods is expected to be $Q_1(X_\theta)\tilde{Z}_2(p_2^\theta)$, but it is in fact $Q_1(X_\theta)Z_2(p_2^\theta)$. Hence, she has a mistaken belief about the second unit consumption.

Lemma 1. Let π be the actual probability of consumption and $\tilde{\pi}$ the perceived probability of consumption at the contacting period. A naively addicted consumer makes no mistake about the probability of consuming one unit, namely $\pi(q_1 = 1) = \tilde{\pi}(q_1 = 1)$ and $\pi(q_2 = 1|q_1 = 0) = \tilde{\pi}(q_2 = 1|q_1 = 0)$. Moreover, she underestimates the probability of consuming two units, $\pi(q_2 = 1|q_1 = 1) > \tilde{\pi}(q_2 = 1|q_1 = 1)$. This holds both when she is mostly naively habit-forming and mostly naively addicted.

In addition, because of her naivety, the consumer mistakenly evaluates the value of the offered contract. In the case, where she is *mostly naively habit-forming*, she under-evaluates the value of the offered contract at the contracting stage. First, the consumer does not anticipate that consuming in the first period will increase the valuation of her second unit, so she does not expect a greater surplus $V_2(p_2^\theta) > \tilde{V}_2(p_2^\theta)$, and she does not consider it in the *ex ante* valuation of the whole contract. Second, she underestimates the probability of consuming the second unit, and thus acquiring this extra utility. In the case of being *mostly naively addicted*, she over-evaluates the value of the offered contract at the contracting stage, as $V_2(p_2^\theta) < \tilde{V}_2(p_2^\theta)$ and underestimates the probability of consuming the second unit, and thus suffering this extra cost.

4. A monopoly market

■ Let me assume that there is a monopolistic firm in the market. The cost of the production of one unit of the good is $\overline{v} > c > 0$.

□ **Informed monopolist.** Consider first the case in which the firm can observe the type of consumer and can offer a type-specific contract. The firm recognizes that it faces a naively addicted consumer, whose participation depends on her mistaken expected utility $\tilde{V}(p_1^\theta, p_2^\theta)$ (equation (2)).

The firm maximizes its profits subject to the participation constraint of the consumer as she perceives it at the contracting period, namely $\tilde{V}(p_1^\theta, p_2^\theta) - F^\theta \geq 0$. Thus, the optimization problem of the firm is:

$$\begin{aligned}
\max_{\sigma^N} \Pi = \{ & Q_1(X_\theta)[p_1^\theta - c + Z_2(p_2^\theta)(p_2^\theta - c)] \\
& + [1 - Q_1(X_\theta)]Q_1(p_1^\theta)(p_1^\theta - c) + F^\theta\} \\
\text{s.t.} \quad & V_1(X_\theta) + V_1(p_1^\theta) - F^\theta \geq 0,
\end{aligned}$$

where $Z_2(p_2^\theta)$ is the true probability of consuming the second unit, and X_θ is a function of the perceived probability of consuming the second unit $\tilde{Z}_2(p_2^\theta)$ (equation (4)). Moreover, the firm chooses a pricing scheme that makes the participation constraint binding, $V_1(X_\theta) + V_1(p_1^\theta) - F^\theta = 0$. As mentioned, the consumer undervalues the contract at the contracting stage if she is mostly habit-forming or overvalues it if she is mostly addicted.

The maximization problem of the monopolist becomes:

$$\begin{aligned}
\max_{\sigma^\theta} \Pi = \{ & Q_1(X_\theta)[p_1^\theta - c + Z_2(p_2^\theta)(p_2^\theta - c)] \\
& + [1 - Q_1(X_\theta)]Q_1(p_1^\theta)(p_1^\theta - c) + V_1(X_\theta) + V_1(p_1^\theta)\} \\
\text{s.t.} \quad & V_1(X_\theta) + V_1(p_1^\theta) - F^\theta = 0.
\end{aligned}$$

Calculating the marginal prices that maximize the above expression, the result depends on the level of sophistication of the consumer. If $\theta = 1$, namely the consumer is sophisticated, then the following result is obtained.

Proposition 1. If the consumer is *rationally* addicted, the equilibrium allocation is the first-best allocation. Marginal cost pricing is implemented, with prices that maximize the firm's profits being $(p_1^{1*}, p_2^{1*}) = (c, c)$, and the fixed fee F^1 equals the gross consumer surplus, given by $V(c, c)$.

In this case, the firm maximizes its profit by charging marginal prices that induce the first best allocation, and then with the fixed fee F^1 it extracts all the consumer surplus (see Appendix A).

On the other hand, if the consumer is naively addicted and $\theta \in [0, 1)$, then the optimal pricing changes, and the following result is obtained

Proposition 2. Monopoly: If the consumer is naively addicted, the optimal marginal pricing scheme is: $p_1^{\theta*} < c$, and $p_2^{\theta*} > c$. The fixed fee F^θ equals the gross perceived consumer surplus, which is given by $\tilde{V}(p_1^{\theta*}, p_2^{\theta*})$.

Proof. See Appendix A □

The optimal pricing scheme when the consumer is naively addicted resembles the scheme observed in several markets, namely the *"bargain then rip-off"* scheme. This consists of a fixed fee, an included allowance of units, for which the marginal price is smaller than the marginal cost, and a positive large marginal price for units beyond the allowance.[14]

A firm facing a naively addicted consumer has an incentive to distort the efficient allocation in order to maximize its profits. As the consumer misperceives her expected utility, the participation constraint is biased. In the case where the consumer is *mostly habit-forming*, the firm cannot extract the surplus produced through a fixed fee, because the perceived surplus is smaller than the one produced.

The exact way in which the marginal prices are distorted depends on the characteristics of the consumer's behaviour. Firstly, the mostly naively habit-forming consumer underestimates[15] the probability of consuming the second unit and thus underestimates the surplus that it produces. The firm cannot extract *ex ante* the second unit surplus, and with a price p_2^θ bigger than the cost, partially manages to extract it *ex post*. On the other hand, given that the consumer is forward-looking and takes into consideration the opportunity cost of consuming the first unit, without anticipating the magnitude of the increase in her valuation for the good, she consumes less often to avoid the price increase. In response, the firm finds it optimal to decrease the marginal price of the first unit below cost so as to constrict the downward bias in consumption and incentivize the consumer to invest in her habit.

These marginal prices exacerbate the mistake[16] of the second unit consumption. The naive consumer fails to invest on her own in acquiring the habit. On the one hand, the firms want to incentivize the naive consumer to invest and so decreases the marginal price of the first unit below marginal cost, in order to make its consumption more probable. The firm can extract all the first unit surplus, so the surplus losses from a small price distortion are second order. Moreover, the first unit price decrease makes the consumption of the second unit more probable and the second unit surplus increases. Thus, this price decrease has a positive first order effect in both q_1 and q_2. On the other hand, the firm cannot extract all the surplus of the second unit, because it only extracts it *ex post* through $p_2^\theta > c$. This *ex post* extraction of surplus causes standard monopoly dead-weight loss and the consumer is left with a positive surplus. Thus, the firm has an incentive to increase the first-period optimal threshold to minimize the part of the consumer surplus that it cannot extract. The firm bears all the costs of lowering p_1^θ, but only a fraction of its benefits, and it finds it optimal to under-invest as well incentivize consumption. This leads to an inefficiently low probability of consumption for the first unit relative to the efficient sophisticated case.[17]

Similarly, there is under-consumption of the second unit. The optimal second unit threshold for the naive consumer is always greater than that of the sophisticated consumer, $p_2^\theta > c$. The firm prefers to extract some of the surplus that cannot be extracted *ex ante*, even if, in this way, it lowers the probability of consumption.

[14] I could consider $F_2(v) > F_1(v)$; describing a "novelty thrill" or a "fashion good", the less novel or fashionable, the less someone wants to consume it. Then, the purchasing probability is decreasing without being aware of it *ex ante* and the opposite pricing scheme is optimal, that is, $p_1^N > c$, $p_2^N < c$.

[15] This underestimation makes it optimal for the firm to distort pricing, similar to behaviours such as hyperbolic discounting and myopia.

[16] DellaVigna and Malmendier (2004) were the first to point out that firms might design contracts to exacerbate consumer's mistakes. Since their pioneering contribution, many articles have explored the specific ways to exploit consumer naivety.

[17] In the Appendix, I solve an example that illustrates that $X_\theta(p_1^{\theta*}, p_2^{\theta*}) > p_1^{1*} = c$.

In the telecommunication market, we observe that the offered contracts are non-linear during a single month of the "bargain then rip-off" structure, but that they also create a commitment for repeated monthly payments of this type for one or two years. I do not model the repeated monthly payments, though; intuitively, this kind of contract helps to better form habits and to extract surplus over time. The low marginal price for the first unit helps the firm to encourage habit formation. Still, as habits have not yet been formed, relatively low consumption means that a high marginal price for the second unit has less probability of being considered. However, the low-cost units continue to boost the habit in the following months, and the probability of consuming the most costly units increases. So, even if the low marginal price for the first unit reduces surplus, the extraction is worth it, given the initial months' considerations. Moreover, with habits well-formed over time, the high marginal price after the end of the discounted units increasingly helps to extract the surplus.

The overall gain or loss for the consumer of buying the contract depends on the difference between the perceived consumer surplus and the true consumer surplus. Let us define, Δ, as the misperception rent which is the consumer surplus that cannot be extracted by the firm due to her naivety:

$$\Delta = V(p_1^\theta, p_2^\theta) - \tilde{V}(p_1^\theta, p_2^\theta) = V_1(X^\theta) - \tilde{V}_1(X_\theta)$$

where $X_1 = p_1^\theta + V_1(p_1^\theta) - V_2(p_2^\theta)$ and $X_\theta = p_1^\theta + V_1(p_1^\theta) - \tilde{V}_2(p_2^\theta)$.

If $\tilde{V}_2(p_2^{\theta*}) < V_2(p_2^{\theta*})$, namely the consumer is *mostly habit-forming*, then $X_\theta(p_1^{\theta*}, p_2^{\theta*}) > X_1(p_1^{\theta*}, p_2^{\theta*})$. The consumer is left *ex post* with positive consumer surplus $\tilde{V}(p_1^{\theta*}, p_2^{\theta*}) < V(p_1^{\theta*}, p_2^{\theta*})$ and $\Delta > 0$, because the firm cannot extract it all. This misperception rent would give an incentive to the consumer to remain naive and not pay the cost of becoming sophisticated and learning her true type. Remaining naive is beneficial for her both because the firm cannot extract all of her surplus and because she avoids paying any information cost to become sophisticated. Yet, as the naive consumer underestimate the value of the contract, she will not purchase even if the value for the contract is greater than its cost, leading to a participation distortion. Therefore, staying naive is beneficial only for the consumers who participate in the market, but it is not beneficial for those who do not participate exactly because of their naivety. Heidhues and Köszegi (2015) shows that the magnitude of such an inefficiency that arises in the extensive margin can be significantly large.

The optimal pricing is the same for the *mostly naively addicted* consumer but there are significant differences with respect to the implications of her naivete. The sophisticated consumer would consume less often than the naive consumer in the first period, $X_\theta(p_1^{\theta*}, p_2^{\theta*}) > X_1(p_1^{\theta*}, p_2^{\theta*})$, because being sophisticated, she can foresee that her future utility flow decreases with her current consumption. On the contrary, the naive consumer does not anticipate this decrease, and over-consumes in the first period. This makes it more likely that the consumer will face the decision of consuming the second unit. A unit that she consumes more often than expected, as $Z_2(p_2^\theta) > \tilde{Z}_2(p_2^\theta)$.

Moreover, the naive consumer would over-value the offered contract at the contract period, for the same reason. If $\tilde{V}_2(p_2^\theta) > V_2(p_2^\theta)$ the good is *mostly addictive*, then $X_\theta(p_1^{\theta*}, p_2^{\theta*}) < X_1(p_1^{\theta*}, p_2^{\theta*})$. The consumer is left *ex post* with negative consumer surplus $\tilde{V}(p_1^{\theta*}, p_2^{\theta*}) > V(p_1^{\theta*}, p_2^{\theta*})$ and the misperception rent is $\Delta < 0$. Thus, there are the opposite welfare implications. The over-valuation of the offered contract would lead to the exploitation of consumers, because at the contractual period the naive consumer would be willing to pay more than the actual expected value of the contract. This would lead to the inverse participation distortion with respect to the habit-forming case; namely, consumers would participate in the market even if their actual valuation for the contract is below its cost. Thus, in summary, the participation is more than the efficient one and the consumer who participates is exploited when the good is addictive.

The fact that a "bargain then rip-off" structure is exploiting the consumer's addiction leads to the following question: what would the implications of banning this kind of contract be when the consumer is mostly addicted? Forcing the firm to charge the same price for all the units consumed makes the firm find it optimal to charge a price $p^* > c$ for all units. Such a policy is welfare improving when the consumer significantly underestimates the quantity that she consumes in the second period, that is, the $\tilde{Z}_2(p_2^\theta) < Z_2(p_2^\theta)$ is significantly large.[18]

A typical concern is whether naivety dissipates with learning or whether it can be mitigated when appropriate feedback is provided (Bolger and Onkal-Atay, 2004), however, consumers may learn slowly (Grubb and Osborne, 2015), or forget what is learned (Agarwal et al., 2013). "Bargain and rip-off", nonetheless, is optimal when consumers are partially naive, which could resemble the period in which she learns her true type.

□ **Uninformed monopolist.** Now suppose that the firm cannot observe the type of the consumer and that there are only two types of *mostly habit-forming consumers*: first, the sophisticated consumer with $\theta = 1$; and second, the naive consumer with $\theta \in [0, 1)$.[19] However, it is known both by the firm and the consumers that the probability that the consumer is sophisticated is γ.

The screening is done with respect to the pricing scheme, and the firm offers a menu of contracts. Without any loss of generality, I can restrict the analysis to the case in which it offers as many contracts as the number of types; thus, two. Let $\boldsymbol{\sigma}^\theta = \{F^\theta, p_1^\theta, p_2^\theta\}$ and $\boldsymbol{\sigma}^1 = \{F^1, p_1^1, p_2^1\}$ be the contracts intended for the naive and the sophisticated consumer, respectively. This menu of tariffs completely identifies the allocation.

The maximization problem of the firm is:

$$\max_{\sigma^1,\sigma^\theta} \quad \gamma\big(Q_1(X_1)\big(p_1^1 - c + Z_2(p_2^1)(p_2^1 - c)\big) + (1 - Q_1(X_1))Q_1(p_1^1)(p_1^1 - c) + F^1\big)$$

$$+ (1-\gamma)\big(Q_1(X_\theta)\big(p_1^\theta - c + Z(p_2^\theta)(p_2^\theta - c)\big) + (1 - Q_1(X_\theta))Q_1(p_1^\theta)(p_1^\theta - c) + F^\theta\big)$$

$$\text{s.t.} \quad \begin{array}{ll} \tilde{V}(\mathbf{p}^\theta) - F^\theta \geq 0 & IR_\theta \\ V(\mathbf{p^1}) - F^1 \geq 0 & IR_1 \\ \tilde{V}(\mathbf{p}^\theta) - F^\theta \geq \tilde{V}(\mathbf{p^1}) - F^1 & IC_\theta \\ V(\mathbf{p^1}) - F^1 \geq V(\mathbf{p}^\theta) - F^\theta & IC_1. \end{array}$$

$\tilde{V}(\mathbf{p}^\theta) - F^\theta \geq 0$ and $V(\mathbf{p^1}) - F^1 \geq 0$ are the *participation constraints* of the naive and sophisticated consumer, respectively. Moreover, $\tilde{V}(\mathbf{p}^\theta) - F^\theta \geq \tilde{V}(\mathbf{p^1}) - F^1$ and $V(\mathbf{p^1}) - F^1 \geq V(\mathbf{p}^\theta) - F^\theta$ are the *incentive compatibility constraints*; that is, each type should not have any incentive to mimic the other at the optimal allocation. Note that the participation constraint must hold *ex ante*. Once the consumer has signed the contract, she is obliged to comply for the whole contract period, even if she would have an incentive to deviate.

The naive consumer at the contract period does not know that she will acquire a habit and that her utility will be greater than the one she expects. Marginal cost pricing creates a larger expected utility for the sophisticated consumer than for the naive consumer, thus the firm charges a fixed fee that the naive consumer would not be willing to pay. This suggests that the incentive compatibility constraint of the naive consumers, IC_θ, does not bind at the optimum.

On the other hand, the optimal full information contract is not incentive compatible for the sophisticated consumer, because she would prefer the contract of the naive consumer rather than her own first-best allocation. Even if the marginal pricing is distorted, it allows her to enjoy a strictly positive surplus equal to $V(\mathbf{p}^\theta) - \tilde{V}(\mathbf{p}^\theta)$. This suggests intuitively that it is the incentive compatibility constraint IC_1 that binds in the second-best problem. This intuition is confirmed formally in the following Lemma 2, which characterizes the constraints that bind and those that do not:

[18] See the Appendix for the proof and discussion of all the different cases.

[19] I assume that all the naive consumers have the same level of sophistication θ.

Lemma 2. If IC_θ is slack at the solution of the asymmetric information model, then the constraints IR_θ and IC_1 bind, whereas the constraint IC_θ is redundant. More specifically:

$$\begin{aligned} \tilde{V}(\mathbf{p}^\theta) - F^\theta &= 0 && IR_\theta \\ V(\mathbf{p}^1) - F^1 &> 0 && IR_1 \\ V(\mathbf{p}^1) - F^1 &= V(\mathbf{p}^\theta) - F^\theta && IC_1. \end{aligned}$$

Proof. See Appendix A □

The assumption that IC_θ is slack at the optimum implies that there will be marginal cost pricing for the sophisticated consumer.

Thus, taking Lemma 2 into consideration, the maximization problem can be relaxed and becomes:

$$\max_{p_1^\theta, p_2^\theta} \gamma \underbrace{\left(V(\mathbf{c}) - (V(\mathbf{p}^\theta) - \tilde{V}(\mathbf{p}^\theta)\right)}_{\Pi^1}$$

$$+ (1-\gamma) \underbrace{\left(Q_1(X_\theta^N)\left(p_1^\theta - c + Q(p_2^\theta)(p_2^\theta - c)\right) + (1 - Q_1(X_\theta^N))Q_1(p_1^\theta)(p_1^\theta - c) + \tilde{V}(\mathbf{p}^\theta)\right)}_{\Pi^\theta}$$

Interestingly, both types of consumers are left with a rent and the firm cannot extract all their surplus. The sophisticated consumer has an information rent due to the asymmetry of information. The naive consumer, even if she has no incentive to deviate, is left with a *mis-perception rent*. This rent is due to her naivety. She would not sign a more expensive contract at the contracting stage, and so she is left *ex post* with a *mis-perception rent* Δ that is bigger than her expected surplus at the contract period, $\Delta = V(\mathbf{p}^\theta) - \tilde{V}(\mathbf{p}^\theta) > \tilde{V}(\mathbf{p}^\theta) - F^\theta = 0$.

The solution of the relaxed maximization problem of the firm is described by Proposition 3.

Proposition 3. The optimal screening contract that the firm offers to sophisticated and naive habit forming consumers is:

- **Sophisticated consumer**: $p_1^1 = c, \quad p_2^1 = c, \quad F^1 = V(\mathbf{p}^1) - V(\mathbf{p}^\theta)$;
- **Naive consumer**: $p_1^\theta < c, \quad p_2^\theta > c$ and the fixed fee, $F^\theta = \tilde{V}(\mathbf{p}^\theta)$, equals the perceived consumer gross surplus of the naive consumer.

Proof. See Appendix A □

The firm offers a menu of contracts consisting of a two-part tariff for the sophisticated consumer and a "bargain then rip-off" contract for the naive consumer. Qualitatively, the pricing patterns that are optimal under full information are still optimal under asymmetric information. If the fraction of sophisticated consumers is quite small, then the firm finds it optimal to offer only the contract intended for naive consumers and vice versa.

It remains to check that all the constraints are met, and in particular that the incentive compatibility constraint of the naive consumers is slack at the optimum. This is shown in the Appendix.

The marginal prices of the contract of the sophisticated consumer $\{p_1^1, p_2^1\}$ remain equal to the marginal cost, whereas the fixed fee, F^1, decreases. Thus, naive consumers exert a positive externality on the sophisticated consumers.[20] On the other hand, the marginal prices for the naive consumer, $\{p_1^\theta, p_2^\theta\}$, are distorted upward and the fixed fee, F^θ is lower. Thus, there are two opposing effects on the welfare of naive consumers. However, it can be shown that, overall, this type

[20] This is a quite common result in the Behavioral I.O. literature. See, for example, Gabaix and Laibson (2006).

of consumer is worse off in the presence of more sophisticated consumers. More specifically, the derivatives with respect to the marginal prices are:

$$\frac{d\Delta}{dp_1} < 0 \quad \text{and} \quad \frac{d\Delta}{dp_2} < 0.$$

This means that an increase in marginal prices decreases the mis-perception rent. The marginal prices are greater than in the full information case, and thus the naive consumer is worse off.

The profits of the firm decrease with respect to the full information case, both for the sophisticated and the naive consumer. The fact that the firm cannot exploit the naivety of the consumer, and, at the same time cannot observe her type, decreases its profits.

Importantly, there is still allocative inefficiency. The consumer is left with a positive consumer surplus and this could be seen as a reason for no policy intervention. However, there is also participation distortion; namely inefficiencies in the extensive margin. There are consumers who would like to participate in the market if they were sophisticated, but they do not. Thus, the deadweight loss created by underparticipation could raise concerns. Regulatory authorities may consider the need for analysis of the possible policies to alleviate this efficiency loss. For example, a possible intervention could be to inform consumers of their habit-forming behaviours.

5. Competitive markets

■ In this section, I introduce competition into the model. I consider the case of perfect competition, both when the firms in the market are informed about the type of their consumers and when they are uninformed, and they screen between them. The profits of the firms are zero. Interestingly, the marginal pricing qualitatively does not depend on the assumption of the monopolistic market structure.[21]

Informed perfect competitors. I first consider the case where the firms are informed about the type of the consumer, and whether or not they can distinguish the level of θ; namely, the level of sophistication.

Let assume that there are enough firms in the market, so that none of the firms has any market power. The firms in equilibrium will charge the prices that maximize the consumer surplus subject to the constraint that they can participate in the market, namely that they have non-negative profits. In this case the maximization problem of the firms is:

$$\begin{aligned} \max_{\sigma^\theta} \quad & V_1(X_\theta) + V_1(p_1^\theta) - F^\theta \\ \text{s.t.} \quad & \Pi = Q_1(X_\theta)\big(p_1^\theta - c + Z_2(p_2^\theta)(p_2^\theta - c)\big) \\ & \quad + (1 - Q_1(X_\theta))Q_1(p_1^\theta)(p_1^\theta - c) + F^\theta \geq 0, \end{aligned}$$

where perfect competition drives the profits of the firms to zero, and firms continue entering the market up until their participation constraint is binding. Consequently, the objective function becomes equivalent to that of the monopolistic case (equation (4)).

Thus, if the consumer is sophisticated and $\theta = 1$ the optimal marginal prices are the same for the monopolistic case, $p_1^{1*} = p_2^{1*} = c$, with a different fixed fee $F^{1*} = 0$. If the consumer is naive and $\theta \in [0, 1)$, the marginal prices are again the same as in the monopolistic case, $p_1^\theta < c$ and $p_2^\theta > c$, with a different fixed fee, $-F^\theta = Q_1(X_\theta)\left(p_1^\theta - c + Z_2(p_2^\theta)(p_2^\theta - c)\right) + (1 - Q_1(X_\theta))Q_1(p_1^\theta)(p_1^\theta - c)$. Therefore, competition only affects the distribution of the surplus among firms and consumers and not marginal prices.

[21] See Armstrong (2015) for a review of models with similar result.

Uninformed perfect competitors. Let us now consider the case in which the firms cannot observe the type of the consumer and they need to screen between them. The firms will compete perfectly, their profits will be driven to zero and they will offer a menu of contracts that maximize the expected utility of each respective type of consumer. Even if there are multiple types in the market and the firm cannot observe who is who, the consumer does not need or want to use this information asymmetry to her advantage. This is because the contract designed in the informed monopolist case is also incentive compatible when the consumer has better information about herself and she could imitate being of another type. By the construction of the maximum in the single tariff model, the offered contracts are the ones maximizing *ex ante* the utility provided to respective types of consumers, and thus they are incentive compatible. Screening does not distort marginal prices with respect to the full information case, although marginal prices are smaller than that of the screening monopolist.

The above discussion is summarized in Proposition (4).

Proposition 4. Perfect Competition: If the market is perfectly competitive, the optimal marginal prices and total surplus produced are equivalent to those of the informed monopolist. The sophisticated consumers are offered a two-part tariff contract, whereas the naive consumers are offered a "bargain then rip-off" contract. This applies to both informed and uninformed firms.

Competition makes the two types of consumers better off when the firms are uninformed, both because the optimal marginal prices are the same as that of the informed monopolist (and not of the uninformed one), but also because the fixed fees are smaller. Furthermore, the total surplus produced is bigger because it does not suffer the cost of asymmetric information.

6. Conclusion

■ Over the last few decades, the provision of "bargain then rip-off" contracts have become increasingly prevalent in a number of markets. Moreover, there is evidence that the consumption of communication services, such as cell phones and the internet, is habit- forming (Oulasvirta et al., 2012; Bianchi and Phillips, 2005). The literature has also identified symptoms of addiction to the mobile phone among adolescents and young adults (Billieux, 2012; Park, 2005), but also a specific "digital addiction" (Allcott et al., 2021; Tromholt, 2016; Sagioglou and Greitemeyer, 2014; Hunt et al., 2018; Vanman et al., 2018; Mosquera et al., 2020; Acland and Chow, 2018; Allcott et al., 2020).

This article shows that addiction can explain these observed pricing schemes. In particular, naive addiction makes it optimal for the firm to use the "bargain then rip-off" contract.

I show that this pricing scheme is optimal if the consumption choice is made sequentially within the contract period and the consumer is naive and underestimates high demand independently if the good is mostly habit-forming or mostly addictive.

Interestingly, the firm cannot exploit the consumer's naivety when the good is mostly habit-forming. However, the mostly naively addicted consumer can be exploited as she is willing to pay more than the actual value of the contract.

Moreover, this article shows that the observed menu of contracts could be explained by the existence of habit-forming consumers who have varying levels of sophistication about their habit-forming behaviours. It is demonstrated that the firm finds it optimal to offer a two-part tariff to sophisticated consumers and a "bargain then rip-off" contract to naive ones.

The presence of naive consumers in the market exerts a positive externality to the sophisticated consumers, instead of the converse. The sophisticated consumer has an incentive to pretend to be naive, even though she consumes less because, in this way, she is left with a rent. For this reason, the firm finds it optimal to leave information rent to sophisticated consumers.

The naive consumers are *ex post* worst off in the presence of sophisticated consumers, because the objective of the firm to make the contract intended for naive consumers less attractive to sophisticated ones leads to a decrease in the *ex post* misperception rent.

The consumers' naivety induces inefficiencies in the market, both in the intensive and the extensive margins. The naive consumer under-consumes both units and participates in the market less than if she were sophisticated. Thus, there are serious welfare implications, and the need for a policy intervention to decrease the deadweight loss created is essential. Banning this kind of contract would be welfare improving only in the case that the good is mostly addictive and the market is monopolistic. A potential policy to increase the overall welfare in the market would be to inform naive consumers of their mistaken beliefs.

Appendix A

□ **Monopolist, two prices.** The participation constraint is binding. The monopolist charges $F^\theta = \tilde{V}(p^1_\theta, p^2_\theta)$ as an *ex ante* fixed fee, where $\tilde{V}(p^1_\theta, p^2_\theta)$ is equation (2). If the monopolist has unit cost c, its profit with the price pair (p^θ_1, p^θ_2) and the above fixed fee is:

$$\max_{\sigma^\theta} \Pi^\theta = \{Q_1(X_\theta)[p^\theta_1 - c + Z_2(p^\theta_2)(p^\theta_2 - c)] + [1 - Q_1(X_\theta)]Q_1(p^\theta_1)(p^\theta_1 - c) + V_1(X_\theta) + V_1(p^\theta_1)\}$$
$$\text{s.t.} \quad V_1(X_\theta) + V_1(p^\theta_1) - F^\theta = 0$$

The objective function is a continuous and differentiable function (C1) then the first order conditions are necessary for optimality. Moreover, the domain of the profit function is the compact set $p^\theta_1 \times p^\theta_2 \in [\underline{v} - V_1(\underline{v}); \overline{v}] \times [\underline{v}; \overline{v} - w]$. The firm would never charge a price smaller than p^θ_1 such that $Q_1(X_\theta) = 1$, that is, $X_\theta = p^\theta_1 + V_1(p^\theta_1) - \tilde{V}_2(p^\theta_2) = \underline{v} \Rightarrow \underline{p}^\theta_1 = \underline{v} - V_1(p^\theta_1) + \tilde{V}_2(p^\theta_2)$. The minimum possible is $\underline{p}^\theta_1 = \underline{v} - V_1(\underline{v}) + \tilde{V}_2(\overline{v}) = \underline{v} - V_1(\underline{v})$, that makes also $Q_1(p^\theta_1) = 1$. The maximum possible p^θ_1 is the one that makes $Q_1(X_\theta) = 0$ thus $\overline{p}^\theta_1 = \overline{v} - (\tilde{V}_2(\overline{v}) - V_1(\overline{p}^\theta_1))$ if $\tilde{V}_2(\overline{v}) - V_1(\overline{p}^\theta_1)) \leq 0$, but the only maximum price relevant is $\overline{p}^\theta_1 = \overline{v}$. Following the same logic p^θ_2 cannot be smaller than $\underline{v}$, as $\tilde{V}_2(p_2)$ enters negatively into the X_θ function. The maximum price that makes $Z_2(v) = \tilde{Z}_2(v) = 0$ is $p^\theta_2 = \overline{v} - w$. Thus, a maximum exists, as expected from the extreme value theorem. Moreover, let for simplicity that $f_t(\underline{v}) = f_t(\overline{v}) = 0$ where $t = \{1, 2\}$ period.

The first order conditions (f.o.c.) are:

$$\frac{\partial \Pi^\theta}{\partial p^\theta_1} = (p^\theta_1 - c)\big(Q'_1(X_\theta)(1 - Q_1(p^\theta_1))^2 + (1 - Q_1(X_\theta))Q'_1(p^\theta_1)\big) + (p^\theta_2 - c)Q'_1(X_\theta)(1 - Q_1(p^\theta_1))Z_2(p^\theta_2) = 0$$

$$\frac{\partial \Pi^\theta}{\partial p^\theta_2} = (p^\theta_1 - c)Q'_1(X_\theta)\tilde{Z}_2(p^\theta_2)(1 - Q_1(p^\theta_1)) + (p^\theta_2 - c)\big(Q'_1(X_\theta)\tilde{Z}_2(p^\theta_2)Z_2(p^\theta_2) + Q_1(X_\theta)Z'_2(p^\theta_2)\big) + Q_1(X_\theta)(Z_2(p^\theta_2) - \tilde{Z}_2(p^\theta_2)) = 0$$

Manipulating, the system of first order conditions I get:

$$p^{\theta*}_1 = c + \frac{A}{B} < c \quad \text{and} \quad p^{\theta*}_2 = c + \frac{C}{B} > c$$

as

$$A = Q'_1(X_\theta)Q_1(X_\theta)(1 - Q_1(p^\theta_1))Z_2(p^\theta_2)(Z_2(p^\theta_2) - \tilde{Z}_2(p^\theta_2)) < 0$$
$$B = Q'_1(X_\theta)Z'_2(p^\theta_2)(1 - Q_1(p^\theta_1))^2 Q_1(X_\theta) + + Q'_1(p^\theta_1)(1 - Q_1(X_\theta))\big(Z'_2(p^\theta_2)Q_1(X_\theta) + Q'_1(X_\theta)\tilde{Z}_2(p^\theta_2)Z_2(p^\theta_2)\big) > 0$$
$$C = Q_1(X_\theta)(\tilde{Z}_2(p^\theta_2) - Z_2(p^\theta_2))\big(Q'_1(X_\theta)(1 - Q_1(p^\theta_1))^2 + Q'_1(p^\theta_1)(1 - Q_1(X_\theta))\big) > 0$$

□ **Proof of Proposition 1.** Let $\Pi^1(p^1_1; p^1_2)$ be the profit when there are only sophisticated consumers, with $\theta = 1$ in the market, and $Z_2(p^1_2) = \tilde{Z}_2(p^1_2)$. Then, the first order conditions evaluated at the marginal cost become:

$$\left.\frac{\partial \Pi^1(p^1_1; p^1_2)}{\partial p^1_1}\right|_{c,c} = 0 \quad \text{and} \quad \left.\frac{\partial \Pi^1(p^1_1; p^1_2)}{\partial p^1_2}\right|_{c,c} = 0$$

Thus, the optimal pricing scheme when the consumer is sophisticated is the two-part tariff $\{F^1 = V, p_1^{1*} = c, p_2^{1*} = c\}$ where V is equation (3).

□ **Proof of Proposition 2.** Let, now $\Pi^\theta(p_1^\theta; p_2^\theta)$ be the profit function when in the market there are only naive consumers, with $\theta \in [0, 1)$ then $Z_2(p_2^\theta) > \tilde{Z}_2(p_2^\theta)$. The first order derivatives evaluated at $\{p_1^\theta, p_2^\theta\} = \{c, c\}$ are:

$$\left.\frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta)}{\partial p_1^\theta}\right|_{c,c} = 0$$

$$\left.\frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta)}{\partial p_2^\theta}\right|_{c,c} = Q_1(X_\theta)(Z_2(c) - \tilde{Z}_2(c)) > 0 \Rightarrow p_2^{\theta*} > c$$

Then, because at $\{p_1^\theta, p_2^\theta\} = \{c, c\}$ the second unit price is $p_2^{\theta*} > c$, the first order derivative with respect to p_1^θ at $\{p_1^\theta, p_2^\theta\} = \{c, p_2^{\theta*}\}$ is:

$$\left.\frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta)}{\partial p_1^\theta}\right|_{c,p_2^{\theta*}} < 0 \Rightarrow p_1^{\theta*} < c$$

Then, if the consumer is either naive mostly habit-forming or the good is mostly addictive there is an interior optimum that is "bargain then rip-off", that is, $\{F^\theta = \tilde{V}, p_1^{\theta*} < c, p_2^{\theta*} > c\}$, which satisfies the above first order conditions. I can show that the global maximum has these characteristics and that there is no other maximum with different characteristics on the borders of the domain.

Let $p_1^{\theta*} \le c$ and $p_2^{\theta*} \le c$ be the maximum on the border of the domain then there are the following cases:

i. $\{p_1^{\theta*} = \underline{v}, p_2^{\theta*} \in [\underline{v} - w, c]\}$ then $Q_1(p_1^{\theta*}) = 1$ and $Q_1'(p_1^{\theta*}) = 0$, the f.o.c. is:

$$\left.\frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta)}{\partial p_1^\theta}\right|_{\{p_1^{\theta*}=\underline{v}, p_2^{\theta*}\in[\underline{v}-w,c]\}} = 0 \quad \text{but}$$

$$\left.\frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta)}{\partial p_2^\theta}\right|_{\{p_1^{\theta*}=\underline{v}, p_2^{\theta*}\in[\underline{v}-w,c]\}} = (p_2^\theta - c)\big(Q_1'(X_\theta)\tilde{Z}_2(p_2^\theta)Z_2(p_2^\theta) + Q_1(X_\theta)Z_2'(p_2^\theta)\big)$$
$$+ Q_1(X_\theta)(Z_2(p_2^\theta) - \tilde{Z}_2(p_2^\theta)) > 0$$

ii. $\{p_1^{\theta*} \in [\underline{v}, c], p_2^{\theta*} = \underline{v} - w\}$ and $Z_2(p_2^{\theta*}) = 1$, $Z_2'(p_2^{\theta*}) = 1$, $0 < \tilde{Z}_2(p_2^{\theta*}) < 1$ and $0 < \tilde{Z}_2'(p_2^{\theta*}) < 1$ the f.o.c. is:

$$\left.\frac{\partial \Pi^\theta}{\partial p_2^\theta}\right|_{\{p_1^{\theta*}\in[\underline{v},c], p_2^{\theta*}=\underline{v}-w\}} = (p_1^{\theta*} - c)Q_1'(X_\theta)\tilde{Z}_2(p_2^{\theta*})(1 - Q_1(p_1^{\theta*}))$$
$$+ (p_2^{\theta*} - c)\big(Q_1'(X_\theta)\tilde{Z}_2(p_2^{\theta*})\big) + Q_1(X_\theta)(1 - \tilde{Z}_2(p_2^\theta)) > 0$$

iii. $\{p_1^{\theta*} \in [\underline{v}, c], p_2^{\theta*} = \underline{v}\}$ then $\tilde{Z}_2(p_2^{\theta*}) = Z_2(p_2^{\theta*}) = 1$ and $\tilde{Z}_2'(p_2^{\theta*}) = Z_2'(p_2^{\theta*}) = 0$ the f.o.c. is:

$$\left.\frac{\partial \Pi^\theta}{\partial p_2^\theta}\right|_{\{p_1^{\theta*}\in[\underline{v},c], p_2^{\theta*}=\underline{v}-w\}} = (p_1^{\theta*} - c)Q_1'(X_\theta)(1 - Q_1(p_1^{\theta*})) + (p_2^{\theta*} - c)\big(Q_1'(X_\theta)\big) > 0$$

iv. $\{p_1^{\theta*} < c, p_2^{\theta*} < c\}$ such that $X_\theta = \underline{v}$ then $Q_1(X_\theta) = 1$ and $Q_1'(X_\theta) = 0$. The f.o.c. is:

$$\left.\frac{\partial \Pi^\theta}{\partial p_2^\theta}\right|_{X_\theta=\underline{v}} = (p_2^{\theta*} - c)Z_2'(p_2^{\theta*}) + (Z_2(p_2^{\theta*}) - \tilde{Z}_2(p_2^{\theta*})) > 0$$

v. $\{p_1^{\theta*} < c, p_2^{\theta*} < c\}$ such that $X_\theta = \overline{v}$ then $Q_1(X_\theta) = 0$ and $Q_1'(X_\theta) = 0$. The f.o.c. is:

$$\left.\frac{\partial \Pi^\theta}{\partial p_2^\theta}\right|_{X_\theta=\overline{v}} = (p_2^{\theta*} - c)Q_1'(p_1^{\theta*}) > 0$$

In all these cases there is a contradiction and $p_1^{\theta*} \le c$ and $p_2^{\theta*} \le c$ cannot be a maximum because the firms have an incentive to increase their prices.

Let now $p_1^{\theta*} \ge c$ and $p_2^{\theta*} \ge c$ be the maximum then again there are the following potential cases:

i. $\{p_1^{\theta*} = \overline{v}, p_2^{\theta*} \in [c, \overline{v} - w]\}$ then $Q_1(p_1^{\theta*}) = 0$, $Q_1'(p_1^{\theta*}) = 0$ and the f.o.c. is:

$$\left.\frac{\partial \Pi^\theta}{\partial p_1^\theta}\right|_{\{p_1^{\theta*}=\overline{v}, p_2^{\theta*}\in[c,\overline{v}-w]\}} = (p_1^{\theta*} - c)\big(Q_1'(X_\theta)\big) + (p_2^{\theta*} - c)Q_1'(X_\theta)Z_2(p_2^{\theta*}) < 0$$

ii. $\{p_1^{\theta*} \in [c, \bar{v}], p_2^{\theta*} = \bar{v} - w\}$ then $Z_2(p_2^{\theta*}) = \tilde{Z}_2(p_2^{\theta*}) = 1$ and $Z_2'(p_2^{\theta*}) = \tilde{Z}_2'(p_2^{\theta*}) = 0$, the f.o.c.s become:

$$\left.\frac{\partial \Pi^\theta}{\partial p_2^\theta}\right|_{\{p_1^{\theta*} \in [c,\bar{v}], p_2^{\theta*} = \bar{v} - w\}} = 0 \quad \text{and}$$

$$\left.\frac{\partial \Pi^\theta}{\partial p_1^\theta}\right|_{\{p_1^{\theta*} \in [c,\bar{v}], p_2^{\theta*} = \bar{v} - w\}} = (p_1^\theta - c)\big(Q_1'(X_\theta)(1 - Q_1(p_1^\theta))^2 + (1 - Q_1(X_\theta))Q_1'(p_1^\theta)\big) + (p_2^\theta - c)Q_1'(X_\theta)(1 - Q_1(p_1^\theta)) < 0$$

iii. $\{p_1^{\theta*} > c, p_2^{\theta*} > c\}$ such that $X_\theta = \bar{v}$ then $Q_1(X_\theta) = 0$ and $Q_1'(X_\theta) = 0$:

$$\frac{\partial \Pi^\theta}{\partial p_1^\theta} = (p_1^{\theta*} - c)Q_1'(p_1^{\theta*}) < 0$$

In all of these cases, there is a contradiction and $p_1^{\theta*} \geq c$ and $p_2^{\theta*} \geq c$ cannot be a maximum because the firms have an incentive to decrease the prices in order to increase their profits.

Finally, let $p_1^{\theta*} \geq c$ and $p_2^{\theta*} \leq c$ be the maximum, then the f.o.c.s can be both larger or smaller than zero. The two possible cases are:

i. $\{p_1^{\theta*} = \bar{v}, p_2^{\theta*} \in [\underline{v} - w, c]\}$, $Q_1(p_1^{\theta*}) = 0$ and $Q_1'(p_1^{\theta*}) = 0$.
ii. $\{p_1^{\theta*} \in [c, \bar{v}], p_2^{\theta*} = \underline{v}\}$ and $Z_2(p_2^{\theta*}) = \tilde{Z}_2(p_2^{\theta*}) = 1$ and $Z_2'(p_2^{\theta*}) = \tilde{Z}_2'(p_2^{\theta*}) = 0$.

If $p_1^{\theta*}$ is significantly large and $p_2^{\theta*}$ significantly small, then $\frac{\partial \Pi^\theta}{\partial p_1^\theta} < 0$ and $p_1^{\theta*}$ should decrease away of $p_1^\theta = \bar{v}$. Though, both f.o.c.s are equal to zero only when $p_1^{\theta*} < c$ and $p_2^{\theta*} > c$, thus it is again a contradiction.

□ **Underconsumption of the first unit.** The optimal marginal price for the first unit is $p_1^{\theta*} < c$ but the consumer consumes if the realization of the first unit valuation is bigger than $X_\theta = p_1^\theta + V_1(p_1^\theta) - \tilde{V}(p_2^\theta)$. Thus, overconsumption or underconsumption of the naive consumer with respect to the sophisticated consumer depends not only on $p_1^{\theta*}$ but also on the perceived foregone second period consumer surplus if $q_1 = 1$, namely $V_1(p_1^\theta) - \tilde{V}_2(p_2^\theta)$. In order to show whether the consumer under consumes at the optimum, let me assume that $c = 0$ and the domain of the CDFs is the [0,1]. I manipulate the system of equations of first order conditions with respect to $\{p_1^\theta, p_2^\theta\}$, where the optimal marginal prices are $p_1^{\theta*} = 0$ because if $p_1^{\theta*} < 0$ then $Q_1(p_1^\theta) = 1$ and the numerator of the optimal $p_1^{\theta*}$ equals zero. Moreover $p_2^{\theta*} > 0 = c$ and importantly $X_\theta = V_1(0) - \tilde{V}_2(p_2^\theta) > 0 = c = p_1^{1*}$ thus the naive consumer at the optimum under-consumes when compared to the sophisticated one.

□ **Monopolist, date-dependent marginal pricing.** Let me now assume that date-dependent pricing is feasible. The marginal prices are p_1^θ for the first unit in the first period, p_2^θ for the second unit in the second period and p_3^θ for the first unit in the second period. The first period optimal threshold in this case is $X_\theta = p_1^\theta + V_1(p_3^\theta) - \tilde{V}(p_2^\theta)$. The monopolist can charge U^θ as an *ex ante* fixed fee F^θ so that the participation constraint of the consumer binds. If the monopolist has unit cost c, the maximization problem of the firm is:

$$\max_{\{p_1^\theta, p_2^\theta, p_3^\theta\}} \Pi^\theta(p_1^\theta; p_2^\theta; p_3^\theta) = \{Q_1(X_\theta)[p_1^\theta - c + Z_2(p_2^\theta)(p_2^\theta - c)] + [1 - Q_1(X_\theta)]Q_1(p_3^\theta)(p_3^\theta - c) + V_1(X_\theta) + V_1(p_3^\theta)\}$$

$$\text{s.t.} \quad V_1(X_\theta) + V_1(p_3^\theta) - F^\theta = 0$$

The first order conditions are:

$$\frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta; p_3^\theta)}{\partial p_1^\theta} = (p_1^\theta - c)Q_1'(X_\theta) + (p_2^\theta - c)Q_1'(X_\theta)Z_2(p_2^\theta) - (p_3^\theta - c)Q_1'(X_\theta)Q_1(p_3^\theta) = 0$$

$$\frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta; p_3^\theta)}{\partial p_2^\theta} = (p_1^\theta - c)Q_1'(X_\theta)\tilde{Z}_2(p_2^\theta) + (p_2^\theta - c)\big(Q_1'(X_\theta)\tilde{Z}_2(p_2^\theta)Z_2(p_2^\theta) + Q_1(X_\theta)Z_2'(p_2^\theta)\big) - (p_3^\theta - c)Q_1'(X_\theta)\tilde{Z}_2(p_2^\theta)Q_1(p_3^\theta) + Q_1(X_\theta)(Z_2(p_2^\theta) - \tilde{Z}_2(p_2^\theta)) = 0$$

$$\frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta; p_3^\theta)}{\partial p_3^\theta} = -(p_1^\theta - c)Q_1'(X_\theta)Q_1(p_3^\theta) - (p_2^\theta - c)Q_1'(X_\theta)Q_1(p_3^\theta)Z_2(p_2^\theta) + (p_3^\theta - c)\big(Q_1'(X_\theta)Q_1(p_3^\theta)^2 + (1 - Q_1(X_\theta))Q_1'(p_3^\theta)\big) = 0$$

Manipulating the system of the first order conditions, as the interior solution, I get:

$$p_1^{\theta*} = c - \frac{Z_2(p_2^\theta)\big(\tilde{Z}_2(p_2^\theta) - Z_2(p_2^\theta)\big)}{Z_2'(p_2^\theta)}$$

$$p_2^{\theta*} = c + \frac{\tilde{Z}_2(p_2^\theta) - Z_2(p_2^\theta)}{Z_2'(p_2^\theta)}$$

$$p_3^{\theta*} = c$$

If the consumer is sophisticated, $\theta = 1$ and $Z_2(p_2^\theta) = \tilde{Z}_2(p_2^\theta)$ then $p_1^{\theta*} = c$, $p_2^{\theta*} = c$ and $p_3^{\theta*} = c$. If the consumer is naive, $\theta \in [0, 1)$ and $Z_2(p_2^\theta) > \tilde{Z}_2(p_2^\theta)$ then $p_1^{\theta*} < c$, $p_2^{\theta*} > c$ and $p_3^{\theta*} = c$. I show that this is the global maximum and there is no maximum on the border of the domain. The domain is $p_1 \in [\underline{v} - V_1(\underline{v}), \overline{v}]$, $p_2 \in [\underline{v}, \overline{v} - w]$ and $p_3 \in [\underline{v}, \overline{v}]$.

Let me assume that $p_1^{\theta*} < c$, $p_2^{\theta*} < c$ and $p_3^{\theta*} = c$ is the maximum. Then there are the following potential cases:

i. $p_1^{\theta*}$, $p_2^{\theta*}$ and $p_3^{\theta*}$ such that $X_\theta = \underline{v}$ then $Q_1(X_\theta) = 1$, the f.o.c is $\left.\frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta; p_3^\theta)}{\partial p_2^\theta}\right|_{X_\theta = \underline{v}} > 0$

ii. $\{p_1^{\theta*} \in [\underline{v}, c], p_2^{\theta*} = \underline{v}, p_3^{\theta*} = c\}$ then $Z_2(p_2^{\theta*}) = \tilde{Z}_2(p_2^{\theta*}) = 1$. The f.o.c. is $\left.\frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta; p_3^\theta)}{\partial p_2^\theta}\right|_{\{p_1^{\theta*} \in [\underline{v}, c], p_2^{\theta*}\}} > 0$.

thus there is a contradiction, the firm finds optimal to increase the prices to increase its profits, and it has the incentive to increase p_2^θ above cost when $p_1^{\theta*} \leq c$.

Let assume that $p_1^{\theta*} > c$, $p_2^{\theta*} > c$ and $p_3^{\theta*} = c$ is the maximum. Then there are the following potential cases:

i. $p_1^{\theta*}$, $p_2^{\theta*}$ and $p_3^{\theta*}$ such that $X_\theta = \overline{v}$ then $Q_1(X_\theta) = 0$. This is a minimum of the profit function. The firm extracts only the consumer surplus of the 1st unit in the second period and obstructs consumption in the first period or consumption of two units.

ii. $\{p_1^{\theta*} \in [c, \overline{v}], p_2^{\theta*} = \overline{v} - w, p_3^{\theta*} = c\}$ then $Z_2(p_2^{\theta*}) = \tilde{Z}_2(p_2^{\theta*}) = 0$. The f.o.c. is $\left.\frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta; p_3^\theta)}{\partial p_2^\theta}\right|_{\{p_1^{\theta*} \in [\underline{v}, c], p_2^{\theta*} = \underline{v} - w, p_3^{\theta*} = c\}} < 0$.

Thus it is a contradiction, whereby the firm finds it optimal to decrease the prices to increase its profits.

Let me assume that $p_1^{\theta*} > c$, $p_2^{\theta*} < c$ and $p_3^{\theta*} = c$ is the optimum then the following case arise:

i. $\{p_1^{\theta*} = \overline{v}, p_2^{\theta*} \in [\underline{v}, c], p_3^{\theta*} = c\}$ such that $X_\theta = \underline{v}$ then $Q_1(X_\theta) = 1$. Then the f.o.cs are:

$$\frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta; p_3^\theta)}{\partial p_1^\theta} \lesseqgtr 0 \quad \text{and} \quad \frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta; p_3^\theta)}{\partial p_2^\theta} \lesseqgtr 0$$

ii. $\{p_1^{\theta*} \in [c, \overline{v}], p_2^{\theta*} = \underline{v}, p_3^{\theta*} = c\}$ then $Z_2(p_2^{\theta*}) = \tilde{Z}_2(p_2^{\theta*}) = 1$. Then the f.o.cs are:

$$\frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta; p_3^\theta)}{\partial p_1^\theta} \lesseqgtr 0 \quad \text{and} \quad \frac{\partial \Pi^\theta(p_1^\theta; p_2^\theta; p_3^\theta)}{\partial p_2^\theta} \lesseqgtr 0$$

The two first order condition become equal to zero for $p_1^\theta = p_2^\theta = c$, thus there is a contradiction.

□ **Banning "bargains then rip-offs".** Let consider the implications of the introduction of a policy that bans "bargain then rip-off" contracts. The firm is constrained to charge the same price for all units and all periods. Thus, the optimal first period threshold for the consumer is $X_\theta = p + V_1(p) - \tilde{V}_2(p)$. The monopolist can charge U_θ as an *ex ante* fixed fee F^θ that makes its constrained from the consumer's expected utility binding. If the monopolist has unit cost c, its profit with the price p and the above fixed fee is:

$$\max_{\sigma^\theta} \Pi = \{Q_1(X_\theta)[p - c + Z_2(p)(p - c)]$$

$$+ [1 - Q_1(X_\theta)]Q_1(p)(p - c) + V_1(X_\theta) + V_1(p)\}$$

$$\text{s.t.} \quad V_1(X_\theta) + V_1(p) - F^\theta = 0$$

The function is continuous and differentiable. The first order conditions are:

$$\frac{\partial \Pi}{\partial p} = (p - c)\big(Q_1'(X_\theta)(1 + \tilde{Z}_2(p) - Q_1(p))(1 + Z_2(p) - Q_1(p)) + (1 - Q_1(X_\theta))Q_1'(p)$$

$$+ Q_1(X_\theta)Z_2'(p)\big) + Q_1(X_\theta)(Z_2(p) - \tilde{Z}_2(p)) = 0$$

and manipulating the first order condition the optimal price is:

$$p^* = c + \frac{Q_1(X_\theta)(\tilde{Z}_2(p) - Z_2(p))}{-Q_1'(p)(1 - Q_1(X_\theta)) - Q_1'(X_\theta)(1 + \tilde{Z}_2(p) - Q_1(p))(1 + Z_2(p) - Q_1(p)) - Q_1'(X_\theta)Z_2(p)}$$

The domain is bounded and a maximum exist. If the consumer is sophisticated, $\theta = 1$ then $Z_2(p) = \tilde{Z}_2(p)$ and $p^* = c$. If the consumer is naive, $\theta = 0$ then $Z_2(p) > \tilde{Z}_2(p)$ and at the optimum $p^* > c$. When we allow more freedom in the maximization problem at the optimum $p_1^{\theta *} < c$ and $p_2^{\theta *} > c$, then in the maximization with less freedom it holds that $p_1^{\theta *} < p^* < p_2^{\theta *}$. I show that this is the global maximum and that there is no maximum at the borders of the domain.

Let $\underline{p}$ be the price such that $Q_1(\underline{p}) = Z_2(\underline{p}) = \tilde{Z}_2(\underline{p}) = 1$ and $Q_1'(\underline{p}) = Z_2'(\underline{p}) = \tilde{Z}_2'(\underline{p}) = 0$. Moreover, let $\overline{p}$ be the price such that $Q_1(\overline{p}) = Z_2(\overline{p}) = \tilde{Z}_2(\overline{p}) = 1$ and $Q_1'(\overline{p}) = Z_2'(\overline{p}) = \tilde{Z}_2'(\overline{p}) = 0$.

$$\left.\frac{\partial \Pi}{\partial p}\right|_{\underline{p}} = (\underline{p} - c)Q_1'(X_\theta) > 0, \qquad \left.\frac{\partial \Pi}{\partial p}\right|_{\overline{p}} = (\overline{p} - c)Q_1'(X_\theta) < 0$$

$$\left.\frac{\partial \Pi}{\partial p}\right|_{X_\theta = \underline{v}} = (p - c)Z_2'(p) + (Z_2(p) - \tilde{Z}_2(p)) > 0, \qquad \left.\frac{\partial \Pi}{\partial p}\right|_{X_\theta = \overline{v}} = (p - c)Q_1'(p) < 0.$$

The global maximum is the interior optimum as the firm has no incentive to charge prices on the border of the domain.

Welfare implications. Banning “bargain then rip-off” contracts has no welfare implications *ex ante*, because the expected consumer surplus is equal to zero in both cases and the participation constraint is binding. However, let me define as consumer’s misperception rent the consumer surplus gains or cost because of her naivety. More specifically, the misperception rent, which is the difference between the actual and the perceived expected consumer surplus is:

$$\Delta = V - \tilde{V} = V_1(X_1) - \tilde{V}_1(X_\theta)$$

where $X_1 = p_1 + V_1(p_1) - V_2(p_2)$ and $X_\theta = p_1 + V_1(p_1) - \tilde{V}_2(p_2)$.

The derivative of the misperception rent with respect to the prices p_1 and p_2 are:

$$\frac{d\Delta}{dp_1} = \frac{dV_1}{dX_1}\frac{\partial X_1}{\partial p_1} + \frac{dV_1}{dX_\theta}\frac{\partial X_\theta}{\partial p_1} = (1 - Q_1(p_1))(Q_1(X_\theta) - Q_1(X_1))$$

and

$$\frac{\partial \Delta}{\partial p_2} = \frac{dV_1}{dX_1}\frac{\partial X_1}{\partial p_2} + \frac{dV_1}{dX_\theta}\frac{\partial X_\theta}{\partial p_2} = Q_1(X_\theta)\tilde{Z}_2(p_2) - Q_1(X_1)Z_2(p_2)$$

If $\tilde{V}_2(p_2) < V_2(p_2)$, that is, the consumer is *mostly habit-forming*, then $X_\theta > X_1$. The consumer is left *ex post* with a positive consumer surplus $\Delta > 0$ as $\tilde{V} < V$. Moreover, the sign of the derivatives are $\frac{d\Delta}{dp_1} < 0$ and $\frac{\partial \Delta}{\partial p_2} < 0$ as $Q_1(X_\theta) < Q_1(X_1)$ and $\tilde{Z}_2(p_2) < Z_2(p_2)$.

If $\tilde{V}_2(p_2) > V_2(p_2)$, that is, the good is *mostly addictive*, then $X_\theta < X_1$. The consumer is left *ex post* with a negative consumer surplus $\Delta < 0$ as $\tilde{V} > V$. Then, the sign of $\frac{\partial \Delta}{\partial p_1} > 0$, is positive, because $X_\theta < X_1 \Rightarrow Q_1(X_\theta) > Q_1(X_\theta)$, and consequently it reverses with respect to before. Nonetheless, the sign of $\frac{\partial \Delta}{\partial p_2}$ is ambiguous and depends on the relative magnitude of $Q_1(X_\theta) > Q_1(X_1)$ and $\tilde{Z}_2(p_2) < Z_2(p_2)$.

Monopolist, banning "bargains then rip-offs”. If the good is *mostly addictive* and the inequality $\tilde{Z}_2(p_2) < Z_2(p_2)$ is significantly large, meaning the consumer significantly underestimates the quantity that she will consume in the second period, then the sign of $\frac{\partial \Delta}{\partial p_2}$ is negative. Thus, the increase of p_1 and the decrease in p_2 increase Δ. In this case, banning bargains then rip-offs increases consumers welfare.

If bargain then rip-off is banned and the consumer is *mostly habit-forming*, the increase of p_1, as $p_1^* < p^*$, will decrease the consumer’s welfare, and the decrease of p_2 will increase the consumer’s welfare. Thus, the overall effect is ambiguous for the consumer. On the other hand, the firm is better off when it is free to choose different prices for each unit. Thus, the overall welfare implications for the economy are ambiguous.

Perfect competition, banning “bargains then rip-offs”. Mostly Habit-Forming and Mostly Addictive: In the case of competition, the firm maximizes the consumer surplus subject to the participation constraint of the firm. As I have shown in Section 5, the objective function that the firm maximizes is the same as the case of the monopolist. Thus, the optimal price when the bargains then rip-offs are banned and the market is competitive is also as in the monopolistic market, that is, $p^* > c$. The participation constraint of the firm is binding, thus the profit of the firm is zero in both cases, with and without banning. The consumer is better off when bargains then rip-offs are not banned, in both cases. The firm has the possibility to create more economic surplus when there are no restrictions on the contract, and it can offer to the consumer a contract with better terms, through the fixed fee. Finally, the social surplus is greater with bargains then rip-offs not being banned, because consumers are better off and the firms are indifferent between the two.

□ **Proof of Proposition 3: Monopolistic screening.** Let the maximization problem of the firm be:

$$\max_{\sigma^1,\sigma^\theta} \Big\{\gamma\big(Q_1(X_1)\big(p_1^1 - c + Z_2(p_2^1)(p_2^1 - c)\big) + (1 - Q_1(X_1))Q_1(p_1^1)(p_1^1 - c) + F^1\big)$$

$$+(1-\gamma)\big(Q_1(X_\theta)\big(p_1^\theta - c + Z_2(p_2^\theta)(p_2^\theta - c)\big) + (1 - Q_1(X_\theta))Q_1(p_1^\theta)(p_1^\theta - c) + F^\theta\big)\Big\}$$

$$\text{s.t.}\quad \begin{array}{ll} \tilde{V}(\mathbf{p}^\theta) - F^\theta \geq 0 & IR_\theta \\ V(\mathbf{p^1}) - F^1 \geq 0 & IR_1 \\ \tilde{V}(\mathbf{p}^\theta) - F^\theta \geq \tilde{V}(\mathbf{p_1}) - F^1 & IC_\theta \\ V(\mathbf{p^1}) - F^1 \geq V(\mathbf{p}^\theta) - F^\theta & IC_1. \end{array}$$

□ **Proof of Lemma 2.** IR_θ *bind*: Otherwise, increasing the fixed fee of both the sophisticated and the naive consumer by a small positive ϵ would preserve the IR_θ, would not affect the IC_1 and IC_θ, and would raise profits, which contradicts $\mathbf{p^1}$ and $\mathbf{p}^\theta$ being optimal.

IC_1 *bind*: Suppose not, so that $V(\mathbf{p^1}) - F^1 > V(\mathbf{p}^\theta) - F^\theta$. Then, the firm could raise the fixed fee of the sophisticated consumer, F^1, relaxing IC_θ, without affecting IR_θ and without violating the IC_1, but increasing its profits and this would be a profitable deviation. Thus, IC_1 binds at the optimum.

IR_1 *slack*: We show that if IR_θ and IC_1 hold at the optimum then IR_1 can be discarded.

$$V(\mathbf{p^1}) - F^1 \geq V(\mathbf{p}^\theta) - F^\theta \geq \tilde{V}(\mathbf{p}^\theta) - F^\theta \geq 0 \Rightarrow V(\mathbf{p^1}) - F^1 \geq 0$$

I assume that IC_θ is slack and show that the optimum satisfies this assumption. Thus, the constraints of the maximization problems become:

$$\begin{array}{ll} \tilde{V}(\mathbf{p}^\theta) - F^\theta = 0 & IR_\theta \\ V(\mathbf{p^1}) - F^1 > 0 & IR_1 \\ \tilde{V}(\mathbf{p}^\theta) - F^\theta > \tilde{V}(\mathbf{p^1}) - F^1 & IC_\theta \\ V(\mathbf{p^1}) - F^1 = V(\mathbf{p}^\theta) - F^\theta & IC_1. \end{array}$$

Then, the maximization problem is:

$$\max_{\sigma^1,\sigma^\theta} \gamma\big(V(\mathbf{c}) - (V(\mathbf{p}^\theta) - \tilde{V}(\mathbf{p}^\theta))\big)$$

$$+ (1-\gamma)\big(Q_1(X_\theta)\big(p_1^\theta - c + Z_2(p_2^\theta)(p_2^\theta - c)\big) + (1 - Q_1(X_\theta))Q_1(p_1^\theta)(p_1^\theta - c) + \tilde{V}(\mathbf{p}^\theta)\big)$$

The objective function is a continuous and differentiable function with domain the compact set $p_1^\theta \times p_2^\theta \in [\underline{v} - V_1(\underline{v}), \overline{v}] \times [\underline{v}, \overline{v} - w]$, thus a maximum should exist, as expected from the extreme value theorem. Moreover, let for simplicity that $f_t(\underline{v}) = f_t(\overline{v}) = 0$ where $t = \{1, 2\}$ period.

The first order conditions of this maximization problem with respect to p_1^θ is:

$$\frac{\partial \Pi}{\partial p_1^\theta} = \gamma \frac{\partial \Pi^1}{\partial p_1^\theta} + (1-\gamma)\frac{\partial \Pi^\theta}{\partial p_1^\theta}$$

$$\gamma \frac{\partial \Pi^1}{\partial p_1^\theta} = -\gamma\left(-Q_1(X^1)\frac{\partial X^1}{\partial p_1^\theta} + Q_1(X_\theta)\frac{\partial X_\theta}{\partial p_1^\theta}\right)$$

$$= -\gamma(1 - Q_1(p_1^\theta))(Q_1(X_\theta) - Q_1(X^1))$$

$$(1-\gamma)\frac{\partial \Pi^\theta}{\partial p_1^\theta} = (1-\gamma)\big((p_1^\theta - c)\big(Q_1'(X_\theta)(1 - Q_1(p_1^\theta))^2 + (1 - Q_1(X_\theta))Q_1'(p_1^\theta)\big)$$

$$+ (p_2^\theta - c)Q_1'(X_\theta)(1 - Q_1(p_1^\theta))Z_2(p_2^\theta)\big)$$

Then the first order condition with respect to p_1^θ is:

$$\frac{\partial \Pi}{\partial p_1^\theta} = -\gamma(1 - Q_1(p_1^\theta))(Q_1(X_\theta) - Q_1(X^1))$$

$$+ (1-\gamma)\big((p_1^\theta - c)\big(Q_1'(X_\theta)(1 - Q_1(p_1^\theta))^2 + (1 - Q_1(X_\theta))Q_1'(p_1^\theta)\big)$$

$$+ (p_2^\theta - c)Q_1'(X_\theta)(1 - Q_1(p_1^\theta))Z_2(p_2^\theta)\big)$$

Moreover, the first order condition with respect to p_2^θ is:

$$\frac{\partial \Pi}{\partial p_2^\theta} = \gamma \frac{\partial \Pi^1}{\partial p_2^\theta} + (1-\gamma)\frac{\partial \Pi^\theta}{\partial p_2^\theta}$$

more specifically:

$$
\begin{aligned}
\gamma \frac{\partial \Pi^1}{\partial p_2^\theta} &= -\gamma \Bigg(\frac{\partial X^1}{\partial p_2^\theta} (-Q_1(X_1) + Q_1'(X_1)(V_2(p_2^\theta) - V_1(p_1^\theta)) - Q_1(X_1)Z_2(p_2^\theta)) \\
&\quad - \frac{\partial X_\theta}{\partial p_2^\theta} (-Q_1(X_\theta) + Q_1'(X_\theta)(V_1(p_2^\theta) - V_1(p_1^\theta)) + Q_1(X_\theta)Q_1(p_2^\theta)) \Bigg) \\
&= \gamma \big(Z_2(p_2^\theta)Q_1(X_1) - Q_1(p_2^\theta)Q_1(X_\theta) \big) \\
(1-\gamma) \frac{\partial \Pi^\theta}{\partial p_2^\theta} &= (1-\gamma) \big((p_1^\theta - c)Q_1'(X_\theta)\tilde{Z}_2(p_2^\theta)(1 - Q_1(p_1^\theta)) \\
&\quad + (p_2^\theta - c)\big(Q_1'(X_\theta)\tilde{Z}_2(p_2^\theta)Z_2(p_2^\theta) + Q_1(X_\theta)Z_2'(p_2^\theta)\big) \\
&\quad + Q_1(X_\theta)(Z_2(p_2^\theta) - \tilde{Z}_2(p_2^\theta)) \big)
\end{aligned}
$$

then the first order derivative becomes:

$$
\begin{aligned}
\frac{\partial \Pi}{\partial p_2^\theta} &= \gamma \big(Z_2(p_2^\theta)Q_1(X_1) - \tilde{Z}_2(p_2^\theta)Q_1(X_\theta) \big) \\
&\quad + (1-\gamma) \big((p_1^\theta - c)Q_1'(X_\theta)\tilde{Z}_2(p_2^\theta)(1 - Q_1(p_1^\theta)) \\
&\quad + (p_2^\theta - c)\big(Q_1'(X_\theta)\tilde{Z}_2(p_2^\theta)Z_2(p_2^\theta) + Q_1(X_\theta)Z_2'(p_2^\theta)\big) \\
&\quad + Q_1(X_\theta)(Z_2(p_2^\theta) - \tilde{Z}_2(p_2^\theta)) \big)
\end{aligned}
$$

Manipulating the first order derivatives, I get:

$$
\begin{aligned}
p_1^{\theta*} &= c - \frac{E}{F} \\
p_2^{\theta*} &= c + \frac{G}{F} \\
E &= -(1 - Q_1(p_1^\theta))(Q_1'(X_\theta)Q_1(X_\theta)Z_2(p_2^\theta)(Z_2(p_2^\theta) - \tilde{Z}_2(p_2^\theta)) \\
&\quad + \gamma(Q_1(X_\theta) - Q_1(X_1))(Q_1(X_\theta)Z_2'(p_2^\theta) + Q_1'(X_\theta)(\tilde{Z}_2(p_2^\theta) - Z_2(p_2^\theta))Z_2(p_2^\theta))) \\
F &= (1-\gamma)\big((1 - Q_1(p_1^\theta))^2 Q_1'(X_\theta)Q_1(X_\theta)Z_2'(p_2^\theta) \\
&\quad + Q_1'(p_1^\theta)(1 - Q_1(X_\theta))(Q_1(X_\theta)Z_2'(p_2^\theta) + Q_1'(X_\theta)\tilde{Z}_2(p_2^\theta)Z_2(p_2^\theta))\big) \\
G &= (1 - Q_1(p_1^\theta))^2 Q_1'(X_\theta)((1-\gamma)Q_1(X_\theta) - \gamma Q_1(X_1))(\tilde{Z}_2(p_2^\theta) - Z_2(p_2^\theta)) \\
&\quad - Q_1'(p_1^\theta)(1 - Q_1(X_\theta))(-\gamma Q_1(X_\theta)Z_2(p_2^\theta) + Q_1(X_\theta)(\tilde{Z}_2(p_2^\theta) - (1-\gamma)Z_2(p_2^\theta)))
\end{aligned}
$$

Then, the first unit optimal price is smaller than the cost, $p_1^{\theta*} < c$, either if the consumer is sufficiently naive about her habit-formation, $Z_2(p_2^\theta) - \tilde{Z}_2(p_2^\theta) > \frac{Q_1(X_\theta)Z_2'(p_2^\theta)(Q_1(X^1) - Q_1(X_\theta))}{Q_1'(X^\theta)Q_1(X^1)Z(p_2^\theta)}$; or if she is not sufficiently naive, $0 < Z_2(p_2^\theta) - \tilde{Z}_2(p_2^\theta) \leq \frac{Q_1(X_\theta)Z_2'(p_2^\theta)(Q_1(X^1) - Q_1(X_\theta))}{Q_1'(X^\theta)Q_1(X^1)Z(p_2^\theta)}$, and there is a sufficiently small percentage of sophisticated consumers in the market $0 \leq \gamma < \frac{Q_1'(X_\theta)Q_1(X_\theta)Z_2(p_2^\theta)(Z_2(p_2^\theta) - \tilde{Z}_2(p_2^\theta))}{(Q_1(X_\theta) - Q_1(X^1))(-Q_1(X_\theta)Z_2'(p_2^\theta) + Q_1'(X_\theta)Z_2(p_2^\theta)(Z_2(p_2^\theta) - \tilde{Z}_2(p_2^\theta)))}$. The second unit price is, in any case, greater than the cost when there are naive consumers, $p_2^{\theta*} > c$ in the market. This internal optimum is the global maximum, as there is no optimum on the borders of the domain. More specifically, if $p_1^{\theta*} < c$ and $p_2^{\theta*} < c$ then $\frac{\partial \Pi}{\partial p_2^\theta} > 0$ at the border, thus p_2 should increase and by contradiction $p_2^{\theta*} < c$ is not optimum. If $p_1^{\theta*} > c$ and $p_2^{\theta*} > c$ then $\frac{\partial \Pi}{\partial p_1^\theta} < 0$ at the border, thus p_1 should decrease and by contradiction $p_1^{\theta*} > c$ is not optimum. If $p_1^{\theta*} > c$ and $p_2^{\theta*} < c$ then $\frac{\partial \Pi}{\partial p_1^\theta} \lesseqgtr 0$ and $\frac{\partial \Pi}{\partial p_2^\theta} \lesseqgtr 0$ at the border. If $p_1^{\theta*}$ is significantly larger and $p_2^{\theta*}$ significantly smaller than the cost then $\frac{\partial \Pi^\theta}{\partial p_1^\theta} < 0$ and $p_1^{\theta*}$ should decrease away of $p_1^{\theta*} > c$. Both first order derivatives converge to zero only when $p_1^{\theta*} \leq c$ and $p_2^{\theta*} \geq c$. Moreover, if $p_1^{\theta*}$ and $p_2^{\theta*}$ are such that $X_\theta = \underline{v}$, $Q(X_\theta) = 1$ and $Q'(X_\theta) = 0$ then $\frac{\partial \Pi^\theta}{\partial p_1^\theta} = -\gamma(1 - Q_1(p_1^\theta))(1 - Q_1(X^1)) < 0$ and p_1^θ should decrease thus there is a contradiction. There could be an optimum where $p_1^{\theta*}$ and $p_2^{\theta*}$ are such that $X_\theta = \overline{v}$, $Q_1(X_\theta) = 0$ and $Q_1'(X_\theta) = 0$ then $\frac{\partial \Pi}{\partial p_2^\theta} = \gamma Z_2(p_2^\theta)Q_1(X_1) > 0$ thus there is a contradiction and they cannot be a maximum also because an increase of p_2 to the maximum means zero profits for the firm.

Both marginal prices are bigger than the optimal marginal prices for naive consumers charged by informed monopolist, as $\frac{\partial \Pi}{\partial p_2^\theta}\Big|_{c,c} > \frac{\partial \Pi^\theta}{\partial p_2^\theta}\Big|_{c,c}$ and $\frac{\partial \Pi}{\partial p_1^\theta}\Big|_{c,c} > \frac{\partial \Pi^\theta}{\partial p_1^\theta}\Big|_{c,c}$. On the other hand, the fixed fee for the naive consumer $F^\theta = \tilde{V}(\mathbf{p}^\theta)$ is decreasing with respect to the informed monopolist case:

$$
\frac{\partial \tilde{V}}{\partial p_1} = -Q_1(p_1^\theta) - Q_1(X_\theta)(1 - Q_1(p_1^\theta)) < 0 \quad \text{and} \quad \frac{\partial \tilde{V}}{\partial p_2} = -Q_1(X_\theta)Z_2(p_2^\theta) < 0
$$

To show that IC_θ is satisfied. I need to show that $\tilde{V}(\mathbf{p}^1) - F^1 < 0$ at the optimum. Moreover, as $F^1 = V(\mathbf{p}^1)$ it follows that I need to show that $\tilde{V}(\mathbf{p}^{1*}) - V(\mathbf{p}^{1*}) < 0$ at the optimum $(p_1^{1*}, p_2^{1*}) = (c, c)$

$$\begin{aligned}\tilde{V}(\mathbf{p}^{1*}) - V(\mathbf{p}^{1*}) &= V_1(c) + V_1(X_\theta(c)) - (V_1(c) + V_1(X_1(c))) = \\ &= V_1(X_\theta(c)) - V_1(X_1(c)) = \\ &= V_1\big(c + V_1(c) - \tilde{V}_2(c)\big) - V_1(c + V_1(c) - V_2(c))\end{aligned}$$

then if $\tilde{V}_2(c) < V_2(c)$ then $X_\theta > X_1$ and $V_1(X_\theta) < V_1(X_1) \Rightarrow V_1(X_\theta) - V_1(X_1) < 0$ thus the assumption that the IC_θ slack is satisfied.

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