Free vs fee: a model of price discrimination*

Maia Cufré
Universidad Torcuato Di Tella

Abstract

I study the trade-off faced by a firm that operates on a platform and generates revenues from subscriptions and advertising in an economy with heterogeneous agents. I present a basic model with a no-discrimination policy, as it is the main business strategy many firms adopt in this field. In this scenario, the firm can choose a subscription fee and a paywall (readings free of charge). I show that whether or not it is optimal to use these tools depends on the consumer types' distribution. In addition, I extend this structure by considering a screening model that allows the firm to offer different contracts to different types of consumers. Such a policy allows the firm to increase its profits. Finally, I conduct an empirical analysis with a unique database from one of the leading traditional Argentinian media outlets. I calibrate the model and study the optimality of the firm policy choice. I show that by changing the policy in the margin, the firm can increase its profits. In addition, I suggest a few changes in the firm's policy such as price discrimination based on location and free access to some notes.

Keywords: asymetric information, contract design

JEL Codes: D86 D82 D21 L82

1 Introduction

This study aims to analyze the trade-off that arises when a firm can generate revenue through two primary channels: subscription and advertising. Many platforms bridge two sides of the market: those demanding advertising space and those who can provide exposure to such advertising to their consumers. A typical case of what was described above can be observed in digital news platforms, where (potentially heterogeneous) consumers may have access to the platform, and the firm must choose its optimal policy.

Hence, I present a static model to study the business strategy of a firm that operates on a platform and faces a trade-off between revenues for subscriptions and advertising. I consider a firm that uses a digital news journal as its primary revenue stream, generating income through two channels. Firstly, selling subscriptions to the journal that provides subscribers unlimited access to its content. Secondly, by selling advertising space for each reading session. I consider a scenario with pre-contractual asymmetric information as consumers are heterogeneous, and their type is private information.

This trade-off is particularly relevant given the revolution the Internet has provoked in consumption behavior. Küng et al. (2016) study the development that online news has had since its creation. The

*I would like to thank Leandro Arozamena, Andrés Neumeyer, Mariano Tappata and Federico Weinschelbaum for helpful conversations.
The interactive figures of this paper here.

authors explain that online news started as the provision of news using websites on the Internet, but it has evolved into an environment of multiple digital platforms. These platforms offered a way to reach audiences and advertisers. Furthermore, the transference from printed newspapers to digital versions generated a significant change in the traditional advertising pricing models: the authors consider that the advertising space in the digital world is nearly unlimited, and supply outstripped demand. Thus, advertising prices decreased, and the volume of advertising exposure for readers increased. Hence, the trade-off mentioned above is affecting the firm's revenues in a different way than under the print business strategy.

While this framework cannot analyze issues related to the intertemporal decisions of economic agents, it is valuable for studying the trade-off between subscription revenue and advertising revenue. Furthermore, I assume there is no competition in the readings market, i.e., a monopolistic structure for the firm. In contrast, in my models, the firm is a price taker in the advertising market. These assumptions aim to attain a simplified structure for precisely examining the aforementioned trade-off.

Varian (2000) presents a model with large costs of production and small variable costs of reproduction. Hence, the price system in a context like this one is not particularly sensible to the cost structure. In fact, the paper proposes value-based prices. I will adopt a similar approach, considering an economy with heterogeneous consumers who have different valuations for the good and thus, different willingness to pay for them, too. In this scenario, strategies that allow the firm to discriminate prices will play a key role. In the paper, the author focuses on a particular aspect of price discrimination: quality discrimination or versioning, where the firm offers different versions of the same good at different prices. The consumers choose among these options the one that fits the most. This allows the firm to discriminate prices as consumers will self-select themselves in equilibrium.

Deneckere and Preston McAfee (1996) propose a model where the firm damages part of the good to price discriminate. This strategy allows the firm to offer inferior substitutes to those consumers who do not value the product enough. By doing so, it can sell the product at a high cost to those who value it the most, without significantly decreasing the demand. With the same aim, will propose a set of contracts to offer different but close substitutes in the market.

Armstrong (2006) and Rochet and Tirole (2003) study the competition in two-sided markets. When two groups interact via "platforms", how much a group benefits from joining the platform depends on the size of the other group. When these groups interact, surplus is created or destroyed as externalities are generally present. In my model, there will be cross-group externalities, as described in Armstrong (2006): readers prefer to read in a digital journal with less advertising while advertisers prefer more viewers. Rochet and Tirole (2003) discusses a "case study" of newspapers: it uses readers to attract advertisers. It explains that this business model has grown with the development of the Internet. Furthermore, it is suggested that this industry is considering moving to for-free content to maximize advertising revenues. I will study this case in this work.

In this study, I propose two different models: on one hand, I consider the typical business strategy that many digital news journals adopt today. This strategy involves setting a subscription price in exchange for unlimited access to content, along with a fixed number of articles available free of charge to anyone who accesses the platform. This strategy seems reasonable in cases where there are readers with a low willingness to pay for access but who are willing to read the news. By providing them with free access, the firm can capture advertising revenue. In contrast, readers with a high willingness to pay, valuing the product relatively more (higher valuation for each digital news), will be willing to subscribe to avoid losing access, on the margin, to additional readings. I call this the Basic Model.

On the other hand, in the second model, which I call the Screening Model, the firm has additional instruments to fix its policy. In particular, I propose a *menu pricing* structure in which the firm offers a continuum of different menus with a tariff for access to a fixed number of available readings. This structure addresses the problem of asymmetric information, as consumers will self-select by choosing the contracts designed by the firm for them. I follow Bolton and Dewatripont (2004) to find the optimal policy.

In Section 2 and Section 3, I develop both models. In Section 4, I study the main differences in the equilibrium results among both models. In particular, I am interested in the welfare results. Thus, I also present some numerical examples to illustrate the results. In Section 5, I work with a database of a firm that operates in a digital news journal. I compare the model's main results with the empirical evidence. In Section 6, I propose some future works and approaches. Finally, Section 7 presents my conclusion and final remarks.

2 Basic Model

In this section, I consider the firm's and consumers' problems separately. Then, I analyze the welfare effects of the policy. I develop a benchmark scenario with perfect discrimination to contrast the equilibrium results. Finally, I compute two numerical examples to illustrate the ideas of the section.

2.1 Firm

I consider a firm that chooses a subscription fee, p, and a paywall (maximum number of digital news the consumers can read without a subscription), $\bar{x}$. The firm aims to maximize its profits and monopolizes the digital news market. Furthermore, I assume that the news production decision is fixed; hence, the production cost is given. In this study, I am not interested in examining the relationship between the production policy and its effects on consumer decisions, so I will normalize these costs to zero. Then, the goal of the firm is to maximize its income.

Let q denote the advertising space price for each digital news. I assume that in this market, the firm is a price taker. Then, there are two sources of revenue for the firm:

1. Subscription: each subscriber pays a fee p independently of how much digital articles she reads.
2. Advertising space: the firm earns q for each reading.

2.2 Consumers

I consider a continuum of heterogeneous consumers whose total mass is normalized to 1. Their heterogeneity is identified with their type θ, which is a preference parameter with distribution given by $\theta \sim F(\theta)$, and support in $[\underline{\theta}, \bar{\theta}]$. I consider a dummy variable, s, that takes the value of 1 if the consumer subscribes to the digital journal and 0 otherwise. These consumers enjoy reading digital news, but they do not like advertising.

Consumers may differ in the type of news they read; for example, some may prefer sports news, while others may be more interested in entertainment news. However, in any case, the same readers decide which news to access (if they have the opportunity). Therefore, I will work with a utility function that depends on the number of articles read rather than the type of article. I will assume that the set of news available on the platform is always large enough so that a consumer may access any specific type of news she wishes. Hence, the distinction of the kind of news is irrelevant and can be ignored in the analysis.

Then, the utility of a consumer type θ that reads x digital news and pays a price of subscription p in case of being a subscriber is given by the quasilinear utility:

$$U(x, s; \theta) = \theta\phi(x) - k(x) - p \cdot s \tag{1}$$

Where:

- $\phi(x)$ and $k(x)$ are continuous and differentiable functions, with $\phi(x)' > 0$, $\phi(x)'' < 0$, $k(x)' > 0$ and $k(x)'' > 0$.
- $\phi(x)$ accounts for the utility obtained from the news. I assume the consumers enjoy reading but with a decreasing marginal utility.
- $k(x)$ accounts for the disutility from being exposed to ads.
- I assume that these functions are such that $\phi(0) = 0$, $k(0) = 0$, $\lim_{x \to +\infty} k(x) = +\infty$ and $\lim_{x \to +\infty} \phi'(x) = 0$. Hence, there is a well-defined x^* that maximizes the utility of the consumer type θ.

A consumer type θ must decide between subscribe/not subscribe, on the one hand, and how much news to read (potentially bounded), on the other hand.

The optimal number of readings for a consumer type θ that maximize her gross utility is given by the solution to this problem:

$$\max_x U(x; \theta) = \theta\phi(x) - k(x)$$

As the objective function is strictly concave, the first order condition, given by $H(x; \theta)$, is necessary and sufficient to characterize the solution, $x^*(\theta)$:

$$H(x^*(\theta); \theta) \equiv \theta\phi'(x^*(\theta)) - k'(x^*(\theta)) = 0 \tag{2}$$

Proposition 1. *The number of readings that maximize the consumer's gross utility for a consumer type θ, $x^*(\theta)$, increases in θ.*

From (2), using the implicit function theorem it can be proved that the proposition:

$$\frac{\partial x^*(\theta)}{\partial \theta} = -\frac{\phi'(x^*(\theta))}{\theta\phi''(x^*(\theta)) - k''(x^*(\theta))} > 0$$

Where the numerator is positive by hypothesis, and the denominator is negative as the objective function is strictly concave.

Thus, depending on her subscriber's status, a consumer type θ reads $x^*(\theta)$ if available (if $x^*(\theta) \leq \bar{x}$ or if she is a subscriber) or she faces a binding constraint and reads $\bar{x}$.

Given a firm's policy, $\{p, \bar{x}\}$, different groups of consumers can be identified. To begin with, given the support of types, $\theta \in [\underline{\theta}, \bar{\theta}]$, if $\underline{\theta}$ is small enough, there will be a $\theta_1 \in (\underline{\theta}, \bar{\theta})$, with $\theta_1 \neq 0$, that verifies:

$$\theta_1 \phi'(0) - k'(0) = 0$$

Then, the consumer type θ_1 is the first type for whom it is optimal to read a positive quantity of news (in case all consumers find optimal to read a positive amount, I set $\theta_1 = \underline{\theta}$)). Hence, the firm's business strategy is irrelevant for consumers of type $\theta \in [\underline{\theta}, \theta_1]$.

On the other hand, for a given policy of the firm $\{p, \bar{x}\}$, there are two other relevant consumers. I define θ_2 as the consumer's type for whom it is optimal to read $x = \bar{x}$, i.e:

$$\theta_2 \phi'(\bar{x}) - k'(\bar{x}) = 0$$

And again, if $\bar{x}$ is low enough such that all types of consumers find it optimal to read more than $\bar{x}$ I set $\theta_2 = \underline{\theta}$.

Finally, θ_3 is the consumer indifferent between buying the subscription or not, i.e.:

$$\theta_3 \phi(x^*(\theta_3)) - p - k(x^*(\theta_3)) = \theta_3 \phi(\bar{x}) - k(\bar{x}) \tag{3}$$

For the three critical values defined above, the types of consumers can be grouped into:

1. Group 1: $\theta \in [\underline{\theta}, \theta_1]$: do not read, do not subscribe.
2. Group 2: $\theta \in [\theta_1, \theta_2(\bar{x})]$: given $\bar{x}$ they do not subscribe and the paywall is never binding.
3. Group 3: $\theta \in [\theta_2(\bar{x}), \theta_3(\bar{x}, p)]$: given the price and the paywall that is always binding, it is optimum for them to be non-subscribers.
4. Group 4: $\theta \in [\theta_3(\bar{x}, p), \bar{\theta}]$: they become subscribers and read the optimal quantity.

Proposition 2. *The mass of subscribers, $1 - F(\theta_3)$, is decreasing in $\bar{x}$ and in p.*

From (3):

$$\frac{\partial \theta_3}{\partial \bar{x}} = \frac{\theta_3 \phi'(\bar{x}) - k'(\bar{x})}{\phi(x^*(\theta_3)) - \phi(\bar{x})} > 0$$
$$\frac{\partial \theta_3}{\partial p} = \frac{1}{\phi(x^*(\theta_3)) - \phi(\bar{x})} > 0$$

From Proposition 2 (proof in Appendix 1), it can be inferred how the firm's policy affects the mass of subscribers and, consequently, the consumer's endogenous decisions.

The trade-off faced by the firm when choosing its optimal policy is complex. The different effects of changing each endogenous variable can be summarized as:

- A higher price of subscription p implies (i) a lower mass of subscribers paying a higher price (which effect predominates over the revenues from subscription is a priori undetermined). This reduction in the mass of subscribers implies (ii) lower incomes from advertising as the mass of consumers in group 3 (facing a binding constraint over readings) has increased.

- A higher paywall $\bar{x}$ implies (i) an increase in advertising revenues from those types of consumers who were not subscribers previously, those who belonged to group 3 and faced a binding constraint (this constraint is now relaxed). Additionally, it implies (ii) a reduction in advertising revenue from those consumers who chose to subscribe with the low paywall and opt not to do so when offered additional news for free (now they face a binding constraint). Finally, (iii) there is a decrease in subscription revenues as the subscriber base declines.

2.3 First Best

In this economy, there are two sources of surplus: consumer utility and advertising incomes. Given that the advertising space pays $q > 0$ for each reading, the number of readings that should happen in equilibrium by each consumer type θ to maximize the total surplus is higher than the quantity that maximizes the consumer's utility. The reason behind this result is simple: every time a piece of digital news is read, a surplus for advertising is generated. Nevertheless, this positive externality for the economy is not internalized by the consumer and, consequently, is not considered in the reading decision. The firm has no tool to subsidize the readings, so it cannot induce digital news to be read in equilibrium. Furthermore, as the consumer's utility function is linear in prices, the minimal transfer that the firm should perform at the margin to induce more readings should be q monetary units per read (netting out the advertising revenue generated from its perspective).

The fact that the socially optimal quantities (the first best allocation) are higher than $x^*(\theta)$ can be seen directly from the first-order condition of the planner when maximizing the total welfare of the economy:

$$\max_{\{x(\theta)\}_{\theta\in[\underline{\theta},\bar{\theta}]}} W = \int_{\underline{\theta}}^{\bar{\theta}} \Big[\theta\phi(x(\theta)) - k(x(\theta)) + qx(\theta)\Big] f(\theta)d\theta$$

$$(x(\theta)) : \underbrace{\theta\phi'(x(\theta)) - k(x(\theta))}_{\text{solves } x^*(\theta)} + q = 0 \quad \forall\theta \in [\underline{\theta}, \bar{\theta}] \tag{4}$$

As the utility function is concave, the socially optimal quantities would imply, in the optimum, a negative marginal utility for the consumer θ.

For further analysis, I call $x^{so}(\theta)$ the socially optimal quantities for each type of consumer.

2.4 Perfect Discrimination

To begin with, I will analyze the best scenario for the firm under the assumption that it does not have tools for subsidy readings. I will use these results as a benchmark for the welfare analysis, as it provides the allocation the firm wants to induce.

If the firm has a technology to identify each consumer type and consumers cannot arbitrate, an equilibrium with perfect discrimination can be achieved. In this case, an equilibrium is characterized by a policy for the firm $((p(\theta), \bar{x}(\theta))$ and a vector $(s(\theta), x(\theta))$ such that, given the distribution $F(\theta)$:

1. Each consumer type θ maximizes utility choosing $(s(\theta), x(\theta))$, given the firm's policy.

2. The firm's policy maximizes its profits.

There is an equilibrium in which the firm offers a null paywall for every consumer, $\bar{x}(\theta) = \bar{x} = 0$, and the maximum price for each type $\theta \in [\theta_1, \bar{\theta}]$ such that the consumer chooses to become a subscriber:

$$U(x^*(\theta), 1; \theta) = \theta\phi(x^*(\theta)) - k(x^*(\theta)) - p(\theta) = 0$$

Then,

$$p(\theta) = \theta\phi(x^*(\theta)) - k(x^*(\theta))$$

In this equilibrium, all consumers of type $\theta \in [\theta_1, \bar{\theta}]$ are subscribers and they read their optimal quantities ($x^*(\theta)$ is implicitly defined in (2)). The firm obtains the whole surplus of the market, with profits given by:

$$\Pi = \int_{\theta_1}^{\bar{\theta}} [\underbrace{\theta\phi(x^*(\theta)) - k(x^*(\theta))}_{\text{Subscription}} + \underbrace{qx^*(\theta)]}_{\text{Advertising}} f(\theta) d\theta$$

This is the best scenario for the firm, considering that it cannot subsidy readings, as all consumers are achieving the allocation that maximizes their utility, given the prices. And the firm is taking all the reading surplus via the price system.

As the externality from the advertising space is present in this context, as it was mentioned above, the efficiency loss is given by:

$$DWL = \int_{\theta_1}^{\bar{\theta}} [\theta(\phi(x^{so}(\theta)) - \phi(x^*(\theta))) - (k(x^{so}(\theta)) - k(x^*(\theta))) + q(x^{so}(\theta) - x^*(\theta))] f(\theta) d\theta$$

2.5 No discrimination

In this subsection, I will consider the case in which the business strategy of the firm is restricted to choosing only a pair $\{p, \bar{x}\}$ as no perfect discrimination is possible and the type θ of the consumer is private information. I assume the firm knows the distribution of types, $F(\theta)$. The equilibrium is characterized by a policy for the firm $(p, \bar{x})$ and a vector $(s(\theta), x(\theta))$ such that, given the distribution $F(\theta)$:

1. Each consumer type θ maximize utility choosing $(s(\theta), x(\theta))$, given the firm's policy.
2. The firm's policy maximizes its profits.

It is valuable to note that there are cases where the allocations in this equilibrium may coincide with the previous one. For example, the result may be the same if q is high enough (the firm's opportunity cost of setting a binding paywall may be too high and not worth it). Hence, all consumer may read the quantities that maximize their utility.

Finally, the firm's problem is given by:

$$\max_{\{p, \bar{x}\}} \Pi = \underbrace{\int_{\theta_1}^{\theta_2} qx^*(\theta) f(\theta) d\theta}_{(1)} + \underbrace{\int_{\theta_2}^{\theta_3} q\bar{x} f(\theta) d\theta}_{(2)} + \underbrace{\int_{\theta_3}^{\bar{\theta}} (p + qx^*(\theta)) f(\theta) d\theta}_{(3)} \tag{5}$$

Where each term accounts for:

(1) the revenues from advertising from group 2, who read the optimal quantity.

(2) the revenues from advertising from group 3, which always read up to the paywall.

(3) the revenues from advertising and subscriptions from group 4.

As the objective function may not be strictly concave, the first-order conditions characterize the candidate to an inner solution:

$$\frac{\partial \Pi}{\partial p} = q\bar{x}f(\theta_3)\frac{\partial \theta_3}{\partial p} - \frac{\partial \theta_3}{\partial p}\left[p + qx^*(\theta_3)\right]f(\theta_3) + \int_{\theta_3}^{\bar{\theta}} f(\theta)d\theta = 0$$

$$= \frac{\partial \theta_3}{\partial p}f(\theta_3)\left[q(\bar{x} - x^*(\theta_3)) - p\right] + (1 - F(\theta_3)) = 0 \quad (6)$$

$$\frac{\partial \Pi}{\partial \bar{x}} = \frac{\partial \theta_2}{\partial \bar{x}}qx^*(\theta_2)f(\theta_2) + \left[\frac{\partial F(\theta_3)}{\partial \theta_3}\frac{\partial \theta_3}{\partial \bar{x}} - \frac{\partial F(\theta_2)}{\partial \theta_2}\frac{\partial \theta_2}{\partial \bar{x}}\right]q\bar{x} + (F(\theta_3) - F(\theta_2))q - \frac{\partial \theta_3}{\partial \bar{x}}(p + qx^*(\theta_3))f(\theta_3) = 0$$

$$= \frac{\partial \theta_2}{\partial \bar{x}}q\left(x^*(\theta_2) - \bar{x}\right)f(\theta_2) - \frac{\partial \theta_3}{\partial \bar{x}}\left[q(x^*(\theta_3) - \bar{x}) + p\right]f(\theta_3) + (F(\theta_3) - F(\theta_2))q = 0$$

$$= (F(\theta_3) - F(\theta_2))q - \frac{\partial \theta_3}{\partial \bar{x}}f(\theta_3)[q(x^*(\theta_3) - \bar{x}) + p] = 0 \quad (7)$$

The equations (6) and (7) characterize the solution for the price and the paywall for said candidate to optimum under the restricted scenario.

In addition, the firm might find the optimum to be in a corner solution. There are two relevant candidates:

(i) $\bar{x} = 0$, the firm faces the classical problem of choosing a price of subscription facing heterogeneous consumers.

(ii) $p = 0$, in this case, $\bar{x}$ is irrelevant as the consumers can have full access to the digital readings at a null cost.

Figure 1 shows the relationship between the readings and the types of consumers under both scenarios, assuming an inner solution to the firm's problem.

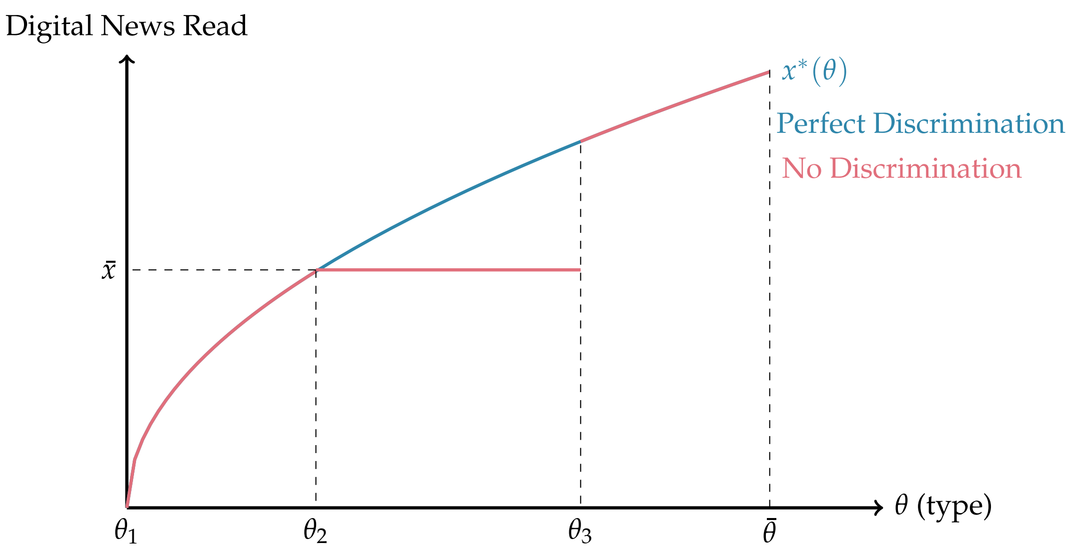

Figure 1: Readings as function of θ

From Figure 1, it can be concluded that the spread gap between θ_2 and θ_3 is generating additional welfare loss under the no discrimination scenario, as those consumers are facing a binding constraint over their decision of readings. For the other types of consumers, the allocation that maximizes their utility is achieved.

The aggregate profits are given by:

$$\Pi = \int_{\theta_1}^{\theta_2} qx^*(\theta)f(\theta)d\theta + \int_{\theta_2}^{\theta_3} q\bar{x}f(\theta)d\theta + \int_{\theta_3}^{\bar{\theta}} [p + qx^*(\theta)]f(\theta)d\theta \tag{8}$$

In this scenario, there are two sources of efficiency loss: (i) a reduction in readings given by group 3 and (ii) the positive externality effect that implies that any consumer reads less than her socially optimal quantity given her type. Thus, the deadweight loss is given by:

$$DWL = \underbrace{\int_{\theta_1}^{\bar{\theta}} [\theta(\phi(x^*(\theta)) - \phi(x^{so}(\theta))) - (k(x^{so}(\theta)) - k(x^*(\theta))) + q(x^{so}(\theta) - x^*(\theta))]f(\theta)d\theta}_{\text{externality effect}} + \underbrace{\int_{\theta_2}^{\theta_3} [\theta \cdot (\phi(x^*(\theta)) - \phi(\bar{x})) - (k(x^*(\theta)) - k(\bar{x}))]f(\theta)d\theta}_{\text{reduction of readings}} + \underbrace{\int_{\theta_2}^{\theta_3} q[x^*(\theta) - \bar{x}]f(\theta)d\theta}_{\text{advertising space loss}} \tag{9}$$

2.6 Numerical examples

The trade-off between the subscription price and the paywall may cause the firm, in equilibrium, to opt not to use one of its tools, optimizing in a corner solution. As explained above, increasing $\bar{x}$ has many simultaneous effects that, overall, may have a negative effect on profits. To show this, I provide two simple examples. I assume that the types of consumers follow a Beta distribution with parameters s_1 and s_2, and a range in $[A, B]$: $\theta \sim \{B \cdot beta(s_1, s_2) + A\}$. The distribution $beta(s_1, s_2)$ has a range in $[0, 1]$. The parameter B affects the width of the range (scale). The parameter A allows the distribution to move horizontally. The particular case of $s_1 = s_2 = 1$ is a uniform distribution.

Example I: I consider the following parameters:

$$\begin{cases} q = 0.1, \quad \beta = 2 \quad \rho = \frac{1}{4} \quad \eta = \frac{1}{2} \\ \phi(x) = \dfrac{x^{1-\rho}}{1-\rho} \qquad k(x) = \dfrac{x^{1+\eta}}{1+\eta} \qquad \theta \sim \{10 \cdot beta(1,1) + 1\} \end{cases}$$

In Figure 2, the profits across policies are shown (interactive chart here). The optimal solution is with $\bar{x}^* = 0$ and $p^* = 12.07$. The first consumer who reads is $\theta_3 = 7.88$.

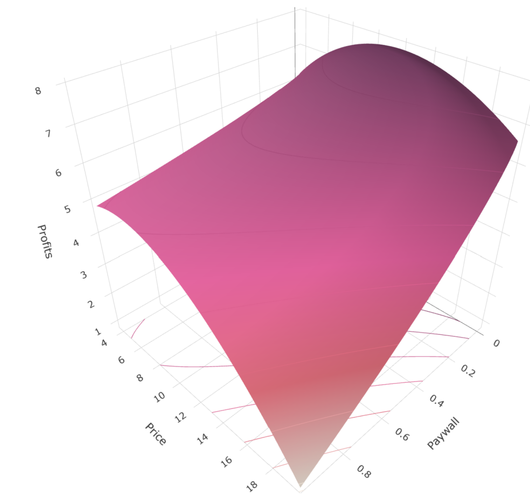

Figure 2: Example I

In this example, the reduction in revenues - from advertising (for consumers who stop being subscribers) and from subscriptions when increasing the paywall - dominates over the increase in revenues from advertising from the relaxation of the constraint over those consumers who decide not to subscribe. Hence, the firm does not use this tool.

Example II: Nevertheless, many firms that face this kind of problem choose policies that allow consumers to read some news without a subscription. For the effect of the increase in revenues from advertising from the mass of not subscribers to dominate, the variations in the margin over θ_3 must be small enough. For example, the following specification has an inner solution to the firm's problem:

$$\begin{cases} q = 10, \quad \beta = 2 \quad \rho = \frac{1}{4} \quad \eta = \frac{1}{2} \\ \phi(x) = \dfrac{x^{1-\rho}}{1-\rho} \qquad k(x) = \dfrac{x^{1+\eta}}{1+\eta} \qquad \theta \sim \{10 \cdot Beta(0.01, 0.01) - 1\} \end{cases}$$

In Figure 3 the results are presented (interactive chart here).

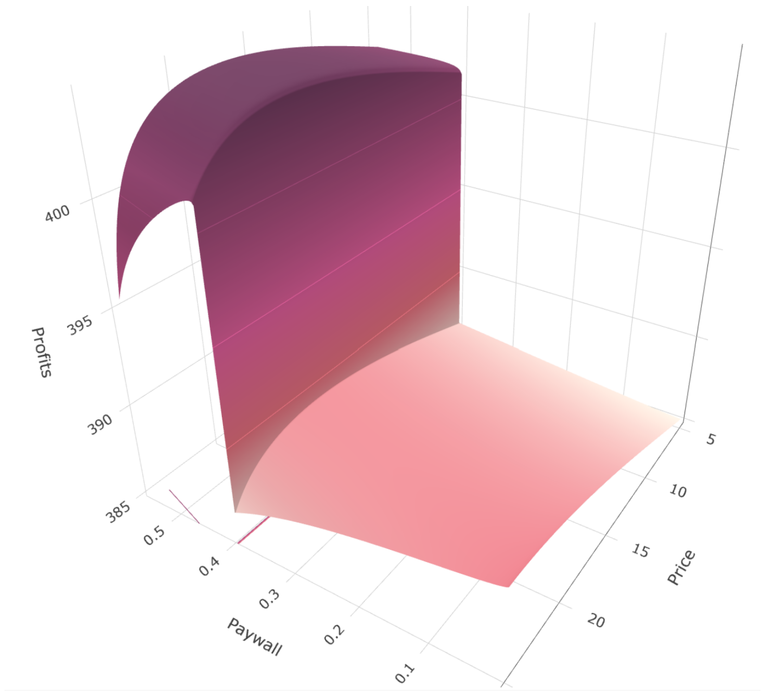

Figure 3: Example II

The optimal policy implies $\bar{x}^* = 0.44$ and $p^* = 18.16$. The first consumer to become a subscriber is $\theta_3 = 8.45$.

The result is intuitive. The beta distribution with those parameters implies a symmetric distribution with high density in the extremes and almost null density for the intermediate types. Hence, it is optimal for the firm to choose a price such that consumers in the right tail of the distribution become subscribers. Continuing to reduce the price is not profitable as the change in the mass of subscribers is small relative to the difference in the price. It is also optimal to choose little readings available free of charge, as there is a vast mass of subscribers for whom it is optimal to read this number and, at the same time, for the other tail of the distribution, these free readings are just a few, thus changing from subscriber to not subscriber is not worthy. Figure 4 shows in the left axis the distribution of readings: the dashed line accounts for the optimal number of readings for a consumer type θ, $x^*(\theta)$. The solid line accounts for the quantities read in equilibrium for each consumer type θ. The right axis shows the density distribution. The paywall choice is clear: the firm does not want to resign the advertising revenues from the left tail of the distribution with high density.

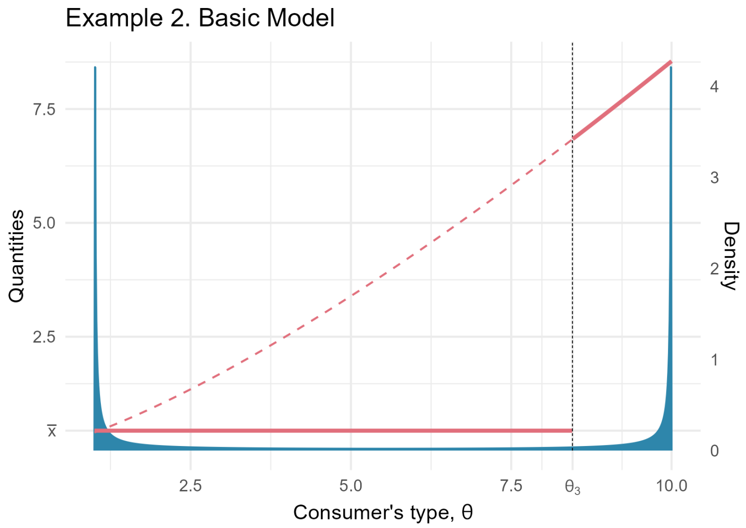

Figure 4: Quantities and density across types

3 Screening Model

By studying Figure 1 and with equation (9) in mind, a relevant question would be whether or not the firm can "convexify" the readings even if it cannot practice perfect discrimination. In that case, a higher total surplus and thus profits for the firm may be generated.

Given the structure of the problem, the firm may opt for a business strategy considering a *menu pricing*. As the firm knows the actual distribution of types θ, it can create *menus* for the consumers to be self-selective. To model this situation, I will consider a monopolistic screening model, following Bolton and Dewatripont (2004)). The problem consists of choosing a pair of numbers of readings ($x(\theta)$) and tariffs ($T(\theta)$) for each consumer type θ for whom the firm wants to sell, such that the profits are maximized.

The firm's problem, given the mass of consumers it wants to sell to, is:

$$\max_{\{x(\theta),T(\theta)\}_{\theta\in\Theta}} \int_{\hat{\theta}}^{\bar{\theta}} (T(\theta) + qx(\theta))f(\theta)d\theta$$

$$\text{s.t.} \begin{cases} \theta\phi(x(\theta)) - k(x(\theta)) - T(\theta) \geq 0 \quad \forall\theta \in \Theta \\ \theta\phi(x(\theta)) - k(x(\theta)) - T(\theta) \geq \theta\phi(x(\theta')) - k(x(\theta')) - T(\theta') \quad \forall\theta, \theta' \in \Theta \\ x(\theta) \leq x^*(\theta) \quad \forall\theta \in \Theta \end{cases}$$

Where $\Theta = [\hat{\theta}, \bar{\theta}]$ accounts for the mass of consumers the firm wants to sell to (in a further step, the first consumer who buys, $\hat{\theta}$, must be chosen to maximize profits). The first constraint is the participation constraint (PC) for each type of consumer, where the reserve utility is normalized to zero ($\phi(0) = k(0) = 0$).

The second one:

$$\theta\phi(x(\theta)) - k(x(\theta)) - T(\theta) \geq \theta\phi(x(\theta')) - k(x(\theta')) - T(\theta') \quad \forall\theta, \theta' \in \Theta \tag{ICC}$$

implies that each consumer type wants to take the contract designed for her (incentive compatibility constraint, (ICC)).

Finally, the last constraint:

$$x(\theta) \leq x^*(\theta) \quad \forall \theta \in \Theta \tag{MAX}$$

Imposes a maximum quantity of potential readings for each type of consumer, given by the amount that maximizes their utility (additional notes in the margin will not be read), (MAX). The objective function to maximize is given by the revenues provided by each type of consumer, as costs were normalized to zero: revenues from buying the contract, $T(\theta)$, and from advertising, $q(\theta)x(\theta)$.

The only "relevant" (PC), given the (ICC), is the one for the worst consumer in Θ, the one with the lowest willingness to pay for each given quantity of readings. With the notation of the problem $\hat{\theta}$:

$$\hat{\theta}\phi(x(\hat{\theta})) - k(x(\hat{\theta})) - T(\hat{\theta}) = 0 \tag{PC}$$

This consumer will be indifferent between buying and not buying in equilibrium (as the firm will choose the highest tariff possible, given its quantities such that (PC) holds). For all the other types, the firm must provide them with an informational rent (utility above the reservation utility) to sell them the contracts designed for them.

Now, to search among implementable contracts, I will replace (ICC) with two equivalent conditions: monotonicity (MON), which implies that the quantities of the contract across θ are not decreasing:

$$\frac{\partial x(\theta)}{\partial \theta} \geq 0 \tag{MON}$$

And the local downward incentive constraint (LDIC), that imposes that the utility of the consumer type θ is maximized in the contract designed for her, among local contracts:

$$(\theta\phi'(x(\theta) - k'(\theta))x'(\theta) - T'(\theta) = 0 \quad \forall \theta \in \Theta \tag{LDIC}$$

As in this case, single-crossing holds*, following Bolton and Dewatripont (2004), it can be proved that (MON) and (LDIC) are equivalent to (ICC). Then, the optimization problem is:

$$\max_{\{x(\theta),T(\theta)\}_{\theta\in\Theta}} \int_{\hat{\theta}}^{\bar{\theta}} (T(\theta) + qx(\theta))f(\theta)d\theta \quad \text{s.t.} \begin{cases} \hat{\theta}\phi(x(\hat{\theta})) - k(x(\hat{\theta})) - T(\hat{\theta}) = 0 \\ \dfrac{\partial x(\theta)}{\partial \theta} \geq 0 \quad \forall \theta \in \Theta \\ (\theta\phi'(x(\theta) - k'(\theta))x'(\theta) - T'(\theta) = 0 \quad \forall \theta \in \Theta \\ x(\theta) \leq x^*(\theta) \quad \forall \theta \in \Theta \end{cases}$$

To solve this, I will ignore the second, (MON), and fourth, (MAX), constraints and check at the end whether they hold or not.

I define the value function for consumer type θ as her optimal choice among all the available contracts

* $\frac{\partial}{\partial \theta}\left[-\frac{\frac{\partial u}{\partial x}}{\frac{\partial u}{\partial T}}\right] = \frac{\partial}{\partial \theta}\left[-\frac{(\theta\phi'(x) - k'(x)}{-1}\right] = \phi'(x) > 0$

$(x(\theta'), T(\theta'))$:

$$V(\theta;\hat{\theta}) \equiv \theta\phi(x(\theta)) - k(x(\theta)) - T(\theta) = \max_{\theta'} \theta\phi(x(\theta')) - k(x(\theta')) - T(\theta') \tag{10}$$

Differentiating the value function against θ:

$$\frac{\partial V(\theta;\hat{\theta})}{\partial \theta} = \phi(x(\theta)) + \underbrace{(\theta\phi'(x(\theta) - k'(\theta))x'(\theta) - T'(\theta)}_{=0 \text{ by (LDIC)}}$$

Integrating, and using (PC) which implies that $V(\hat{\theta}) = 0$:

$$V(\theta;\hat{\theta}) = \int_{\hat{\theta}}^{\theta} \phi(x(z))dz + V(\hat{\theta};\hat{\theta})$$
$$V(\theta;\hat{\theta}) = \int_{\hat{\theta}}^{\theta} \phi(x(z))dz \tag{11}$$

The expression in (11) accounts for the informational rent: the marginal utility the consumer obtains from purchasing the contract depends on the mass of consumers worse off than her who also decide to buy. Why cannot the firm extract this surplus from the consumers? The answer holds in the compatibility constraint. First, let's consider the worst consumer buying in the notation of the exercise $\hat{\theta}$. Her participation constraint implies that her utility will be null in equilibrium. Why? Because if that were not the case, the firm could increase the tariff of her contract so that (PC) remains valid. This consumer continues to make a purchase. If the rest of the consumers were not willing to accept this contract before, they would not want to do so now that it has become more expensive. Therefore, the firm's profit increases. Consequently, the least favorable consumer must settle for their reservation utility in equilibrium. Having said that, let's consider the consumer in the margin of $\hat{\theta}$, θ'. This type can choose from all the contracts available. In particular, this consumer can choose the contract designed for $\hat{\theta}$. In that case, her utility would be given by: $(\theta' - \hat{\theta})\phi(x(\hat{\theta}))$. Hence, to induce the consumer type θ' to choose the contract designed for her and not the one for $\hat{\theta}$, the firm must leave her an informational rent of at least $(\theta' - \hat{\theta})\phi(x(\hat{\theta}))$. Therefore, every consumer of type $\theta > \hat{\theta}$ must receive a positive surplus in their contract to prevent them from choosing the contract designed for $\hat{\theta}$ (as the expression $(\theta' - \hat{\theta}$ is increasing in θ'). Moreover, they must receive at least the surplus they would obtain by choosing the contract of the worst-off consumer type just behind them. This way, it follows that the expression for the informational rent of a consumer of type θ will be the integral over all consumers worse off than them who purchase a contract according to the function $\phi(.)$, which captures the marginal valuation of the contract for type θ.

Therefore, the trade-off faced by the firm is whether selling to a larger mass of consumers while leaving a higher informational rent for the right tail of the distribution (a higher informational rent implies a lower tariff for the consumer type θ and, consequently, lower profits derived from this group). Or to reduce the mass of buyers, increasing the tariff for those buying.

Following the problem, replacing (11) in (10), an expression for the tariff as a function of the quantity of the contract can be obtained:

$$T(\theta;\hat{\theta}) = \theta\phi(x(\theta;\hat{\theta})) - k(x(\theta;\hat{\theta})) - \int_{\hat{\theta}}^{\theta} \phi(x(z;\hat{\theta}))dz \tag{12}$$

Finally, replacing (12) in the objective function:

$$\pi(\theta;\hat{\theta}) = \int_{\hat{\theta}}^{\bar{\theta}} \left[\theta\phi(x(\theta;\hat{\theta})) - k(x(\theta;\hat{\theta})) - \int_{\hat{\theta}}^{\theta} \phi(x(z;\hat{\theta}))dz + qx(\theta;\hat{\theta})\right] f(\theta)d\theta$$

Working with the previous expression, the problem for the firm (ignoring (MON) and (MAX)), and its first order condition is:

$$\max_{\{x(\theta)\}} \int_{\hat{\theta}}^{\bar{\theta}} \left[\left[\theta\phi(x(\theta;\hat{\theta})) - k(x(\theta;\hat{\theta})) + qx(\theta;\hat{\theta})\right] f(\theta) - \phi(x(\theta;\hat{\theta}))(1-F(\theta))\right] d\theta$$

$$(x(\theta)) : \left[\theta\phi'(x(\theta;\hat{\theta})) - k'(x(\theta;\hat{\theta})) + q\right] f(\theta) - \phi'(x(\theta;\hat{\theta}))(1-F(\theta)) = 0$$

$$\underbrace{\theta\phi'(x(\theta;\hat{\theta})) - k'(x(\theta;\hat{\theta}))}_{(*)} = \frac{1-F(\theta)}{f(\theta)}\phi'(x(\theta;\hat{\theta})) - q \tag{13}$$

Let's note that $(*)$ characterizes $x^*(\theta)$, the number of readings that maximize the utility of the consumer type θ, and thus the maximum number of readings she would read if available. From the right hand of the equation, it can be concluded that, as $q \neq 0$, there would be a continuation of types for whom (MAX) will be binding. In particular, when considering $\theta = \bar{\theta}$, as the first term of the right hand is zero, and the utility function is concave, the $x(\theta;\hat{\theta})$ that solves the first order condition implies $x(\theta;\hat{\theta}) > x^*(\theta)$. In particular, for $\theta = \bar{\theta}$, the solution for that FOC is the socially optimal quantity, (4).

Hence, the quantities for each contract can be characterized by:

$$x(\theta;\hat{\theta})^{contract} = \min\{x(\theta;\hat{\theta})_{FOC}, x^*(\theta)\} \tag{14}$$

with $x(\theta;\hat{\theta})_{FOC}$ being the solution for (13).

Proposition 3. *The quantities offered by the firm to the consumer type θ are invariant to the mass of consumers buying contracts.*

When choosing the optimal quantities for consumer type θ, the firm accounts for the informational rent of those with a higher willingness to pay than θ. It may not offer the optimal quantity $x^*(\theta)$ to all the types, as these types of contracts imply higher informational rents for the right tail of the distribution. However, the decision is not affected by those with a lower willingness to pay as the consumers' decision is not altered by the contract for the consumers with higher θ. Then, independently of which mass of the consumers the firm decides to sell to, i.e., independently of $\hat{\theta}$, the quantities offered for a given type of consumer θ will remain fixed, proving Proposition 3. What is the consumer $\hat{\theta}$ affecting? The price system of the contracts (the tariff in each contract). As discussed above, the informational rent, and in consequence, the tariff of the contract, depends positively on the mass of consumers purchasing in equilibrium.

Additionally, (MON), the second constraint of the problem, must hold in equilibrium. Once the function $x(\theta;\hat{\theta})^{contract}$ is obtained, this condition must be checked.

The next step consists of computing the tariff for each contract. With (12):

$$T(\theta;\hat{\theta})^{contract} = \theta\phi(x(\theta;\hat{\theta})^{contract}) - k(x(\theta;\hat{\theta})^{contract}) - \int_{\hat{\theta}}^{\theta} \phi(x(z;\hat{\theta})^{contract})dz \tag{15}$$

Finally, the profits as a function of the mass of buyers are given by:

$$\pi(\theta;\hat{\theta})^{contract} = \int_{\hat{\theta}}^{\bar{\theta}} \left[T(\theta;\hat{\theta})^{contract} + qx(\theta;\hat{\theta})^{contract}\right] f(\theta)d\theta \tag{16}$$

Now, the firm has to optimize against $\hat{\theta}$ to find the optimal mass of consumers to sell. The optimal solution consists of $\{x(\theta)^{opt}, T(\theta)^{opt}, \Theta^{opt}\}$.

This model will have efficiency loss from three sources:

(i) Those $\theta \notin \Theta$ and $\theta \geq \theta_1$ are not reading in equilibrium.

(ii) Some consumers are reading the quantities that maximize their utility but not the socially optimal ones (externality effect).

(iii) Some consumers are reading less than their optimum (consumer and advertising surplus is lost in equilibrium).

The expression for the dead weight loss is:

$$DWL = \int_{\theta \in \Theta^{opt}} \left[z(\phi(x^{so}(z)) - \phi(x(z)^{opt}) - (k(x^{so}(z) - k(x(z)^{opt})) + q(x^{so}(z) - x(z)^{opt})\right] f(z)dz \tag{17}$$

The maximum profits the firm can obtain in this model weakly dominate those obtained in the Basic Model, as it is a particular case with two types of contracts: one with a null tariff and $x = \bar{x}$, and the second one with $x \geq x^*(\bar{\theta})$ (such that no consumer faces a binding restriction over readings if they choose this contract) and $T = p^*$. If the firm chooses something different, it must be weakly better off.

4 Welfare Analysis

When considering a degenerated distribution (without heterogeneous consumers), the result of both models coincide, and the result is the same as under the benchmark of perfect discrimination (the firm offers the quantities that maximize the consumer's utility and sets the maximum price such that the "unique" consumer chooses to subscribe). In this example, the results for the firm, the consumer, and the welfare coincide in both models. Furthermore, if there is heterogeneity in consumers but the price paid for advertising space is high enough relative to the consumer's utility, it would be optimal for the firm to design policies such that all consumers read, in equilibrium, the quantity that maximizes their utility. From a welfare point of view, the results under both models coincide again, as the allocations are the same.

Nevertheless, both models have different efficiency loss sources in other cases, as explained in the previous sections. It is not obvious which one will dominate from a welfare point of view. A priori, it would be reasonable to expect overall welfare to be higher in the second model, given that the firm has more tools to choose its business strategy. It would make sense to assume that the firm will select contracts to enhance aggregate welfare, allowing it to capture that surplus through the tariff. To analyze that, I will consider some particular examples: one in which the first model implies a higher welfare and the second one when the result is the other way around.

To do so, I will consider the same specific functional form for the utility, as it is flexible enough for the aim of the exercise:

$$U(x;\theta) = \theta\phi(x) - k(\theta) = \theta\frac{x^{1-\rho}}{1-\rho} - \beta\frac{x^{1+\eta}}{1+\eta} \tag{18}$$

4.1 Example I

With:

$$\begin{cases} q = 0.2, \quad \beta = 0.1 & \rho = \frac{1}{4} \quad \eta = \frac{1}{2} \\ \phi(x) = \dfrac{x^{1-\rho}}{1-\rho} & k(x) = \dfrac{x^{1+\eta}}{1+\eta} \quad \theta \sim \{2 \cdot beta[1,1] + 1\} \end{cases}$$

Basic Model

In the Basic Model, as it can be seen from Figure 5 (interactive chart here), the profits are maximized in a corner solution with $\bar{x} = 0$ and $p = 8.22$. The profits are 14.26.

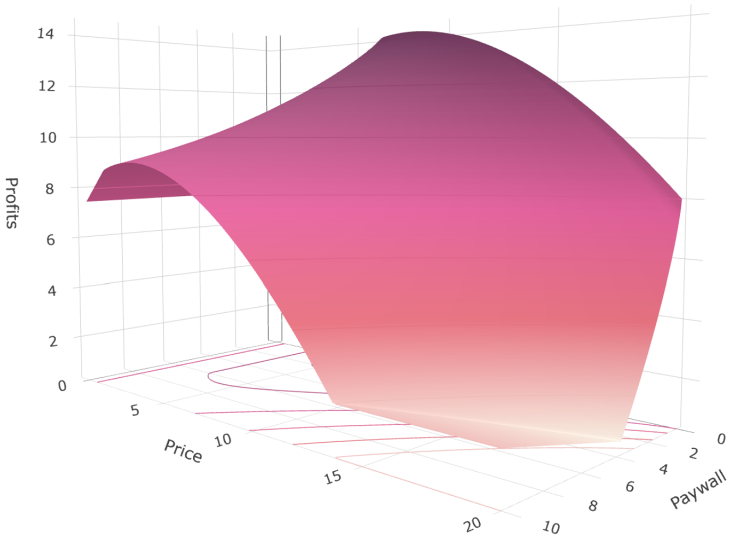

Figure 5: Profit over $\bar{x}$ and p

The first type of consumer who buys can be computed with the equilibrium price. In particular, $\theta_3 = 1.11$. In Figure 6, the readings in equilibrium (solid line), the socially optimal ones (green dashed line), and the optimal readings from the consumer point of view (blue dashed line) are plotted.

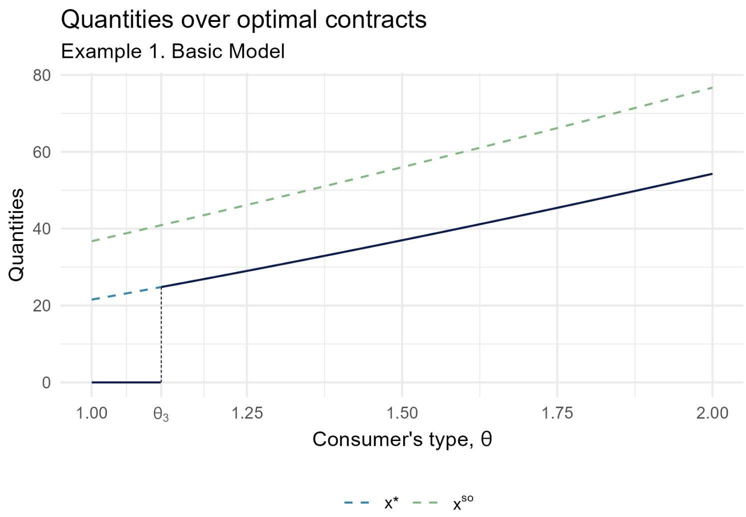

Figure 6: Number of reading across consumer types

Hence, there are two sources of efficiency loss in this equilibrium:

- Those consumers with $\theta < \theta_3$ are not reading.

- Those consumers with $\theta \geq \theta_3$ are reading less than the socially optimal quantities.

The total deadweight loss is $1.8 + 1.32 = 3.12$, where the first term is the loss for the presence of the externality (consumers want to read less than the socially optimal quantities). In contrast, the second one is the loss from the consumers of type in $[\underline{\theta}, \theta_3]$ who are not reading the quantity that they find optimal, $x^*(\theta)$.

Screening Model

In this case, the results are as follows: the firm wants to sell to every type of consumer with different contracts. The profit of this policy is 14.55, while the dead weight loss is $1.8 + 1.46 = 3.3$

In Figure 7, I plot the dynamics of the readings in this equilibrium:

- The dashed green line represents the socially optimal quantities for each given type of consumer in the notation of the model $x^{so}(\theta)$.
- The dashed red line represents the optimal quantities from the consumers' point of view in the model's notation $x^*(\theta)$.
- The dashed blue line represents the quantities that solve the first order condition while ignoring the (MAX) constraint, in the model's notation $x(\theta, \hat{\theta})_{FOC}$.
- The solid black line represents the quantities over the optimal contracts in the model's notation $x(\theta)_{opt}$.

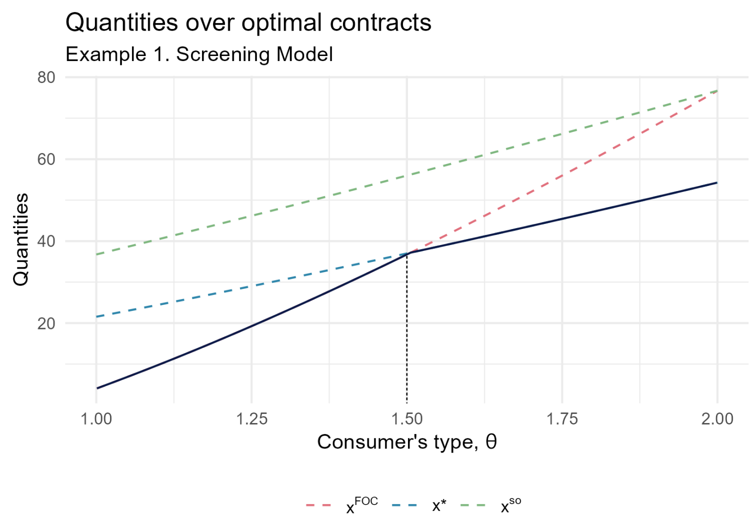

Figure 7: Number of reading across consumer types

The green and the red lines intersect in $\bar{\theta} = 2$. This is the classical result of no distortion at the top. When ignoring the (MAX) constraint, the firm finds it optimum to offer the socially optimal quantity to the best consumer, as she values the readings the most. If the contract had offered less digital news, the firm would have increased its profit by offering higher quantities at a higher tariff. As the tariff is updated, the other consumers will continue taking their contracts (this contract has additional reading that they do not value enough, which is expensive for them), while the firm will be strictly better under this policy. As mentioned before, the distortion in quantities is presented because offering higher amounts in the contract of the "bad consumers" (those with low willingness to pay) implies that the "good consumers" must have a higher informational rent for the incentive compatibility constraints to hold.

In addition, the green line is always higher than the blue line. This is a direct consequence of the externality of advertising space.

In this model, the efficiency loss, in addition to the externality-driven derivative (difference between green and blue line), is because the firm offers (red dashed line) quantities lower than what consumers find optimal (blue dashed line) across a continuous range of types. Therefore, efficiency is lost due to utility and non-externality-derived advertising.

Naturally, the firm obtains higher profits under the Screening Model since it has additional degrees of freedom. Nevertheless, the result regarding efficiency is not the expected one: even though the firm has more instruments to choose its business strategy, from the aggregated point of view, the total surplus is lower in equilibrium. It would have been reasonable to expect that the firm would have increased the total surplus of the economy under the Screening Model to capture part of that surplus and obtain a higher profit in equilibrium.

4.2 Example II

In this case, I consider a lower price for advertising space, leaving all the other parameters fixed.

With:

$$\begin{cases} q = 0.05, \quad \beta = 0.1 \quad \rho = \frac{1}{4} \quad \eta = \frac{1}{2} \\ \phi(x) = \dfrac{x^{1-\rho}}{1-\rho} \qquad k(x) = \dfrac{x^{1+\eta}}{1+\eta} \quad \theta \sim \{2 \cdot beta[1,1] + 1\} \end{cases}$$

Basic Model

In the Basic Model, as it can be seen from Figure 8 (interactive chart here), the profits are maximized with $\bar{x} = 0$ and $p = 10.83$. The profits are 9.37.

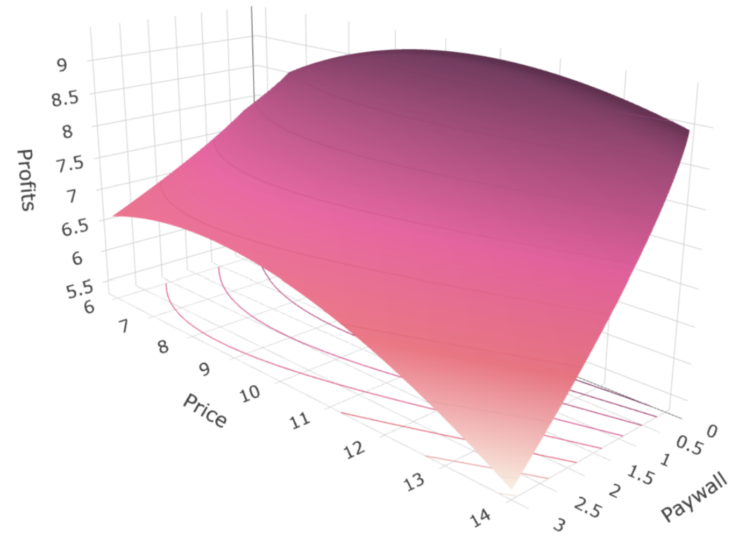

Figure 8: Profit over $\bar{x}$ and p

With the equilibrium price, the first type of consumer who buys can be computed. In particular, $\theta_3 = 1.27$. With the decrease in the advertising price, the opportunity cost of losing revenues from advertising for those consumers who are out of the market is lower. Hence, it is more profitable to increase the price such that a smaller mass of consumers choose to become subscribers, but they pay a higher price in equilibrium. Figure 9 shows the readings in equilibrium (solid line), the socially optimal ones (green dashed line), and the optimal readings from the consumer point of view (blue dashed line).

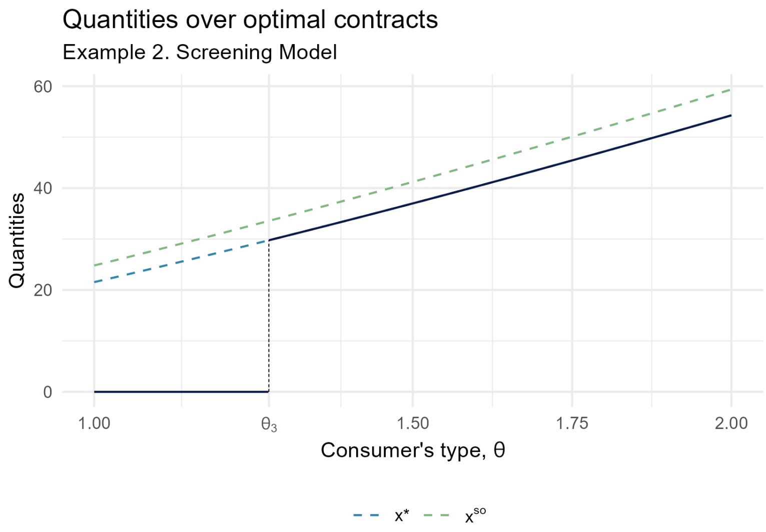

Figure 9: Number of reading across consumer types

The total deadweight loss is $0.1 + 2.84 = 2.94$, where the first term is the loss for the presence of the externality. In contrast, the second one is the loss from the consumers of type in $[1, \theta_3]$ who are not reading the quantity that they find optimal, $x^*(\theta)$.

Screening Model

In this case, the results are as follows: the firm wants to sell to every type of consumer with different contracts. The profit of this policy is 10.11, while the dead weight loss is $0.1 + 2.26 = 2.36$

In Figure 10, I plot the dynamics of the readings in this equilibrium:

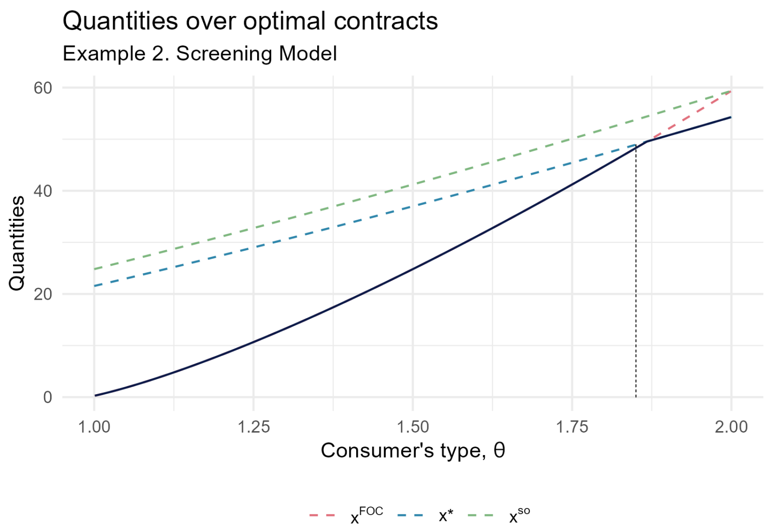

Figure 10: Number of reading across consumer types

Again, the firm is obtaining higher profits under the Screening Model. Nevertheless, the welfare result is the opposite: the first model performs worst. Those consumers that are out of the market in equilibrium are generating much more efficiency loss than the one derived from the distortion over the quantities obtained by consumers in the Screening Model.

5 Empirical Analysis

For the empirical analysis of this study, I use a unique database from one of the leading traditional Argentinian media outlets. This platform has been adapting its operations in the market in response to the digital revolution to align with the changing market dynamics.

It's worldwide a common practice in this industry to adopt a mixed market model. However, in economies like the Argentinian, this model is even more pronounced due to the relatively low advertising revenues as a proportion of the gross product. In May 2021, advertising revenues were around $200 pesos (local currency)[†] for every 1000 articles read, while the monthly subscription price was approximately $600 (local currency). These absolute values might not provide clear insights into an economy like Argentina, where the purchasing power of the currency is constantly diminishing. Nonetheless, they illustrate the existing gap between these two potential revenue sources.

Considering the market study, the fact that the main dynamics occur through electronic devices brings a significant advantage: the firm has a lot of information about the readers' interests (it can capture most of their actions during each session on the platform). In other words, everything can be measured and quantified, making an audience analysis essential, both in terms of lags and expectations.

At a first level, the platform uses a unit of measurement called "Unique Browser (UB)", which consists of cookies that identify the user associated with a device and browser. This allows individual records to be maintained over time for each of these UBs. In the databases, it's possible to identify the same user from one period to another as long as they access the platform from the same medium, for example, using Google Chrome on their computer.

At a second level, there are readers who browse while logged in, for example, through a Google account. This allows for one-to-one identification regardless of the medium they use to access the content. With both methods, the firm can build a user consumption history, enabling them to show news that better matches the user's profile.

Furthermore, the firm collects information about the means by which users access the platform, such as Google Search, direct entry through the medium's website, via social media (redirected from a tweet, for example), through mobile notifications, among others. This type of data, along with previous browsing history and articles read, will help identify and classify readers and design more accurate models to look for the optimal policy.

5.1 Business Model

As previously mentioned, the platform generates revenue through both subscriptions and advertising. Its objective is twofold: to retain subscribers for as long as possible (through a monthly fee) and to maximize the number of articles read.

[†] In May 2021 the nominal exchange rate was $155 pesos for each US dollar.

The company employs what I refer to as a "Paywall" (a variable of choice, denoted as $\bar{x}$) in the theoretical model. This variable represents the maximum number of articles (in this firm's case, 12 articles) that a Unique Browser can read in a 28-day mobile window without subscribing to the medium. Each time an unsubscribed user accesses the platform, the system identifies them, calculates the accumulated number of articles read, and determines if, with the next click, the article will be available or if the user will receive a message informing them that they have exceeded the allowed number of free articles, offering a subscription to the platform.

Here, it is worth noting that recurring readers are aware of the existence of these operational restrictions, although it is not reasonable to assume that they have real-time control over them since they do not know the current accumulated count or the Paywall at any given moment (asymmetric information).

5.2 Data

I have monthly datasets for all the months of 2020, each containing approximately 1,200,000 observations per month. For each user, identified by a previously mentioned ID (UB), I have data **for each given month**[‡], categorized by different variables:

1. Dimension: month; user ID; device used to access; country; city; user type (subscriber, non-subscriber, non-subscriber with free access)
2. Visits:[§] total visits; divided by time of day (morning-afternoon-night); by access method
3. Notes: read notes, classified by type (opinion, politics, entertainment, sports, others)

I do not have a wide variety of covariates that would allow me to make predictions or causal inferences. In particular, I do not have variables such as age, gender, education, income, or subscriptions to other platforms. These variables would be natural controls for possible regressions with explanatory power. Therefore, my analysis will primarily focus on interpreting descriptive statistics and graphs.

Nevertheless, I have access to a natural experiment that I will exploit: randomly, from September 2020 until December 2020, approximately 3% of non-subscribers (classified as non-subscribers with free access) were "unlocked". The company sought to maintain the percentage of those unlocked and, whenever possible, on the same IDs to identify temporal patterns.[¶]

This will allow me to compare how the volume of readings changes for those who choose not to pay but are granted unlimited access to the content. In this sense, I can infer the level of revenue generated by the subscription model, particularly with regard to the marginal revenues that could be generated from advertising if the paywall were lifted for the entire reader base.

5.3 Natural experiment

In the natural experiment, non-subscribers are supposed to have been randomly selected to have free access to the platform. In this subsection, I study the distribution of the observed variables among groups.

[‡] The analysis will be conducted using the month as the unit, even though, in practice, the 28 days are mobile. For this reason, there could be Non-Subscribers who exceed the maximum number of notes, although they should still be limited to 12.

[§] Visits or Sessions are equivalent, measuring the number of times in a month that the ID entered the platform; for a detailed analysis similar to Notes, please refer to the Appendix.

[¶] In September, a subsample was selected to be unlocked, and if in October the same ID from the set accessed the platform, they had unrestricted access again.

In table 1, I show the proportion of each group, subscriber, non-subscriber and non-subscriber with free access, among different variables:

Type	Full sample	Arg	Foreign	Bs As	Other	Desktop	Mobile	Tablet
Non-subscriber	96.14	95.85	96.66	94.78	96.36	93.20	96.66	94.38
Non-sub. w/free access	3.20	3.20	3.20	3.45	3.16	4.15	3.03	3.41
Subscribers	0.66	0.96	0.14	1.78	0.48	2.65	0.30	2.21

Table 1: Type of users

The second column shows the proportion of each group in the whole sample. The next group shows, on the one hand, that the proportion of "unlocked" users is independent of the country they are reading from. On the other hand, the users who access the platform from foreign countries are less likely to become subscribers than those who access from Argentina.

The next category groups the sample into users reading from Buenos Aires (the capital city) or from other cities. There are two main differences between these subsamples: those from Buenos Aires are more likely to become subscribers but also more likely to be "unlocked" by the firm. This pattern does not suggest a *random* assignation. When considering the last group, which classifies the sample according to the device readers use to access, the same pattern is shown in the data: those users reading from a laptop or computer (desktop) are more likely to become subscribers and to get free access. Hence, the firm does not seem to be "unlocking" randomly.

When performing an analogous analysis with the type of reading or with the moment of the day the users access the platform (sessions), the results suggest that the "unlocked" may have been conditional on these characteristics, too. In particular, I show the mean of sessions or readings.

Type	Morning	Afternoon	Night	Politics	Sports	Entertainment	Opinion	Other
Full Sample	19.73	36.34	43.93	11.21	10.23	24.59	1.64	51.80
Non-subscriber	19.31	36.21	44.48	10.19	10.06	25.55	1.36	52.23
Non-sub. w/free access	20.50	36.06	43.44	11.92	10.06	25.89	1.64	50.24
Subscribers	25.56	38.49	35.95	19.58	11.76	15.79	3.97	48.72

Table 2: Means of access and readings

Again, the mean of each group suggests that the assignment was not random. For example, the proportion of political news read by subscribers is higher than among non-subscribers. And the mean for the "unlocked" group is slightly higher than the population's mean. A potential reasonable explanation is that the assignment was conditional on this characteristic. A similar pattern is present in the moment of the day the users access the platform.

Given the differences in the observable characteristics, I will take a subsample of the non-subscribers with free access so that it statistically has the same distribution as the whole sample on the left side (users who do not face a binding constraint over readings) and on the right side (users who become subscriber in case of facing the paywall). To build this data, given the results presented above, I will keep those observations that come from a desktop device and from Buenos Aires[11] (if the assignment had been random, these changes would not have been neccesary).

[11] 133392 observations for the last trimester of 2020.

Figure 11 shows the cumulative distribution of the non-subscriber with and without paywall constraint who read less than the paywall (12 notes)[**]:

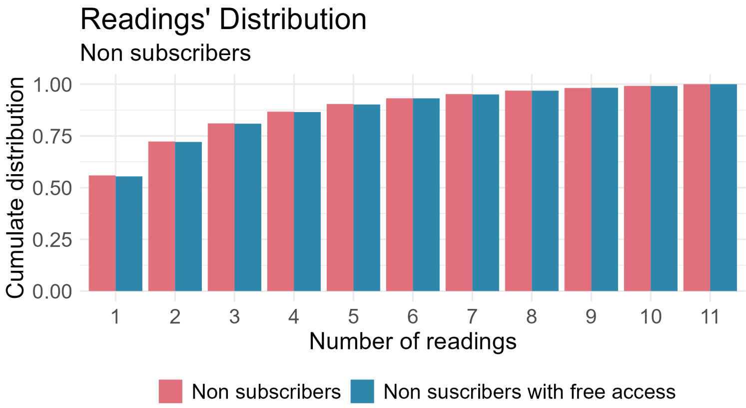

Figure 11: Cumulate distribution

Based on the graph, it can be observed that the two distributions are very similar. I will use a statistic to test whether or not both samples come from the same population distribution. To do so, I will use the Kolmogorov-Smirnov test[††]. The null hypothesis of this test is that both samples were drawn from the same distribution. In this case, the results are:

$$\begin{cases} D^c = 0.004 \\ p\text{-}value \approx 1 \end{cases}$$

As the p-value is greater than 5%, there is evidence in favor of the null hypothesis of equal distributions.

The chart when performing the same analysis for the right tail of the distribution is presented in Figure 12[‡‡].

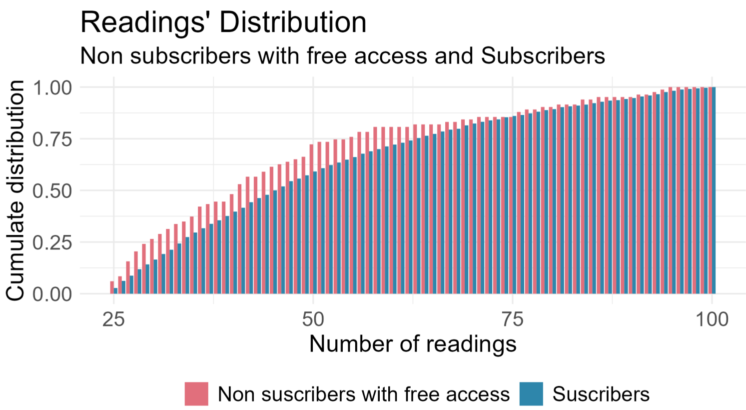

Figure 12: Cumulate distribution

Again, the Kolmogorov-Smirnov test finds evidence in favor of the null hypothesis of both samples

[**]101411 observations for non-subscribers and 4817 observations for non-subscriber with free access
[††]Further detail of the test in Appendix 2.
[‡‡]1452 observations for subscribers and 83 observations for non-subscribers with free access.
I consider those users reading 25 or more digital news per month for the graphical analysis. The analytical results are robust to changes in this cut-off.

being drawn from the same population distribution

$$\begin{cases} D^c = 0.13 \\ p\text{-}value = 0.133 \end{cases}$$

Hence, these subsamples are such that the reading decisions follow the same pattern for those agents in group 2 ($\theta \in [\theta_1, \theta_2]$, do not face a binding constraint) and for those agents in group 4 ($\theta \in [\theta_3, \bar{\theta}]$). Thus, I will assume that the difference among the subsamples for those agents of type $\theta \in [\theta_2, \theta_3]$ is explained by the firm's policy.

A relevant question is whether or not the firm's business policy is optimal. I will carry out, first, a drastic analysis: in the trimester under study users can read up to 12 notes without paying (Paywall), the advertising space price is $q = 0.2$, and the subscription price is $p = 600$. If the firm had opted for a corner solution policy, offering all the readings free of charge, would it have obtained higher profits? Using the non-subscribers with free access distribution as the counterfactual I compute the average revenue per reader under each policy:

Revenues per reader	Actual policy	Readings for free
Average revenues from subscription	29.69	0
Average revenues from advertising	0.73	0.78
Total average revenues	**30.42**	**0.78**

Table 3: Average revenues across policies

For this subsample, the actual policy dominates the alternative approach of offering readings free of charge.

The next question would be whether the business strategy $(\bar{x}, p)$ is optimal under this distribution, considering the specifications of the Basic Model. To evaluate this situation, I need to calibrate the model. In particular, I will use the next functional form for the utility function:

$$u(x;\theta) = \theta \frac{x^{1-\rho}}{1-\rho} - \beta \frac{x^{1+\eta}}{1+\eta}$$

I will assume, for the aim of the exercise, that, given the current policy of $(\bar{x}, p) = (12, 600)$, subscribers are those consumers who find it optimal to read 25 digital news or more. Furthermore, using that $x^*(\theta_3) = 25$, I will set $\rho = 0.3$, $\eta = 0.4$ and $\beta = 2.25$ to be consistent with the model. The firm has further tools to calibrate with better precision those parameters. In particular, a good approach can be to expose consumers to different intensities of advertising. For consumers who are observed over time, the firm can completely eliminate the advertising to calibrate ρ (by observing the reading decision with and without advertising). In addition, by changing the intensity of advertising over subscribers and non-subscribers consumers but keeping it positive, and given the paywall and the fee of subscription, the firm can infer the relation between β and η. Furthermore, given the current policy, the firm can calibrate $x^*(\theta_3)$ by checking how many digital articles are read by those consumers who have just become subscribers (to avoid the intertemporal effects that are not considered in the Basic Model). Given the calibrated parameters, it can infer the types' distribution of θ in the economy. Finally, it can choose the business policy $\{\bar{x}, p\}$.

Given the parameters set above, Figure 13 shows the types' distribution in red[§§]. For the aim of the exercise, as readings from digital journals exhibit heavy-tailed distributions, I will consider a Pareto distribution with a shape 1.52 (in blue). Both distributions follow similar patterns:

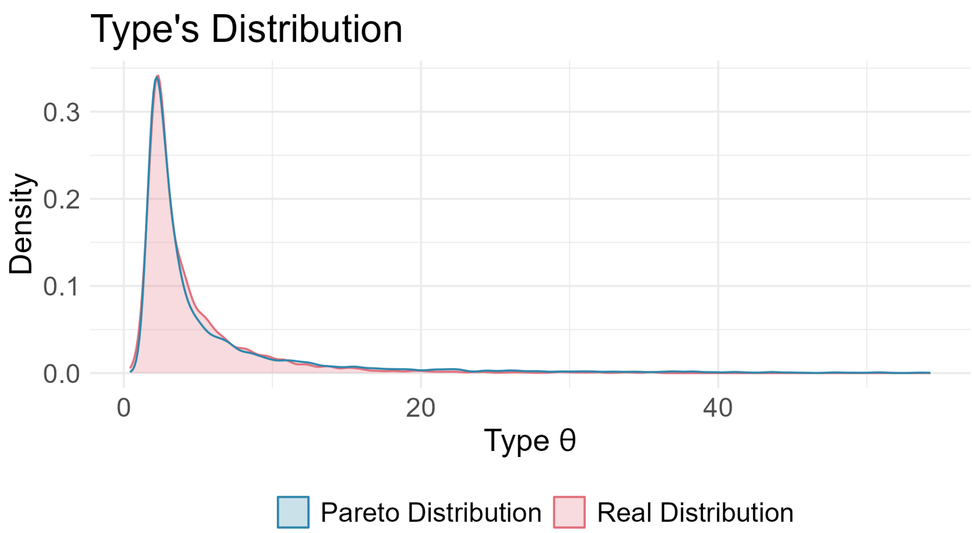

Figure 13: Type's density

In my example, the profit level across different policies are plotted in Figure 14 (interactive chart here).

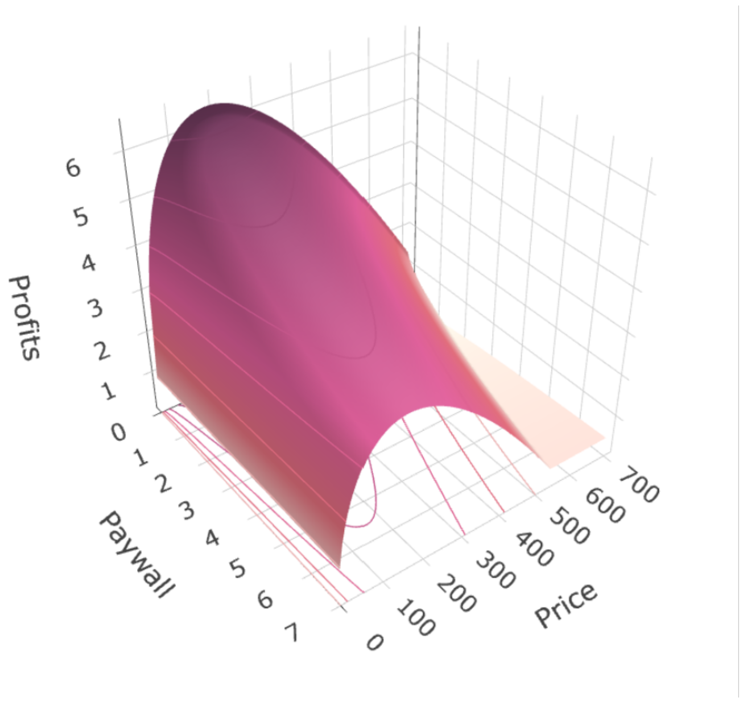

Figure 14: Profits across policies

The optimal set paywall fee is $(\bar{x}, p) = (0, 183.14)$. Hence, if the parameters were correct, there would be space for increasing the firm's profits, given its current business strategy by adopting a corner solution offering readings only to subscriber users.

[§§]As the decision of readings in practice is discrete, and I am assuming a continuous distribution, I added a white noise shock to the data to obtain a consistent distribution.

6 Future works and extensions

6.1 Demand

Up to this point, the analysis has been based on my assumptions about the readers' utility to infer the demand the company faces for each pair $(\bar{x}, p)$ offered in the market. However, there are multiple reasons that could explain the data, and my hypothesis is only one of them.

How can I add robustness to the results? Ideally, I should analyze the other side of the market. Study consumers with greater precision, test hypotheses about their behavior, and determine which factors have the greater explanatory power for a given model. For this reason, I will search the literature for studies that have investigated similar phenomena.

From the company's perspective, it could invest in gathering more user data[¶¶]. An additional problem in this realm is the pace of evolution in this market. Articles that have investigated this phenomenon ten years ago are obsolete since they do not incorporate the role of the smartphone in the dynamics - a device that plays a key role in this market. Furthermore, users' relationships with platforms are constantly changing. The willingness to pay for the service (Willingness To Pay, WTP) has evolved, and there is no indication that it has reached a stationary point. Subscription levels on platforms like *Netflix* or *Spotify* are continually growing. A decade ago, this phenomenon would have been unthinkable. These changes in consumer behavior will have an impact on the relationship established with news platforms. Fletcher and Nielsen (2020) precisely tests this issue and concludes that there is a positive individual-level association between paying for other types of online content (movies, music, books) and paying for online news. Additionally, they find a positive association between paying specifically for online entertainment and paying for news.

Why is there resistance to subscribing (paying) for a service I value? The answer to this question is related to the field under analysis, specifically regarding news. The literature focuses primarily on the presence of close substitutes with free access. This leads to the following discussion: is the company capable of creating vertical differentiation (from the user's perspective) in the product it offers compared to other websites? Rational consumers are not willing to pay for something they can access for free, and news on the internet can be obtained at an essentially null search cost. Therefore, if news on each platform is a sufficiently close substitute, why would someone be willing to subscribe?

On the other hand, since the emergence of the internet, the "culture of free" has developed in parallel (De Bustos and Casado (2010)). This phenomenon, combined with a collective idea that news has little value due to its cheap, undifferentiated creation, with journalists reporting the same stories from the same sources, leads to very low subscription rates. Additionally, social media is displacing news platforms as a source of information. From this new space, information is consolidated, debates are opened, and public agenda tracking occurs.

In addition, Zhang and Nguyen (2004) points to the available payment methods as contributing factors. While this insight comes from a relatively old paper, it is not obsolete. Particularly in societies where necessary levels of confidentiality are not always guaranteed, there is resistance to providing personal and credit card information on websites.

[¶¶]I am aware that the company has additional features. For confidentiality reasons, I am currently working with those who could provide me with data.

Parallel to the mentioned phenomenon, the fact that media generates revenue through advertising (the readers do not realize that they should be the ones paying for the service as they indirectly generate income through advertising) has been significantly reduced in recent years. As mentioned earlier, this is due to other platforms' ability to gather more users in one place and, to a significant extent, the shift from computers to mobile phones. Screens have significantly reduced in size, reducing potential advertising spaces (Berger et al. (2015)).

Finally, it is important to note that the cultural phenomenon should not be underestimated (most papers generally work with American databases). In Argentina, a greater resistance to subscription is observed. Appendix 3 provides statistics on this point.

Let's now examine the possible determinants of WTP. A review of the literature that has empirically tested this phenomenon reveals that the results are not at all surprising. Age and income level are the variables with the greatest explanatory power for WTP[***].

Furthermore, the existence of other successful platforms that consolidate audiences, such as music or movies/series offering paid virtual entertainment, is causing a larger percentage of society to turn to these resources and get used to them. The consulted literature indicates that this change in behavior will also impact news WTP.

In conclusion, there is a lot of room for improvement in this research field, and a firm facing this dilemma must consider that this market is constantly changing. To maximize its advantage, it must be able to adapt quickly to changing demands, offering a high-quality, distinctive, and attractive service to induce the reader to make the dichotomous decision to subscribe.

6.2 Extensions

The functional form for consumer's utility may be too simple for this market. Even though it is useful to study the trade-off between advertising-subscription faced by the firm, to find the policy that maximizes its profit it may be worthy to consider some extensions that account for different sources of heterogeneity. Considering the Basic Model (the current policy of the firm), I propose two simple alternatives: price discrimination based on geographical location and heterogeneous paywalls based on type of notes.

The reading behavior of those consumers who read from abroad is different from the one of those reading from Argentina. In addition, the willingness to pay among these groups may be different, too. The next table shows, for the subsample of users reading from abroad, the five countries with the highest participation:

	Chile	Colombia	Mexico	Spain	United States	Total
Percentage	9.87	10.38	19.85	14.94	10.32	55.49

Table 4: Share of readings from abroad across countries

The proportion of each type of consumer in these subsamples (and proportions for those reading from Argentina as a benchmark):

[***]For a literature review, see Appendix 3.

Type	Argentina	Chile	Colombia	Mexico	Spain	United States
Non-subscriber	95.85	96.23	96.75	96.80	97.71	95.82
Non-sub. w/free access	3.20	3.71	3.24	3.19	2.22	3.70
Subscribers	0.96	0.06	0.01	0.01	0.07	0.48

Table 5: Distribution of type of users

Furthermore, the GDP per capita is quite different across these economies, as it is shown in Figure 15.

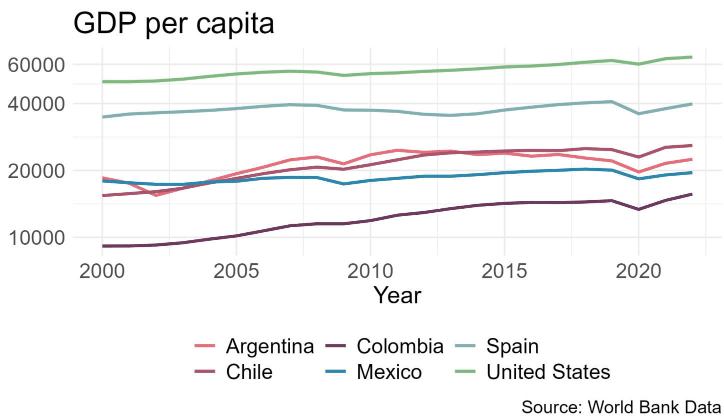

Figure 15: GDP per capita PPP (constant US$ 2017)

From the statistics shown above, it may be reasonable to consider a higher subscription fee for those consumers reading from abroad. In particular, those reading from the United States or Spain seem to be good candidates for this policy. By doing so, the firm may generate higher total revenues from these types of consumers: the advertising price is the same but these consumers may pay a higher price in real terms.

On the other hand, I propose heterogeneous paywalls as a function of the type of reading note. There are some types of notes for which multiple close substitutes are available at a null cost on the internet. This is the case, for example, of entertaining news. There are plenty of platforms offering this kind of news. The quality of them among these platforms is quite constant. Hence, it is unreasonable to think that this kind of notes will generate subscriptions. Furthermore, the firm wants to attract those users to read on the platform instead of recurring to other sources, as they generate advertising revenues. Hence, a less aggressive policy for them may allow the firm to increase its profits.

Table 6 shows the proportion of reading across groups. Those who become subscribers read, on average, a higher proportion of political and opinion news. These are the fields where the firm under study offers differential goods (higher quality) relative to other platforms in the market. Thus, consumers may pay for them to access this vertical differentiation, while non-subscribers read a higher proportion of entertainment news. Hence, the firm can use this new information to design a more efficient model. My proposal is to apply the paywall only over news of politics and opinion and offer free of charge the others.

Type	Politics	Sports	Entertainment	Opinion	Other
Full Sample	11.21	10.23	24.59	1.64	51.80
Non-subscriber	10.19	10.06	25.55	1.36	52.23
Non-sub. w/free access	11.92	10.06	25.89	1.64	50.24
Subscriber	19.58	11.76	15.79	3.97	48.72

Table 6: Distribution of type of readings

7 Conclusions

In this study, I aimed to make two novel contributions: firstly, to model the trade-off between advertising and subscription revenues faced by a digital news firm that acts as a price taker in the advertising space market. Secondly, to deepen the results from an empirical standpoint using a unique database from one of the leading newspapers in Argentina.

On the theoretical models, I proposed two different specifications: on one hand, my first model replicates the business strategy conducted by the firm that has provided me with the data. On the other hand, I proposed an alternative model with menu pricing that will allow the firm to increase its profits when considering a screening model. Both models may generate an efficiency loss in equilibrium from different sources. I studied them and was able to conclude that, a priori, no one strictly dominates the other from a welfare perspective.

The main findings arise from the empirical analysis, aligning with the presented theoretical model. From this study, it can be concluded that there is an optimal paywall-fee subscription combination that maximizes revenues, determined by the user distribution (with varying valuations for articles and consequently different Willingness To Pay - WTP) and the advertising price.

I found evidence of the paywall's effectiveness in restricting consumption, which induces subscriptions to the platform for those who value reading the most. At this point, the trade-off and potential revenues forfeited by maintaining this paywall-fee scheme become clear. Specifically, I demonstrate that given current values, the chosen scheme outperforms the alternative of releasing all readings and maximizing advertising revenues. In addition, I found evidence that illustrates that changes in the current policy in the margin may increase the firm's profits.

Additionally, there are significant differences in the types of news consumed by each user type, suggesting that, for this specific database, a model where reader heterogeneity is multi-dimensional may be more accurate. These distinctions were found both between user types (Subscribers vs Non-Subscribers) and within each group.

Finally, I propose possible extensions. On one hand, future research should micro-found preferences to add validity to the model by studying the demand. On the other hand, different business strategies could be considered. I propose the possibility of price discrimination between readers outside the country versus those reading from Argentina. In particular, I debated the option of setting a lower price within the country and charging more competitive prices abroad.

Another proposed alternative was to release articles based on the type, specifically those that do not seem to be relevant variables in the subscription decision (entertainment notes).

There is much to study, both in the specific case of this firm and in the digital news market in general. This industry is in full development and injected with dynamism; therefore, firms need to be able to adapt quickly to its evolution to satisfy demand and remain competitive in the market.

Bibliography

Mark Armstrong. Competition in two-sided markets. *The RAND journal of economics*, 37(3):668–691, 2006.

Benedikt Berger, Christian Matt, Dennis M Steininger, and Thomas Hess. It is not just about competition with "free": Differences between content formats in consumer preferences and willingness to pay. *Journal of Management Information Systems*, 32(3):105–128, 2015.

Patrick Bolton and Mathias Dewatripont. *Contract theory*. MIT press, 2004.

Hsiang Iris Chyi. Paying for what? how much? and why (not)? predictors of paying intent for multiplatform newspapers. *International journal on media management*, 14(3):227–250, 2012.

Juan Carlos Miguel De Bustos and Miguel Angel Casado. Sobre pago y gratuidad. momentos de crisis en la industria periodística. *Revista Telos Cuadernos de Comunicación e Innovación*, pages 24–35, 2010.

Raymond J Deneckere and R Preston McAfee. Damaged goods. *Journal of Economics & Management Strategy*, 5(2):149–174, 1996.

Richard Fletcher and Rasmus Kleis Nielsen. Are netflix and spotify subscribers more likely to pay for online news? comparative analysis of data from six countries. *International Journal of Communication*, 14, 2020.

Manuel Goyanes. An empirical study of factors that influence the willingness to pay for online news. *Journalism practice*, 8(6):742–757, 2014.

Lucy Küng, Nic Newman, and Robert G. Picard. Online news. In *Handbook on the Economics of the Internet*, chapter 21, pages 443–457. Edward Elgar Publishing, 2016.

Nic Newman, Richard Fletcher, Anne Schulz, Simge Andi, Craig T Robertson, and Rasmus Kleis Nielsen. Reuters institute digital news report 2020. *Reuters Institute for the study of Journalism*, 2020.

Jean-Charles Rochet and Jean Tirole. Platform competition in two-sided markets. *Journal of the european economic association*, 1(4):990–1029, 2003.

Hal R Varian. Versioning information goods. *Internet publishing and beyond: The economics of digital information and intellectual property*, pages 190–2002, 2000.

Yue Zhang and Dat-Dao Nguyen. What makes consumers willing to pay for online services? discovering consumer opinions and determinant factors on charged online services. *Journal of internet commerce*, 2(4): 35–53, 2004.

Appendix 1

Proof. of Proposition 2: *The mass of subscribers is decreasing in $\bar{x}$ and in p*

From (3), let's define:

$$H(\theta_3, \bar{x}, p) \equiv \theta_3 \phi(x^*(\theta_3)) - p - k(x^*(\theta_3)) - \theta_3 \phi(\bar{x}) + k(\bar{x}) = 0$$

Using the Implicit Function Theorem:

$$\begin{aligned}\frac{\partial \theta_3}{\partial \bar{x}} &= -\frac{k'(\bar{x}) - \theta_3 \phi'(\bar{x})}{\phi(x^*(\theta_3)) + [\theta_3 \phi'(x^*(\theta_3)) - k'(x^*(\theta_3)] x^{*\prime}(\theta_3) - \phi(\bar{x})} \\ &= \frac{\theta_3 \phi'(\bar{x}) - k'(\bar{x})}{\phi(x^*(\theta_3)) - \phi(\bar{x}) + \underbrace{[\theta_3 \phi'(x^*(\theta_3)) - k'(x^*(\theta_3))]}_{=0 \text{ by } (2)} x^{*\prime}(\theta_3)} \\ &= \frac{\theta_3 \phi'(\bar{x}) - k'(\bar{x})}{\underbrace{\phi(x^*(\theta_3)) - \phi(\bar{x})}_{>0 \text{ by } \phi'(\cdot) > 0}}\end{aligned}$$

The numerator is positive as $\phi''(\cdot) < 0$, $k''(\cdot) > 0$, $\phi'(x^*(\theta_3)) - k'(x^*(\theta_3)) = 0$ and $x^*(\theta_3) > \bar{x}$.

For the denominator, I use that $x^*(\theta_3) > \bar{x}$ (if it were not true, then it would not have been optimum to subscribe).

Then,

$$\frac{\partial \theta_3}{\bar{x}} > 0$$

To analyze how θ_3 depends on p:

$$\frac{\partial \theta_3}{\partial p} = -\frac{(-1)}{\underbrace{\phi(x^*(\theta_3)) - \phi(\bar{x})}_{>0 \text{ by } \phi'(\cdot) > 0}} > 0$$

Then, given that θ_3 is increasing in $\bar{x}$ and in p, the **mass of subscribers** is decreasing in $\bar{x}$ and in p. ■

Appendix 2

The statistic of the Kolmogorov-Smirnov test involves computing the supremum (maximum difference) between two distributions. Let $G(x)$ be the cumulative distribution function of the number of sessions/notes read by non-subscribers, and $H(x)$ be its counterpart for the liberated group. The critical value is then calculated as:

$$KS = \sup_x |G(x) - H(x)|$$

In other words, for each level of notes/sessions, it calculates the maximum distance between both curves. Naturally, as it is looking at cumulative distribution functions, the statistic takes values between $[0, 1]$, where it is 0 when both distributions are the same, and 1 at the other extreme when the distance is maximum. A p-value smaller than the standard values of confidence (1%, 5% or 10%) is evidence against the null hypothesis, and in favor of different distributions. In both cases, the p-value of the tests are high enough, with evidence in favor of the null hypothesis of same distribution.

Appendix 3

Let's study the cultural effect of media platforms. With this objective in mind, let's analyze the main indicators for Argentina based on the results from the "Reuters Institute Digital News Report 2020 (RIDNR 2020)", (Newman et al. (2020))[†††]:

Regarding the United States and Spain, the results for the following question are reported:

"Which, if any, of the following have you used in the last week as a source of news?"

Country	Online (incl. social media)	TV	Social Media	Radio	Print
USA	73%	60%	47%	21%	26%
Spain	83%	71%	63%	24%	28%
Argentina	90%	77%	78%	24%	30%

Table 7: Source: RIDNR 2020. Data from April 2020

To interpret the data, it is important to note that in April 2020, Argentina was under a total lockdown due to uncertainty in handling the pandemic, which could explain the higher information search. Even though the other two economies were under lockdown, too, Argentina is a more vulnerable country and thus the concern may have been greater.

Keeping the same set of countries, the results to the question: *"Have you paid for ONLINE news content, or accessed a paid-for ONLINE news service in the last year?"* were as follows:

USA	Spain	Argentina
20%	12%	11%

Table 8: Source: RIDNR 2020

Suggesting a lower Willingness To Pay (WTP) in Argentina.

Finally, let's look at Argentina-specific indicators:

Regarding digital sources, they searched in the following sources according to the indicated proportion:

Infobae	40%
TN online	36%
Clarín online	29%
La Nación online	22%
Minuto Uno	15%

Table 9: Weekly reach online. Source: RIDNR 2020

Infobae is a key player in this market, as it consolidates a significant percentage of the audience, mainly due to being freely accessible. The same phenomenon would explain searches on TN Online. Traditional paid portals follow, where Clarín significantly stands out from La Nación by 7 percentage points.

Finally, the report's results regarding Argentina state:

[†††] This report collected data from urban areas and has external validity for this sector of the population.

"Changing Media: Social media have overtaken TV news amongst our online sample for the first time, while weekly print consumption has fallen from 45% to just 23% over the last three years. Eight out of ten (80%) respondents say they now use the smartphone to access news each week." RIDNR (2020)

In this way, it is observed that Argentinians have lower WTP. Hence, the external validity of studies that analyze this phenomenon with databases from other countries is not obvious.

Having drawn these parallels, let's examine the determinants of WTP.

Chyi (2012) developed an Ordinary Least Squares (OLS) model to explain the intention to pay for print, web, and news app versions. The main covariates used are Gender (female), age, education, income, news interest, print newspaper use, online news use, TV news use.

In none of the three regressions do demographic variables appear significant. On the other hand, gender and age influence web and app versions of the models. Particularly, gender is significant at confidence levels of 99% and 95%, respectively, in each model with a negative sign, meaning that men have a higher WTP. Regarding age, it is reasonably predicted to have a negative estimate, as younger people are more willing to pay for this new service. Education level and income have positive coefficients, although in these models, they are not significant at traditional confidence levels (99%, 95%, 90%).

The variable measuring interest in news is significant and positive (reasonably). Lastly, it is not surprising that those who identify with online news consumption yield positive and significant coefficients for web and app formats, while their counterparts in the print version are negative and significant with a confidence level of 99%.

In line with these results, Goyanes (2014) runs a logistic regression where the outcome variable is the dummy that equals 1 if one is willing to pay for online news. The controls are analogous to those mentioned in the previous model. In the same way, they find no evidence of an effect from demographic variables. The effects on age are negative, and in this case, gender does not have explanatory power. They explain this phenomenon because younger people are more connected than older ones. Additionally, the penetration of smartphones and tablets is much higher in this age group. Finally, they find that higher income levels have a positive effect on WTP.

In a second step, the mentioned work seeks to measure if the use of social media (measured with Twitter) predicts the intention to pay. They conclude that people who use Twitter regularly (every day) are two to three times more likely to visit a news website than the average person (this does not mean they are more willing to pay for online news).