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TWO-PART TARIFF COMPETITION WITH SWITCHING COSTS AND SALES AGENTS

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Resumen

En este artículo se analizan los efectos de una estructura de precios en dos partes en un entorno competitivo con productos diferenciados. Este es el caso de los servicios de telefonía a larga distancia, donde existe una tarifa fija mensual y un cargo por minuto. Este es también el caso de varias instituciones financieras, como fondos mutuos o fondos de pensiones. A su vez, se considera la existencia de costos para cambiarse de un proveedor a otro. En muchas de estas industrias existe también este tipo de costos, el que está especialmente asociado a costos de información. En este entorno, los mercados han reaccionado mediante la contratación de agentes de venta para transferir a consumidores de una firma a otra. Sin considerar a los agentes de venta, el bienestar social es el mismo bajo una estructura de precios uniforme o una estructura en dos partes. Sin embargo, la distribución del excedente social es diferente. Cuando los agentes de venta son incorporados al modelo, estos reducen los costos de cambiarse y por esta vía se podría alcanzar un aumento en el bienestar total. Con todo, la presencia de agentes de venta genera una cantidad excesiva de traspasos de una firma a otra respecto al óptimo social.

Abstract

This paper study the effects of two-part tariff pricing in a competitive environment with differentiated products and switching costs. This is the case of long distance telephone service, where there is a fixed monthly fee and a charge per call. This is also the case for some financial institutions like mutual funds or pension funds. In many of these industries there are also switching costs. In this environment, markets have reacted by hiring sales agents to switch consumers from one firm to another. Without considering sales agents, social welfare is the same under a two-part tariff regime as under single pricing, but the distribution of surplus is different. When sales agents are introduced to the model, they are able to reduce switching costs, and welfare might increase; but they generate over-switching with respect to the social optimum.

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1 Introduction

In many industries prices are set as a two part tariff, with a fixed fee and a price per unit purchased. This is the case for long distance telephone service and for some financial institutions like mutual funds or pension funds, in the sense that there is a fixed fee and a fee per call or a fee expressed as a percentage of the amount invested. In many of these markets, there is also a switching cost. If a customer wants to switch they have to look for information and contact a new firm, which implies a cost in terms of time and resources. In many cases these companies hire sales agents to switch customers from one firm to another. They even give rewards to the switchers.

There is a rich literature on nonlinear pricing monopolists that deals mainly with optimal pricing strategies and price discrimination. In this literature, the two part tariff pricing case is discussed as a way of price discriminating across consumers. A review of this literature can be found in Varian (1989) and Wilson (1993). In these references there is some discussion about price discrimination in a competitive environment, but it is not as extensive as in the monopoly case. There are models that deal with nonlinear pricing under Cournot, Bertrand and monopolistic competition; nevertheless, these models don't include the existence of switching costs. On the other hand, there is a vast literature about competition with switching costs and consumer poaching, but these models don't consider the possibility of nonlinear pricing.[1]

The models presented in this paper try to explain why firms may prefer a two part tariff to a single price in a competitive market and the relation of these prices to the existing switching costs in these industries. The aim is to address the effects of this pricing structure on social welfare. I model

[1]For the Cournot case see Ireland (1991), for the Bertrand case see Mandy (1992) and for a model that considers monopolistic competition see Katz (1984) and Armstrong and Vickers (1999). For references on switching costs and consumer poaching see Klemperer (1995), Caminal and Matutes (1989), Chen (1997), Fundenberg and Tirole (1999) and Micco (2000).

the case of horizontal differentiation. Then I include the existence of sales agents and see how this affects prices, profits and social welfare.

2 Two Part Tariff Competition

2.1 Horizontal Differentiation Model

For simplicity I start with a duopoly model with differentiated products without switching costs. The pricing structure is a price per unit plus a fixed fee. This model shows how firms exercise monopoly power given by differentiation and how this is affected by the possibility of charging a two part tariff price.

It is assumed demand is inelastic, the number of consumers is fixed and each individual demands a certain amount independent of the price. Nevertheless, different consumers demand different amounts of the product. In the case of mutual funds or pension funds this might be the case if we believe that savings demand is inelastic, or if we consider that individuals are forced to save a specific amount in a compulsory retirement plan. However, this might not be the case for the long distance services. Holmes (1989) explores the case where there is elastic demand and finds different results under very special circumstances.

Differentiation in this case will be given by firm's characteristics. In the case of mutual funds or pension funds this can be the trust and confidence on the investment of assets, or other services provided by the manager, such as information availability. In the case of long distance services these characteristics might be services such as telephone cards, billing or information services. In this context, transportation costs (sensitivity of consumers to product characteristics) will be a function of the quantity that consumers want to buy. In the case of the mutual fund, the higher the amount of money a person is willing to invest, higher is the sensitivity of the investor to product characteristics (i.e. they will be more concerned about the firm that is administrating these funds). The same is true for long distance services. If the use of this service is low, the consumer will be less worried about the differences between providers. Given their preferences, consumers choose a firm for the next period. This firm might be different from the firm where they currently are, and this might be because their tastes have changed or because firms characteristics change.

I consider the case where there are two firms with differentiated products that have the same market shares. Consumers are willing to buy different amounts of the product, W (This is the amount of assets in the case of the mutual fund or pension fund and number of minutes or number of calls in the case of long distance services). I assume a uniform distribution where W is on the interval $[W_1, W_2]$, with $W_2 - W_1 = 1$, where W_1 the lowest amount bought by a consumer and W_2 is the larger amount, normalizing the difference to one.

For each level of consumption (W) there are different types of consumers, distributed uniformly between the two firms. The location of each individual (x) is a random draw, independent of the firm from which they bought the product the previous period. This is like a Hotelling model for each level of consumption. As stated before, I assume a transportation cost that is linear in quantity, $tW + d$, and each firm is located at an extreme of the line segment, with x on the interval $[0, 1]$.

The cost of providing the service to one more consumer is constant and equal to k. The marginal cost of providing one more unit of the good to a specific consumer is c. This can be the cost of administrating one more dollar in the case of a mutual fund or the cost of one more minute in the case of long distance services. So, the total cost of providing the service for an individual that consumes quantity W is $k + cW$.

I assume a linear utility function for consumers, where u is the level of utility the consumer gets by purchasing this product from either firm. For an individual that purchases quantity W, located at point x, the utility from switching to firm i is:

$$U_{iW} = u - P_i W + F_i - (tW + d)x \tag{1}$$

Stages of the Game

Stage I: There are $\frac{1}{2}$ individuals in each firm. Nature re-distributes consumers along the line segment, so the location x of each individual is a random draw independent of the firm where they where before.[2]

Stage II: Firms Maximize profits by simultaneously deciding the price P as a price per unit and F as the fixed fee.

Stage III: Consumers decide between purchasing from the same firm and switching to the other given the quantity they are willing to buy, their location and the prices charged by each firm.

Consumer's Decision

The utility Function for the consumer that purchases quantity W, located at a distance $(1 - x)$ from firm j, if he stays in this firm is:

$$U_{jW} = u - P_j W + F_j - (tW + d)(1 - x) \tag{2}$$

The demand for products of firm i will be the sum of the consumers that have a higher utility from firm i than from j for each level con consumption W. As we have assumed a uniform distribution of consumers between the two firms, we have that for each level of W the mass of consumers that purchases from firm i is: $\frac{(P_j - P_i)W + F_j - F_i + tW + d}{2(tW+d)}$ and we integrate over W to get total demand.

Demand Function for firm i:

[2] There are some other papers that assume random location for consumers, see Chen (1997) and Caminal and Matutes (1989).

$$D_i(P_i, F_i) = \int_{W_1}^{W_2} \frac{(P_j - P_i)W + F_j - F_i + tW + d}{2(tW+d)} dW \tag{3}$$

Firms Maximize Profits

The demand function specified previously produces the following profit function for firm i:

$$\Pi_i(P_i, F_i) = \int_{W_1}^{W_2} \left[\frac{(P_j - P_i)W + F_j - F_i + tW + d}{2(tW+d)}\right] [(P_i - c)W + F_i - k]\, dW \tag{4}$$

Proposition 1 *Under competition, with a transportation cost of $d + tW$, when firms are allowed to charge a fixed fee and a price per unit, the unique symmetric nash equilibrium fixed fee is: $F_i = F_j = k + d$ and the equilibrium price per unit is: $P_i = P_j = c + t$*

Proof. The proof of this proposition follows from the first order condition for the profit maximization problem of the firms.

$\Pi_i(P_i, F_i) = \int_{W_1}^{W_2} \left[\frac{(P_j - P_i)W + F_j - F_i + tW + d}{2(tW+d)}\right] [(P_i - c)W + F_i - k]\, dW$

$\pi_i = \frac{1}{2}(P_i - c)(P_j - P_i + t)(\xi) + \left(\frac{(P_j - P_i + t)[F_i - k]}{2} + \frac{(F_j - F_i + d)(P_i - c)}{2}\right)\psi -$

$-\frac{(F_j - F_i + d)}{2t}[F_i - k] \ln \frac{(tW_1 + d)}{t(W_1 + 1) + d}$

Where,

$\xi = \frac{1}{2}\frac{2W_1 + 1}{t} + d^2 \frac{\ln \frac{t(W_1+1)+d}{(tW_1+d)}}{t^3} - \frac{d}{t^2}$

$\psi = \frac{t - d \ln \frac{t(W_1+1)+d}{(tW_1+d)}}{t^2}$

Using F.O.C. and symmetry:

$\frac{d\pi}{dP_i} = \left(-\frac{1}{2}(P_i - c) + \frac{1}{2}t\right)\xi - \frac{1}{2}(F_i - k - d)\psi = 0,$

Solution is : $\left\{P_i = \frac{\xi c + \xi t - \psi F_i + \psi k + \psi d}{\xi}\right\}$

$\frac{d\pi}{dF_i} = (\frac{1}{2}t - \frac{1}{2}(P_i - c))\psi - \left[\frac{F_i - k - d}{2}\right]\eta = 0$, Solution is : $\left\{P_i = \frac{\psi c + \psi t - \eta F_i + \eta k + \eta d}{\psi}\right\}$

$\frac{\xi c + \xi t - \psi F_i + \psi k + \psi d}{\xi} = \frac{\psi c + \psi t - \eta F_i + \eta k + \eta d}{\psi}$, Solution is : $\{F_i = k + d\}$

$P_i = \left[\frac{\psi c + \psi t - \eta F_i + \eta k + \eta d}{\psi}\right]_{F_i = k + d} = \frac{\psi c + \psi t}{\psi} \Rightarrow \{P_i = c + t\}$ ■

It is shown that in terms of the percentage fee both firms charge the same price above marginal cost. The intuition for this result is that differentiation in this model depends on the quantity purchased, so the firm can extract consumer surplus more efficiently through a combination of a price per unit and a fixed fee, each of them capturing a different component of the differentiation pattern.

Considering the equilibrium prices, profits are:

$$\Pi_i^{TPT} = \Pi_j^{TPT} = \frac{d}{2} + \frac{t}{4}\delta \tag{5}$$

where δ is $W_1 + W_2$.

The higher the transportation costs, the higher the profits for both firms because this effect increases their monopoly power. Notice that profits are higher if total quantity purchased is higher.

If we assume a trasportation cost that is independent of quantity, ($t = 0$ in the previous equations), equilibrium prices would be $P = c$ and $F = k+d$. So prices would be set as a fixed fee per customer independent ot the amount purchased that captures the rents from differentiation and the price per unit would be equal to marginal cost. However, if $d = 0$ and $t > 0$, prices would be $P = c + t$ and $F = k$.

Note how the pricing structure in these special cases is capturing the structure of the differentiation between firms. There is a positive mark-up on the prices that match consumers' transportation costs in the best way. On the other hand, if the marginal cost c or k were zero, the firm would charge a single price, even if it were allowed to charge a two part tariff. A firm will charge a two part tariff price only if it can better match the differentiation structure or the cost structure.

2.2 Restrictions on the Pricing Structure

Up to this point I have assumed that firms are allowed to charge both, a fixed fee per customer and a price per unit of the good purchased. In this section I consider the case where the fixed fee or the price per unit is not allowed. The previous model enables us to conclude that firms are matching their cost structure and extracting rents from consumers by using this two part tariff. The following analysis will give us some insight about the effects of restricting the pricing structure. A priori we would conclude that this should reduce producer's surplus and increase consumers' surplus. However, in previous literature (Holmes, 1989) there is some evidence indicating that price restrictions might increase profits under special circumstances.[3]

Proposition 2 *Under competition, with a transportation cost of $d + tW$, when firms are allowed to charge only a fixed fee the unique symmetric nash equilibrium fixed fees are:*

$$F_i = F_j = k + \frac{t+c}{\Phi} - \frac{cd}{t} \tag{6}$$

where:
$\Phi = \int_{W_1}^{W_2} \frac{t}{tW+d} dW = \ln\left(\frac{tW_2+d}{tW_1+d}\right)$

In this case profits are:

$$\Pi_i^{FF} = \Pi_j^{FF} = \frac{t+c}{2\Phi} - c\left(\frac{\delta}{2} + \frac{d}{2t}\right) \tag{7}$$

Proof. The proof of this proposition follows from the first order condition for the profit maximization problem of the firms. ■

[3] See Holmes (1989) for an example where profits increase when the price structure is restricted. In his example, price discrimination is driven by cross-price elasticity which in that case does not concide with market price elasticity.

Lemma 3 *: Profits are lower when it is possible to charge only a fixed fee than when firms are allowed to charge a two part tariff.*

Proof. Recall that $\Phi = \int_{W_1}^{W_2} \frac{t}{tW+d} dW$, by Jensen's Inequality $\Phi > \frac{t}{\int_{W_1}^{W_2} \frac{t}{tW+d} dW} = \frac{t}{t\frac{\delta}{2}+d}$. By substituting Φ in the profit function we get that $\Pi^{FF} < \frac{t\delta}{4} + \frac{d}{2} = \Pi^{TPT}$ ■

Proposition 4 *Under competition, with a transportation cost of $d + tW$, when firms are allowed to charge only a price per unit, the unique symmetric nash equilibrium prices are:*

$$P_i = P_j = c + t + \frac{2t(k+d)(t - \Phi d)}{\delta t^2 - 2d(t - \Phi d)} \tag{8}$$

In this case profits are:

$$\Pi_i^{PU} = \Pi_j^{PU} = \frac{t\delta}{4} + \frac{t\delta}{2}\left[\frac{(k+d)(t - \Phi d)}{\delta t^2 - 2d(t - \Phi d)}\right] - \frac{k}{2} \tag{9}$$

Proof. The proof of this proposition follows from the first order condition for the profit maximization problem of the firms. ■

Lemma 5 *Profits are lower when is possible to charge only a percentage fee than when firms are allowed to charge a two part tariff.*

Proof. Recall that $\Phi = \int_{W_1}^{W_2} \frac{t}{tW+d} dW$, by Jensen's Inequality $\Phi > \frac{t}{\int_{W_1}^{W_2} \frac{t}{tW+d} dW} = \frac{t}{t\frac{\delta}{2}+d}$. By substituting Φ in the profit function we get that $\Pi^{PU} < \frac{t\delta}{4} + \frac{d}{2} = \Pi^{TPT}$ ■

In these cases, profits are lower than the case where two part tariff was allowed. Now consumers are charged only a single price. In the case where there is only a price per unit notice that people who buy more units pay a higher amount who people that buy fewer units, even if the cost of providing different quantities of the good is the same (i.e. c is small). Through this mechanism the firm has to be able to recover the cost k that is independent of the number of units purchased and also try to capture rents from differentiation unrelated to the amount consumed. Firms are able to do so to a lower extent than in the case where they are charging a two part tariff, which makes profits decrease.

This result holds under the assumption of inelastic demand, if we relax this assumption and assume for example that the number of units purchased by each type of individual depends on the price per unit, we can find that profits might increase when the pricing structure is restricted. The intuition for this result is that by allowing a two part tariff; even though firms are able to extract more surplus from consumers from the units bought, the total amount purchased might be reduced and profits decreased. If firms are allowed to charge a price per unit in this model, they have incentives to do so and steal customers from the competitor firm, but by charging a price per unit the number of units bought decreases and firms might end up having lower profits.

Proposition 6 *If transportation cost is linear in quantity and considering all individuals equally weighted, total welfare is the same whether we restrict the firm to only one price or allow for a two part tariff. However, the distribution of welfare between firms and consumers, and among consumers of different levels of consumption, will differ depending on the pricing structure that is allowed.*

Proof. To compute total welfare I add consumer and producer surplus. For the consumers, we know some of them will switch from one firm to another and some of them will stay with the same provider. Considering the equilibrium prices, I get the mass of switchers and a mass of people that stays. I also compute the average distance for each group and integrate over consumption to get total consumer surplus. The producer surplus is just total profit. For the welfare comparison I assume that $c = k = 0$ to simplify the expressions, by including these terms the comparison does not change.

Welfare Comparison

	Two Part Tariff	Only Fixed Fee	Only Price per unit*
Consumer	$u - \frac{5d}{4} - \frac{5\delta t}{8}$	$u - \frac{d}{4} - \frac{\delta t}{8} - \frac{t}{\Phi}$	$u - \frac{d}{4} - \frac{5\delta t}{8} - t\delta\Psi$
Producer	$d + \frac{t\delta}{2}$	$\frac{t}{\Phi}$	$\frac{t\delta}{2} + t\delta\Psi$
Total Welfare	$u - \frac{d}{4} - \frac{t\delta}{8}$	$u - \frac{d}{4} - \frac{t\delta}{8}$	$u - \frac{d}{4} - \frac{t\delta}{8}$

* $\Psi = \left[\frac{d(t-\Phi d)}{(\delta t^2 - 2d(t-\Phi d))}\right]$

If we compare total welfare from the previous three alternatives for the pricing structure, we can see that it is the same, but the distribution of welfare is different. In the case with only a price per unit or only a fixed fee firms extract less consumer surplus than in the case where a two part tariff can be charged. This follows from Lemmas 1 and 2. Moreover, if in the previous equations we would have included a fixed cost and a cost per unit higher than zero, we can show that in the case where only a price per unit is charged, the fixed cost, instead of being transferred to consumers through price is shared between firms and consumers. Similarly, with only a fixed fee the cost per dollar is shared between consumers and producers. ■

Therefore, it has been shown that if firms are restricted to only one price, their surplus is lower than under a two part tariff. There are also transfers across consumers of different levels of consumption. For instance, if only a fixed fee is charged, the price for people with different levels of consumption is the same; nevertheless, if $c > 0$, the cost for people that consume larger quantities is higher. So, there would be price discrimination, defined as different mark-ups across individuals, against low-consumption people. But, if only a price per unit is allowed and $k > 0$, then the price discrimination would be in favor of low-consumption people.[4]

[4] Price discrimination defined as different mark-ups, stating that if $\frac{P_i}{c_i} \neq \frac{P_j}{c_j}$ for individuals i and j, follows Phips (1983), Tirole (1988) and Norman (1999). An alternative definition of price discrimination is given by Clarkson and Miller (1982), Stigler (1987) and Varian (1989), in which it is defined as different margins, $P_i - c_i \neq P_j - c_j$ for individuals

According to this analysis, whenever the pricing structure is regulated, the cost structure of the firms involved should be taken into account. It can then be determined if the firms by using a specific pricing structure, are trying to extract surplus from consumers or simply trying to adjust their price to their cost structure. At the same time, given that total welfare is the same under any of these pricing structures, distributional concerns should be considered when regulating the price scheme.

3 Switching and Searching Costs

In this section I consider the existence of switching costs. I incorporate switching costs to the previous model in two different ways. On the one hand, I assume that there is a cost θ_{sc} that has to be paid if someone wants to switch to the competitor firm. This can be understood as paper work that has to be done, paying a fee or time to go to the new firm to set up a contract. Any of these would imply a time or money cost for switching. On the other hand, I consider that there is some inertia in this market, such that people continue buying from the same firm if they do not receive new information that makes them think about their decision. To incorporate this fact I will consider that a percentage s of consumers re-evaluate the decision of their provider and a proportion $(1-s)$ continue with the same firm without thinking about it. If $s<1$, I will say that there is a searching cost, which means that only a proportion of consumers is going to decide to switch or stay with the same firm.

To consider a more general set up I consider market shares to be α and $(1-\alpha)$, where α is between zero and one. As in the previous model consumers are distributed uniformly between the two firms and the location of each individual is a random draw independent of the firm where they bought the product the previous period. Transportation cost is assumed to

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i and j.

be linear, $tW + d$. As before this can be interpreted as differentiation in two dimensions, one that is a function of the amount purchased and the other independent. I assume that $\theta_{sc} < tW + d$, for all W, so that differentiation is more important than the switching costs, at least for some individuals in each level of consumption. If θ_{sc} were sufficiently large, there would be no switching in equilibrium and we would get the monopoly outcome.[5]

The stages of the game are the same as before, but now the initial market shares are not necessarily $\frac{1}{2}$ for each firm and only a portion s of the individuals on each firm decides between switching or staying on the same firm. Additionally, the utility function for an individual that decides to switch from firm j to i includes a switching cost, θ_{sc}, such that:

$$U_i = u - P_i W + F_i - \theta_{sc} - (tW + d)x \tag{10}$$

The demand function in this case is:

$$\begin{aligned} D_i(P_i, F_i) &= \alpha(1-s) + s\int_{W_1}^{W_2} (\alpha \tfrac{(P_j - P_i)W + F_j - F_i + \theta_{sc} + tW + d}{2(tW+d)} \\ &\quad + (1-\alpha)\tfrac{(P_j - P_i)W + F_j - F_i - \theta_{sc} + tW + d}{2(tW+d)}) dW \end{aligned} \tag{11}$$

So that the profit function for firm i is:

$$\begin{aligned} \Pi_i(P_i, F_i) &= \int_{W_1}^{W_2} \{\alpha(1-s) + s(\alpha \tfrac{(P_j - P_i)W + F_j - F_i + \theta_{sc} + tW + d}{2(tW+d)} \\ &\quad + (1-\alpha)\tfrac{(P_j - P_i)W + F_j - F_i - \theta_{sc} + tW + d}{2(tW+d)})\} \\ &\quad [(P_i - c)W + F_i - k]\, dW \end{aligned} \tag{12}$$

[5] See Klemperer (1995).

Proposition 7 *Under competition, with a transportation cost of $d + tW$ and a switching cost of θ_{sc} where a fraction s of consumers decide between switching or not, the equilibrium prices are:*[6]

$$F_i = k + \frac{d}{s} + \frac{\theta_{sc}(2\alpha - 1)}{3} \tag{13}$$

$$F_j = k + \frac{d}{s} + \frac{\theta_{sc}(1 - 2\alpha)}{3} \tag{14}$$

$$P_i = P_j = c + \frac{t}{s} \tag{15}$$

Proof. The proof of this proposition follows from the first order condition for the profit maximization problem of the firms. ■

Notice that if the initial market shares are the same, then we have a symmetric equilibrium where both firms charge a fixed fee of $k + \frac{d}{s}$. But if the initial market shares are different then the fixed fee of the firm that has the larger market share would be larger. This is a consequence of the switching cost. Notice that, independent of how the market is distributed, if we add the fixed fee of both firms we get $2\left(k + \frac{d}{s}\right)$. The larger the switching cost θ_{sc}, the larger is the dispersion of prices. The switching costs θ_{sc} is important in determining prices only if the market shares are different across firms. This follows from the fact that if market shares are the same the effect of this switching cost is cancelled out. The existence of a monetary switching cost helps a firm to keep its consumers, but at the same time it makes it more difficult to steal consumers from the other firm. If α is different from $\frac{1}{2}$,

[6] Notice that in this model the switching cost was assumed to be independent of the quantity purchased. If we assume a switching cost linear on quantity, then the fixed fee would be $k + \frac{d}{s}$ and the price per unit would incorporate the effect of the switching cost θ_{sc}.

then θ_{sc} has a positive effect over the large firm and a negative effect over the smaller one.

On the other hand, the fact that only some of the individuals decide to switch or stay with the same firm gives additional market power to these firms. Notice that as s, the percentage of consumers that is deciding, gets smaller prices are higher. In fact, if θ_{sc} is zero and $s = 1$, there are no switching costs and no searching costs, so we go back to the model presented on the previous section.

Considering the equilibrium prices, profits are:

$$\Pi_i = \frac{d}{2s} + \frac{t}{4s}\delta + \frac{\theta_{sc}(2\alpha - 1)}{3} + \frac{\theta_{sc}^2(2\alpha - 1)^2}{18t} \tag{16}$$

$$\Pi_j = \frac{d}{2s} + \frac{t}{4s}\delta + \frac{\theta_{sc}(1 - 2\alpha)}{3} + \frac{\theta_{sc}^2(1 - 2\alpha)^2}{18t} \tag{17}$$

The higher the transportation cost and the lower is the percentage of people that re-evaluate their decision the higher are the profits for the firms. This can be seen from the first two terms in the profit equations. The third and fourth terms are related to the difference in initial market shares. If they have the same market shares or the switching cost θ_{sc} is zero, these two terms disappear. However, the higher the switching cost, the more important this effect is in increasing the profits of the firm with a higher market share and decreasing the profits of the other firm.[7]

4 Competition with Sales Agents

We observe that some companies sell their products through sales agents that contact the customers personally to switch them from one firm to the other. For this purpose they offer rewards, so that consumers will switch.

[7] A similar result can be found in Klemperer (1995).

This commercialization mechanism appears natural in this model in the sense that firms can obtain rents from stealing customers from competitor firms. For instance, there are incentives for trying to capture consumers. However, in order to do that they need consumers to think about the firm from which they purchase and re-evaluate what is more convenient. At the same time it would also help firms to steal customers if they in fact pay the customers to switch, given that they face a switching cost.

4.1 Incorporating Sales Agents to the Model

In the following model, I consider horizontal differentiation similar to that presented in section 2, but I assume that firms can hire sales agents to switch consumers. These salespersons reduce the switching cost, θ_{sc}, to zero. This can be interpreted as facilitating the customers' switching process or as giving a reward to the consumer as large as the switching cost. Nevertheless, this last interpretation might have different welfare implications than the one stated below. Firms pay a wage equal to a fixed amount to sales agents hired, and I assume a technology such that there are diminishing returns on sales agents. This implies that by hiring more salespersons the number of consumers reached increases at a decreasing rate.

To simplify the expressions I consider the case where these firms have the same market shares, $\alpha = 1 - \alpha = \frac{1}{2}$. Firms choose the price per unit, a fixed fee and the number of sales agents, where l_i is the probability of a consumer being reached by a salesperson of firm i. The technology to generate l_i implies a cost for the firm of $\omega \ln \left(\frac{1}{1-l_i} \right)$. I use this function following the advertisement literature to simplify the results, but a more general function can be used.[8]

Stages of the Game

Stage I: There are $\frac{1}{2}$ individuals buying from each firm. Nature redistributes consumers along the line segment, so the location, x, of each

[8] Grossman and Shapiro (1984).

individual is a random draw independent of the firm where they were before.

Stage II: Firms maximize profits and simultaneously decide the price P as a price per unit, the fixed fee F, and the number of sales agents, which is determined by choosing l, the probability of a customer being visited by a sales agent.

Stage III: Consumers decide between staying with the same firm or switching to the competitor given their level of consumption, their location, the switching cost, the prices charged by each firm and if a salesperson visits them.

The demand for products of firm i is the sum of the consumers that want to stay in firm i and the ones that switch from j to i, considering that a proportion l_j of the consumers in firm i will be visited by a sales agent of firm j and l_i of firm $j's$ consumers is visited by a sales agent from firm i.

Demand Function for firm i:

$$\begin{aligned} D_i(P_i, F_i) &= (1-l_j)\frac{(1-s)}{2} + \frac{1}{2}\int_{W_1}^{W_2} (l_j + l_i)\tfrac{(P_j - P_i)W + F_j - F_i + tW + d}{2(tW+d)} dW \\ &\quad + s\frac{1}{2}\int_{W_1}^{W_2} ((1-l_j)\tfrac{(P_j - P_i)W + F_j - F_i + \theta_{sc} + tW + d}{2(tW+d)} \\ &\quad + (1-l_i)\ \tfrac{(P_j - P_i)W + F_j - F_i - \theta_{sc} + tW + d}{2(tW+d)}) dW \end{aligned} \tag{18}$$

So that the profit function for firm i is:

$$\begin{aligned} \Pi_i(P_i, F_i) &= \int_{W_1}^{W_2} \{(1-l_j)\tfrac{(1-s)}{2} + \tfrac{(l_j + l_i)}{2}\tfrac{(P_j - P_i)W + F_j - F_i + tW + d}{2(tW+d)} \\ &\quad + s\tfrac{1}{2}((1-l_j)\tfrac{(P_j - P_i)W + F_j - F_i + \theta_{sc} + tW + d}{2(tW+d)} + \\ &\quad (1-l_i)\ \tfrac{(P_j - P_i)W + F_j - F_i - \theta_{sc} + tW + d}{2(tW+d)})\} \\ &\quad [(P_i - c)W + F_i - k]\, dW + \omega \ln(1-l_i) \end{aligned} \tag{19}$$

The first term in the previous equation is the number of customers firm i has for the first period that stay for the next period without making any decision. They are not visited by a sales agents and they do not re-evaluate their decisions by their own initiative either. The second term is the number of consumers that, being visited by a salesperson, decide to stay in firm i or to switch to firm i. The last term accounts for the people that decide on their own if they want to switch or stay, and since they have not been visited by a sales agent, they have to pay the switching cost θ_{sc} if they decide to switch.

Proposition 8 *Under competition with switching costs of θ_{sc} and a transportation cost of $d + tW$, when a percentage s of consumers decide between switching or not and firms hire sales agents and are allowed to charge a fixed fee and price per unit, there is a positive number of sales agents if $(1-s)\left(t\frac{\delta}{2}+d\right)+s\theta_{sc} > 4\omega s$. The equilibrium prices and the proportion of consumers that would be reached by a sales agent are:*

$$F_i = F_j = k + \frac{d}{l^*(1-s)+s} \tag{20}$$

$$P_i = P_j = c + \frac{t}{l^*(1-s)+s} \tag{21}$$

$$l^* = l_i = l_j = \frac{(1-s)\left(t\frac{\delta}{2}+d\right)+s\left(\theta_{sc}-4\omega\right)}{(1-s)\left(t\frac{\delta}{2}+d\right)+s\left(\theta_{sc}-4\omega\right)+4\omega} \tag{22}$$

Proof. The proof of this proposition follows from the first order condition for the profit maximization problem of the firms. ■

Notice that since market shares are the same, switching costs θ_{sc} don't directly affect prices; however, prices might be affected by switching costs through the effect on the number of sales agents. In this sense, if there is a higher number of sales agents hired the equilibrium prices would be lower in this market.

This follows from solving the profit maximization problem for the firm, where ω is the wage to sales agent. From equation 22 we observe that the equilibrium percentage of consumers reached by sales agents has three main components. On the one hand, sales agents have a role in informing consumers about product characteristics and making them think about the product they are buying, this generates a surplus of $\left(t\frac{\delta}{2}+d\right)$ for the proportion $(1-s)$ of consumers that according to their preferences should have switched, this surplus is capture by the firm through prices. Second, for the proportion s of consumers that were going to switch by their own means, sales agents have a positive role by reducing the switching cost θ_{sc}. This increases the number of switches for which the firm gets a positive mark-up by $s\frac{\theta_{sc}}{tW+d}$. However, to be able to reduce this cost, sales agents have to be hired and paid a wage ω. Therefore, the proportion of consumers reached by sales agents is the ratio of total benefits generated by sales agents to the total benefits they generate plus total costs.

Notice that as the switching cost θ_{sc} increases, more sales agents will be hired. In the case of an increase in s, the proportion of sales agents that re-evaluate their decision on their own, we have that the effect on the equilibrium number of sales agents might be positive or negative. This is because, on one side, when more people are deciding to switch without a sales agent, the role of informing people becomes less important. At the same time, the reduction on the switching costs that they generate turns out to be more important. Finally, an increase in the cost of sales agents decreases the number of sales agents to be hired.

Recall that prices decrease when more sales agents are hired because more people are informed about the characteristics of the firms and might decide to switch. So in terms of prices, if there is an increase in θ_{sc}, this implies lower prices in this model. This is an interesting result in the sense that it is usually expected that an increase in switching costs increases market power which would mean higher prices. In this case, the role of sales agents it is exactly the opposite because a higher switching cost implies that more sales agents are hired, and prices are reduced by this effect.

Profits for the firm now are:

$$\Pi_i = \frac{1}{2}\int_{W_1}^{W_2} \tfrac{tW+d}{l^*(1-s)+s} dW + \omega \ln(1-l^*) \tag{23}$$

Replacing l^* with its equilibrium level:

$$\begin{aligned}\Pi_i \quad = \quad & \frac{1}{4}\left(t\delta+2d\right)\tfrac{(1-s)(t\delta+2d)+2s\theta_{sc}+8\omega(1-s)}{(1-s)(t\delta+2d)+2s\theta} \\ & -\omega \ln\left(\tfrac{4\omega}{(1-s)\left(t\frac{\delta}{2}+d\right)+s(\theta_{sc}-4\omega)+4\omega}\right)\end{aligned} \tag{24}$$

It can be easily shown that with sales agents profits are lower than when sales agents are forbidden, this is because by hiring sales agents firms end up lowering prices and paying wages to these agents, so that mark-ups are lower and there is now a higher fixed cost.

4.2 Welfare Comparison

Since sales agents reduce switching costs and inform consumers, we may expect an increase in welfare; however, this is not necessarily the case in this model. For the following analysis I assume an interior solution for l^*, compare welfare with that obtained in the two part tariff model without sales agents and compute the social optimum level for the fraction of consumers to be visited by sales agents, l^{SP}.

Proposition 9 *If firms are allowed to hire sales agents, profits are lower and consumer surplus is higher because of the lower prices and the reduction in switching costs and transportation costs, which are higher than the stealing effect.*

Proof. Computing consumer surplus and producer surplus such that social welfare is the sum of both can prove this. As is shown in the following equations, producer surplus is reduced. This is like an advertising game in which both firms end up spending money on sales agents, but this implies lower profits for them. However, in this case sales agents have a positive role in terms of reducing switching costs, so that consumer surplus might increase and also social welfare. ■

Given proposition 9, total welfare would be higher if and only if the positive impact on consumer's surplus, without including the price effect (which is a transfer), is higher than the cost for the firm of generating .

In the case where no sales agents are allowed, consumer surplus is given by the following expression. To simplify the equations from now on we assume that marginal costs are zero ($c = k = 0$):

$$\begin{aligned} CS^{NSA} &= u - \tfrac{d}{s} - \frac{t}{s}\tfrac{\delta}{2} - \tfrac{1}{2}d - \tfrac{1}{4}t\delta + s\left(\tfrac{1}{4}d + \tfrac{1}{8}t\delta\right) \\ &\quad - \tfrac{1}{2}\theta_{sc}s + \tfrac{1}{4t}s\theta_{sc}^{2}\Phi \end{aligned} \tag{25}$$

where $\Phi = \ln \frac{(tW_2+d)}{(tW_1+d)}$

This equation can be interpreted in the following way: u stands for the utility that the product provides to the consumer independent of the firm where they are buying the product, and I then subtract the average price paid in the equilibrium with no sales agents, $\frac{t\delta}{2s} + \frac{d}{2}$. This term, involving t and d accounts for the distance at which consumers are from their most preferred firm. Recall that there is a percentage s of consumers that do not re-evaluate their decision and might end up at a larger distance from the most preferred firm.

When sales agents are introduced, consumer surplus, producer surplus and total welfare are given by:

$$\begin{aligned} CS^{SA} &= u - \tfrac{d}{s+l(1-s)} - \tfrac{t}{s+l(1-s)}\tfrac{\delta}{2} - \tfrac{1}{2}d - \tfrac{1}{4}t\delta + s\left(\tfrac{1}{4}d + \tfrac{1}{8}t\delta\right) \\ &\quad + (1-s)l\left(\tfrac{1}{8}t\delta + \tfrac{1}{4}d\right) - (1-l)\tfrac{1}{2}\theta_{sc}s + (1-l)\tfrac{1}{4t}s\theta_{sc}^2\Phi \end{aligned} \tag{26}$$

$$PS^{SA} = \tfrac{d}{s+l(1-s)} + \tfrac{t}{s+l(1-s)}\frac{\delta}{2} - \omega\ln(\tfrac{1}{1-l}) \tag{27}$$

$$\begin{aligned} W^{SA} &= u - \tfrac{1}{2}d - \tfrac{1}{4}t\delta + s\left(\tfrac{1}{4}d + \tfrac{1}{8}t\delta\right) + (1-s)l\left(\tfrac{1}{8}t\delta + \tfrac{1}{4}d\right) \\ &\quad - (1-l)\tfrac{1}{2}\theta_{sc}s + (1-l)\tfrac{1}{4t}s\theta_{sc}^2\Phi + 2\omega\ln(\tfrac{1}{1-l}) \end{aligned} \tag{28}$$

where $\Phi = \ln\frac{(tW_2+d)}{(tW_1+d)}$

Given our assumptions, equation 26 implies that consumers are better off. Consumer surplus increases because of the lower prices, and additionally, it includes terms that account for the fact that θ_{sc} is not paid when you switch with a sales agent, which is a direct saving for consumers and indirectly, lower transportation costs. Moreover, for $(1-s)l$ consumers there is a gain in terms of being informed about which is the best firm for them and saving on the switching cost as well. However, the last term in equation 26 accounts for the fact that for consumers the cost of not switching, in the absence of sales agents, is lower than θ_{sc}. Recall that some consumers do not switch in the presence of this cost because they are better off staying in the same firm, so for them the reduction of the switching cost increases their utility by less than θ_{sc}. This is captured by this last term, which I call the stealing effect. This factor is not considered by the firm when l^* is determined, which implies that firms hire more sales agents than the efficient number of sales agents. This result is more clearly stated when the social planner optimum is computed later on this section.

On the other hand, we know that firms are worse off; this is because their profits are reduced by the fixed cost generated by sales agents and the resulting lower mark-ups. Overall, society might be better off or worse off in the presence of sales agents. The effect on pricing is just a transfer between firms and consumers, but as we have seen, there are some net benefits for consumers and net costs for firms.

To see how welfare can go either way in the presence of sales agents lets consider the following example: Assuming that $t = 0$ and $s = 1$, I compare the gain in terms of consumer surplus in the presence of sales agents with respect to the cost for the firms -without considering the effects over prices which is a transfer. For simplicity I also assume for this example a quadratic cost funcion for reaching consumers, so that we can get a closed form solution. In this special case we have that if $\omega > \frac{\theta_{sc}}{4} - \frac{\theta_{sc}^2}{8}$ then social welfare is reduced by the presence of sales agents and is increased otherwise. Notice that this expression corresponds to the comparison between the cost of sales agents and the benefits generated by them in terms of reducing the switching costs for consumers.

Regardless, welfare is lower than the optimal level considering that firms have the same cost structure, compete in prices and take l as exogenous. A social planner maximizes social welfare by determining l. In this case l would be given by the following equation:

$$l^{SP} = \frac{(1-s)\left(t\frac{\delta}{2} + d\right) + \theta_{sc}s - 4\omega - \frac{s\theta_{sc}^2}{2t}\Phi}{(1-s)\left(t\frac{\delta}{2} + d\right) + \theta_{sc}s - \frac{s\theta_{sc}^2}{2t}\Phi} \tag{29}$$

where $\Phi = \ln \frac{(tW_2+d)}{(tW_1+d)}$

From equation 29 we conclude that the competitive equilibrium implies over-switching by generating a higher l than the optimal level. The social optimum considers the fact that consumers save less than θ_{sc} when sales agents are present. On the other hand, firms consider the fact that when sales agents are hired, they will be switching consumers that would have switched anyway without sales agents, so the firm has incentives to hire more sales agents.

If the sales agents can determine which consumers are profitable to switch and which not, this equilibrium might change. On the other hand, we can also consider the case where the sales agents can give bribes to consumers to persuade them to switch. In this case the cost of the bribe would have to be considered, along with the negative switching cost for consumers that are visited by a sales agent and bribed to switch.[9]

4.3 Extension: Sales agents discriminate customers

In this section I analyze the effects of assuming that sales agents can determine the effort of searching consumers according to their consumption, without imposing any functional form. To simplify notation, I will assume from now on that transportation costs are given by tW, so that d is zero, and that there are no switching costs ($\theta_{sc} = 0$). This will simplify the results significantly in the model without changing the main conclusions. The rest of the assumptions of the model are the same as the ones stated before but now sales agents may look for consumers according to their consumption level, with an effort level that implied $l(W)$. It is expected l to be an increasing function of W, so that sales agents will make a higher effort of capturing consumers with higher level of consumption.

Proposition 10 *The Symmetric Nash equilibrium in prices and number of sales agents when sales agents are able to allocate their searching efforts according to consumers level of purchases and $4\omega < \frac{t}{s}W(1-s)$ is given by the following equations:*

$$F_i = F_j = 4\omega + k \tag{30}$$

[9] See Berstein and Micco (2002) for a model in which bribing is considered.

$$P_i = P_j = t + c \tag{31}$$

$$l^*(W) == \frac{tW(1-s) - 4\omega s}{tW(1-s) + 4\omega(1-s)} \tag{32}$$

Proof. The proof of this proposition follows from the first order condition for the profit maximization problem of the firms. ■

From the previous equations, it can be shown that l is an increasing function of W. Notice that in this case we have two part tariff pricing even if differentiation is given by tW and $k = 0$ because now the fixed fee is also capturing the cost of hiring sales agents. Notice that a higher wage to sales agents implies a larger fixed fee and lower turnover of consumers.

Under the set of assumption for equations 30 and 31, the equilibrium prices when there are no sales agents is:

$$F_i = F_j = k \tag{33}$$

$$P_i = P_j = \frac{t}{s} + c \tag{34}$$

Note that on average consumers pay the same as in the case where there are no sales agents, but high-quantity consumers will pay a lower price than low-quantity consumers when there are sales agents and l is allowed to be a function of W. It is also interesting to compare with the situation where sales agents are not able to search for specific consumers according to their level of consumption. In this case we have that under these specific assumptions:

$$F_i = F_j = k \tag{35}$$

$$P_i = P_j = t + \frac{8\omega}{\delta} \tag{36}$$

$$l^* = 1 - \frac{4\omega}{(1-s)\left(\frac{t\delta}{2} + 4\omega\right)} \tag{37}$$

It can be observed that average prices are the same in all these cases, but again low-quantity consumers are better off, in terms of the price paid, when sales agents are not able to search for specific consumers. Notice that on average the total portion of consumers visited by sales agents when l is set as a function of W is the following:

$$l^{**} = 1 - \frac{4\omega}{(1-s)}\Omega$$

where $\Omega = \frac{1}{t}\ln\frac{(4\omega+tW_2)}{(4\omega+tW_1)} = \int_{W_1}^{W_2}\frac{1}{(4\omega+tW)}dW$

Proposition 11 *When sales agents are allowed to search for consumers according to the quantity they purchase, the equilibrium number of sales agents hired by the firms is smaller than when these agents are not able to search for specific customers.*

Proof. By Jensen's Inequality $\Omega > \frac{1}{t\frac{\delta}{2}+4\omega} \Longrightarrow l^{**} < l^*$ ■

5 Conclusions

The previous models suggest that under product differentiation with switching costs and two part tariffs, firms charge a fixed fee and a price per unit above marginal cost that captures the rents from product differentiation. If, however, firms are forced to charge a price as a function of some variable that is unrelated to this product differentiation, cross subsidies among consumers are generated. Consumers are better off overall, and firms are worse off. Nevertheless, in this case social welfare is the same as in the case where more flexible prices are allowed.

According to the models presented in this paper, a firm prefers to charge a two part tariff or even a higher number of prices in order to match the different dimensions of consumers' preferences. In this case, in the absence of a fixed fee, the company has to find a less efficient price in order to capture rents from product differentiation. However, it is important to notice that social welfare is the same under the different pricing structures; only the distribution of this surplus differs.

When I introduce sales agents, the model implies that prices will be lower. These lower prices result from the fact that sales agents increase mobility of consumers across firms, increasing price competition. Nevertheless, producer surplus is lower, resulting in an ambiguous effect on total welfare. In the case where sales agents can allocate searching efforts according to the consumption level of potential customers, we have that the equilibrium number of sales agents would be lower and that the pricing structure would account for the fact that differentiated efforts can be allocated. This increases price elasticity of consumers that purchase large quantities relative to low quantity consumers. For instance, fixed fees are higher in this context.

This last model represents what is going on in industries such as the Chilean Pension Fund industry or the long distance service industry. We observe that two part tariffs have been used in these industries and that sales agents or what is called direct advertising or telemarketing exist, which might be a response to the existence of economic rents together with switching and searching costs in these markets.

The model predicts that if the ability of sales agents to reduce the switching costs is restricted, the number of sales agents goes down and prices increase, but the effect on welfare is ambiguous. However, when we allow sales agents to search for specific customers, the effect on the fixed fee might be positive, increasing the price expressed as a fixed fee and decreasing the price per unit.

For further analysis, it would be interesting to include in this model the possibility of bribing consumers to encourage them to switch.[10] It might also be of relevance to set up a dynamic model keeping the same structure used in these models.

[10] See Berstein and Micco (2002).

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