

Vertical Bargaining and Obfuscation*

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VERY PRELIMINARY AND INCOMPLETE

Abstract

Manufacturers often engage in obfuscation practices that impede consumer search. Examples include proliferating product varieties or imposing informational vertical restraints such as MAPs, bans on online sales, etc., that make it more difficult for consumers to compare prices. This paper builds a vertical bargaining framework over wholesale prices and obfuscation levels that enables us to understand the rationale behind such practices. We find that obfuscation arises in equilibrium whenever retailers have some bargaining power. However, once the bargaining power rests with the manufacturer, while the equilibrium involves no obfuscation, final consumers are made worse-off since the manufacturer acts as a monopolist.

JEL Classification: C70; L42; L13

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1 Introduction

Obfuscation practices, defined as actions taken by firms with the intend of increasing consumers' search costs, are prevalent in many markets. In this paper, we focus on analysing cases where product manufacturers engage in such clouding techniques. One way manufacturers obfuscate is by "proliferating product varieties, even along dimensions that customers do not care about, so that comparing prices becomes a complicated and tedious process" Ellison and Ellison [2018]. For instance, Richards, Bonnet, Zohra, and Gordon [2016] show that soft-drink manufacturers offer retail-specific variants of their products, which differ only slightly on their multi-pack or container sizes, as a strategic obfuscation technique that raises consumers' costs of search for retail prices. Vertical restraints are another form of obfuscation manufacturers very often use. Asker and Bar-Isaac [2016] show that informational restraints, such as Minimum Advertised Prices (MAPs) policies, limit the information from retailers to consumers and make it more difficult for them to find and compare products. According to a recent report of the Euroepan Commission [2017], retailers are faced with different informational restraints such as not being allowed to freely advertise prices, sell online or participate in price comparison websites.

Despite the widespread use of such practices by manufacturers, the literature on obfuscation has largely ignored vertical markets. This paper seeks to fill this gap by developing a model that incorporates a vertical framework and enables the analysis of upstream obfuscation. In recent years, the issue of who sets prices and who imposes vertical restraints is less clear. The vertical contracting literature has mainly worked under the assumption that the bargaining power rests upstream. However, given the dramatic developments in retail markets, such as scanner devices and the introduction of discounters, buyer power has increased. In many markets, lately, the general perception is that the bargaining power has shifted towards retailers.¹ Retailers with high bargaining power have also been known to impose restraints on their suppliers. Such type of practices are known as "buyer-driven" restraints.² Therefore, when studying "tight" oligopolies, a framework of vertical bargaining over wholesale prices and obfuscation levels seems reasonable.³

¹Inderst and Wey [2007], Competition Commission [2000], Competition Commission [2008] and OECD [2009] provide evidence on the growing bargaining power of retailers across Europe and in the US.

²For a survey on Buyer-Driven Restraints see Dobson [2008].

³Draganska, Klapper, and Villas-Boas [2010] provide evidence of vertical bargaining in the coffee industry, Crawford and Yurukoglu [2012] show that distributors bargain over input prices in the cable TV

In this paper, we analyse a setting where a monopolist manufacturer produces a homogeneous product and sells it to two downstream retailers who then compete in prices in the downstream market. In the first stage, the manufacturer bargains with the retailers over a linear wholesale price and over the search cost or obfuscation level. Afterwards, the bargaining outcomes become common knowledge and then the retailers set their prices. Lastly, consumers engage in sequential search. The final consumers have unit demands and are modelled à la Stahl [1989], thus a fraction of them are shoppers and can search freely, while a fraction are non-shoppers and incur a search cost to learn firms' prices. The search cost faced by the non-shoppers is an endogenous outcome of the vertical bargaining process between the manufacturer and retailers. We focus on studying a situation where the manufacturer cannot discriminate between its retailers neither through different wholesale prices nor through differences in search costs.

Our paper makes two main contributions. First, it provides a new rationale for the widespread use of obfuscation practices by manufacturers. In particular, our analysis highlights the role of bargaining power by showing that it is the retailers' bargaining power that gives rise to obfuscation. As mentioned, most of the literature on vertical markets assumes that the bargaining power lies with the suppliers. Yet, over the last years, the bargaining power in many markets has shifted to large retailers. Empirical evidence indicates that the strong position of the retailers is positively correlated with buyer-driven vertical restraints. Our analysis confirms this observation. Were bargaining power upstream, the industry monopoly outcome could be achieved without obfuscation; Once retailers have some bargaining power, however, obfuscation by the manufacturer arises in equilibrium.

Secondly, we show that once the vertical structure is considered in an obfuscation model of search, qualitatively different properties can arise compared to settings which disregard upstream arrangements. More specifically, we show that when the production costs of the retailers are not exogenously fixed but set strategically by an upstream manufacturer, an increase in the bargaining power of the retailers, while leading to an increased obfuscation level, results in lower prices for final consumers. Therefore, consumers will be better-off when faced with higher search costs. This happens since an increase in the bargaining power of the retailers does not only affect the obfuscation or search level that

industry and Ho and Lee [2017] analyse bargaining in health care markets.

consumers incur but the input price that the manufacturer sets to the retailers as well.

The mechanism works as follows. An increase in the bargaining power of retailers has two distinct effects. First, it enables the retailers to bargain a higher search cost, since this gives them more market power and increases their profits. We call this the *obfuscation effect*. Second, it allows them to obtain better deals in terms of wholesale prices from the manufacturer, we name this the *input effect*. The *obfuscation effect* puts upward pressure on retail prices, while the *input effect* drives them down. We show that under the setting we consider, where shoppers and non-shoppers have unit demands, the *input effect* dominates and thus consumers are better-off when retailers have higher bargaining power. We find that if the manufacturer has all the bargaining power, no obfuscation will occur in equilibrium and thus the downstream market will be perfectly competitive, consumers, however, will be worse-off. This since, the manufacturer will act as a monopolist and simply charge all retailers the monopoly price and gain monopoly profits by driving both retailers' profits and consumer surplus down to zero.

This paper contributes to the expanding obfuscation literature which analyses firms' incentives to impede consumer search (see, e.g. Carlin [2009], Wilson [2010], Ellison and Wolinsky [2012], Piccione and Speigler [2012], Gamp [2016] and Petrikaitė [2018]). The focus of many of the papers in this literature is the so called "collective action" problem, which notes that while it may be collectively rational for firms to obfuscate, it might not be individually rational for them to do so, especially if the obfuscation level is observed ex-ante by consumers. This issue disappears when analysing a setting with an upstream manufacturer, as in our paper, since the manufacturer partakes in obfuscation.

Unlike the present paper, the existing studies do not consider a vertical setting and thus take the firms' production costs as exogenously given. An exception is Asker and Bar-Isaac [2016], which focuses on the pro- and anti-competitive effects of Minimum Advertised Prices (MAPs). MAPs are seen as restrictions used by an upstream manufacturer in order to obfuscate actual rather than advertised prices. The authors assume that the manufacturer has all the bargaining power and makes take-it or leave-it offers to the retailers. The paper makes use of differences either in consumers' valuations, or in retailers' marginal costs or consider upstream competition, in order to provide either a price discrimination, service provision or collusion rationale for MAPs. We differ from this paper in many aspects. First, by not restricting our analysis to a setting where the bargain-

ing power is entirely with the manufacturer, second by not focusing only on a specific form of vertical restraint, such as MAPs. Lastly, we provide a different rationale for upstream obfuscation which is not driven by differences either in consumers' valuations, retailers marginal costs or on upstream competition, but simply by the bargaining power of retailers and the manufacturer.

This paper also adds to the literature on search in vertically related markets (see, e.g. Janssen and Shelegia [2015], Lubensky [2017], Garcia, Honda, and Janssen [2017], Garcia and Janssen [2018], Rhodes, Watanabe, and Zhou [2018], Janssen and Shelegia [2018] and Janssen and Reshidi [2018]). All of these existing papers work under the assumption that the bargaining power lies entirely either with the upstream manufacturer or, in special instances, with a monopolist intermediary. Therefore, none of them considers the possibility of bargaining between firms in the supply chain. Furthermore, they take the cost of search as exogenously given and do not allow the possibility of obfuscation. This paper differs from the rest of the literature by incorporating vertical bargaining over wholesale prices and search cost levels, thus allowing for the possibility of endogenously affecting the search cost.

The remainder of the paper is organized as follows. First, on Section 2, we describe the model and the vertical bargaining protocol between the manufacturer and the retailers. Then, on Section 3, we characterize the equilibrium, first by analysing the retail market and then by looking at the outcome of the bargaining stage and show comparative static results. Section 4, provides an extension to two-part tariffs and Section 5 gives a discussion on the bargaining model used in the model. Finally, Section 6 concludes.

2 The Model

The model considered in this paper is close to the one used in Janssen and Shelegia [2015], given that it adds an upstream monopolist manufacturer to the model analysed in Stahl [1989]. There are three main differences with the Janssen and Shelegia [2015] setting. First, to incorporate the fact that manufacturers can engage in obfuscation, we enable the manufacturer to endogenously affect consumers' search cost and not only the wholesale prices. Second, we allow for vertical bargaining between the manufacturer and the retailers over these two choice variables. Finally, to simplify the analysis and be able

to study such settings, we focus on the case of unit demand, where we are able to explicitly solve for the reservation price. Therefore, upstream we have a monopolist manufacturer who produces a homogeneous good and sells it to two competing downstream retailers. For simplicity, his production costs are normalized to zero and this is assumed to be common knowledge to all market participants. Retailers compete in prices and the wholesale price bargained over is the only cost they face. The retail price distribution is denoted by $F(p)$ and its density with $f(p)$.

There is a unit mass of final consumers. A consumer wants to buy at most one unit of the good and his valuation of it is denoted by v . A share $\lambda \in (0, 1)$ of consumers are shoppers and have zero search costs, while a share $(1 - \lambda)$ of final consumers are non-shoppers and have to pay a search cost $s > 0$ for every search they make, including the first one. The search cost that the non-shoppers face is an endogenous outcome of the bargaining process between the manufacturer and retailers.

The timing of the game is as follows. First, the manufacturer bargains with both retailers over the wholesale prices and the level of search costs. In principle, the bargaining process can be over different wholesale prices w_i and different levels of search costs s_i . In this paper, however, I focus on an equilibrium which is uniform in wholesale prices and search cost levels. It is assumed that the retailers and the manufacturer can influence the search cost at no cost. Then, the retailers compete in the downstream market and set retail prices. Finally, after observing the wholesale price w and the level the search cost level s , not knowing retail prices, consumers engage in sequential search with perfect recall.

2.1 Bargaining Protocol

In the first stage, the manufacturer bargains with the retailers over the wholesale price and the obfuscation level. We denote the bargaining power of the manufacturer with β , while the bargaining power of each retail is $(1 - \beta)$. When discrimination is forbidden, the two retailers will pay the same wholesale price to the upstream manufacturer and will also negotiate the same obfuscation levels or search costs. In these scenarios, it is not clear what role each retailer plays in determining the price and search costs chosen.

One way of modelling this bargaining stage would be to allow the manufacturer to randomly select one of the two existing retailers and negotiate a mutual price and search

cost⁴. Given that retailers are symmetric in terms of their bargaining power, they are indifferent about which one of them is chosen to bargain with the upstream manufacturer.⁵ Therefore, we assume that the bargaining stage goes as follows. The manufacturer randomly chooses one of the two existing retailers to bargain over the contract terms and then makes a take-it or leave-it offer to the remaining retailer. Following Nash [1950], the generalized bargaining process between the manufacturer and the chosen retailer would then solve:

$$\begin{aligned} & \max_{w,s} [\pi_M(w, s) - \pi_M^0(\hat{w}, \hat{s})]^\beta [\pi_R(w, s) - \pi_R^0]^{1-\beta} \\ \text{s.t.} \quad & \pi_M(w, s) \geq \pi_M^0(\hat{w}, \hat{s}) \quad \text{and} \quad \pi_R(w, s) \geq \pi_R^0 \end{aligned}$$

where (w, s) is the bargaining outcome; $\pi_M(w, s)$ and $\pi_R(w, s)$ are the profits of the manufacturer and the chosen retailer, respectively, and \hat{w} and \hat{s} are the wholesale price and the search cost negotiated with the remaining retailer. Thus, π_M^0 and $\pi_{R_i}^0$ are the disagreement profits in case the negotiation with the chosen retailer breaks down. Given that the manufacturer is a monopolist, we normalize the retailers' disagreement profits π_R^0 to zero, while the manufacturer's disagreement profit $\pi_M^0(\hat{w}, \hat{s})$ needs to be determined endogenously.

3 Equilibrium analysis

In this section, we solve the model by initially considering the retail market and analysing consumers' and retailers' behaviour for a given wholesale price w and a given search cost s . We work under the assumption of observable wholesale prices and search costs. Afterwards, we analyse the outcomes of bargaining and also provide comparative statics results with respect to the bargaining power parameter β .

⁴Such an approach is also followed by O'Brien [2014] when analysing the case of bargaining on the welfare effects of forbidding third-degree price discrimination. Another form of bargaining, would be for M to negotiate jointly with both retailers, we discuss this in Section 5.

⁵The setting would be more complicated to analyse if the retailers were asymmetric in terms of their bargaining power. We abstract from such asymmetries for now, but discuss this issue in more detail in the discussion section.

3.1 The retail market

In a setting with shoppers, $\lambda \in (0, 1)$, and non-shoppers, it is well-known that firms face a trade-off between charging high prices to extract profit from the non-shoppers and charging low prices to attract shoppers. It is established that in such cases there exists no pure strategy equilibrium and that there are no mass points in the equilibrium price distribution. There is, however, a unique symmetric equilibrium in mixed strategies where consumers' behaviour satisfies a reservation price property. In this equilibrium, retailers have to be indifferent between charging any price in the support of $F(p)$. The upper bound of the support is denoted by \bar{p} and must satisfy $\bar{p} = \rho$, which implies that in a symmetric equilibrium no firm will have an incentive to charge a price higher than the consumers' reservation price ρ . Given a mixed strategy chosen by the competitor, a retailer's profit from charging any price p in the support of $F(p)$ will be:

$$\pi_R(p, F(p), w) = (p - w) \left[\frac{(1 - \lambda)}{2} + \lambda(1 - F(p)) \right]$$

and must equal the profit that the retailer would make if it charged the upper bound of the price distribution which equals:

$$\pi_R(\bar{p}, w) = \frac{(1 - \lambda)}{2}(\bar{p} - w) = \frac{(1 - \lambda)}{2}(\rho - w) \quad (1)$$

The equilibrium retail price distribution is characterized in Proposition 1.

Proposition 1 *For $\lambda \in (0, 1)$, the equilibrium price distribution for the subgame starting with a given w and s is given by:*

$$F(p, w) = 1 - \frac{1 - \lambda}{2\lambda} \frac{\bar{p} - p}{p - w} \quad (2)$$

with density

$$f(p, w) = \frac{\bar{p} - w}{(p - w)^2} \frac{1 - \lambda}{2\lambda} \quad (3)$$

and support $[\underline{p}, \bar{p}]$ where $\underline{p} = \frac{(1-\lambda)\bar{p}+2\lambda w}{1+\lambda}$ and $\bar{p} = \rho$.

Proof. See Stahl [1989]. ■

The above proposition characterizes the equilibrium retail price distribution for a given wholesale price w and search cost s , where both are assumed to be observed by the final consumers. Now, we analyse optimal consumer behaviour. Given a distribution of prices $F(p)$ and an observed price p' , the non-shoppers reservation price, ρ , is determined by solving the following equality:

$$v - s - \rho = v - s - \int_{\underline{p}}^{\rho} p' f(p) dp$$

Given that in equilibrium $\bar{p} = \rho$, the above expression becomes:

$$\rho = s + E(p) \tag{4}$$

Janssen, Pichler, and Weidenholzer [2011] have shown that the expected price paid by the shoppers $E(p_l)$ and the expected price paid by the non-shoppers $E(p)$ can be expressed as:

$$E(p_l) = w + \frac{\lambda}{1 - \lambda} s, \tag{5}$$

$$E(p) = w + \frac{\alpha}{1 - \alpha} s, \tag{6}$$

where $\alpha = \int_0^1 \frac{1}{1 + \frac{2\lambda}{1-\lambda}z} dz \in [0, 1)$.

We make use of these results to simplify the expressions needed when analysing the first stage bargaining process. Equations (4) and (6), imply that we can rewrite ρ as:

$$\rho = \bar{p} = w + \frac{s}{1 - \alpha} \tag{7}$$

Furthermore, since we consider the case of first search being costly, we need to take into account the full participation constraint as in Janssen, Moraga-González, and Wildenbeest [2005]. The non-shoppers must find it worthwhile to search once rather than not at all, therefore in equilibrium the following full participation condition needs to be satisfied:

$$v - E(p) - s \geq 0$$

which by making use of equation (6), can be rewritten as:

$$v - w - \frac{s}{(1 - \alpha)} \geq 0 \tag{8}$$

While by using (7), we can rewrite the retail profit given in (1) as:

$$\pi_R(w, s) = \frac{s}{(1-\alpha)} \frac{(1-\lambda)}{2} \quad (9)$$

This summarizes the behaviour of retailers and consumers for given levels of w and s . Next, we focus on characterizing the bargaining process outcome between the monopolist manufacturer and the downstream retailers.

3.2 Wholesale price and obfuscation level bargaining

Suppose the manufacturer chooses to bargain with R_1 and makes a take-it or leave-it offer to R_2 . In order to determine the outcome of the bargaining process between M and R_1 , we first need to determine the disagreement profit $\pi_{M_1}^0$, which is the profit the manufacturer would obtain if the negotiations with R_1 breakdown. In case the negotiation with R_1 breaks down, the manufacturer will have to bargain with the last remaining retailer, R_2 . If the negotiations with R_2 fail then, given that there is no other retailer to bargain with, the manufacturer's disagreement profit when bargaining with R_2 are $\pi_{M_2}^0 = 0$. In this instance, R_2 is a monopolist in the market and his profit will be $\pi_{R_2}(w, s) = (v - s - w)$. The manufacturer's profit will be $\pi_M = w$, since there is a unit mass of final consumers and his production costs are normalized to zero. Therefore, the generalized bargaining process between M and R_2 would then solve the following problem:

$$\begin{aligned} \max_{w,s} & [(w)^\beta (v - s - w)^{(1-\beta)}] \\ \text{s.t.} & \quad w \geq 0 \quad \text{and} \quad v - s - w \geq 0 \end{aligned} \quad (10)$$

Solving we obtain $w^* = \beta v$ and $s^* = 0$. Therefore, the manufacturer's profit in case of a successful negotiation with R_2 would be $\pi_{M_2} = \beta v$. This profit, which is endogenously determined by negotiations between M and R_2 , serves as the manufacturer's disagreement profit when bargaining with the chosen retailer R_1 . Thus, we can write $\pi_{M_1}^0 = \beta v$. We have calculated and simplified the profit of a given retailer in the retail market analysis above. This profit is given in (9) and will now serve as the profit of the chosen retailer R_1 . Furthermore, note that the wholesale price and obfuscation level outcomes are subject to the full participation constraint explained and simplified in (8).

Therefore, the generalized Nash bargaining problem between M and R_1 is:

$$\max_{w,s} \left[(w - \beta v)^\beta \left(\frac{s}{(1-\alpha)} \frac{(1-\lambda)}{2} \right)^{(1-\beta)} \right] \quad (11)$$

$$s.t. \quad v - w - \frac{s}{1-\alpha} \geq 0$$

Proposition 2 below characterizes the equilibrium outcome of the bargaining stage.

Proposition 2 *Under uniform wholesale prices and search cost levels, the wholesale price and search level are given by:*

$$w^* = \beta v(2 - \beta) \quad (12)$$

$$s^* = v(1 - \alpha)(1 - \beta)^2 \quad (13)$$

where $\alpha = \int_0^1 \frac{1}{1 + \frac{2\lambda}{(1-\lambda)z}} dz \in [0, 1)$. The wholesale price is increasing in β , while the search cost level is decreasing in β . The profit of the manufacturer increases in β , while the retail profits decreases in β .

The above result shows that if the bargaining power rests downstream, i.e when $\beta = 0$, the manufacturer sets the wholesale price equal to his marginal cost, which we have normalized to zero, and chooses the highest value of obfuscation that can be set without losing any consumers. By contrast, if the bargaining power lies entirely with the manufacturer, i.e, when $\beta = 1$, the manufacturer does not engage in obfuscation and sets the wholesale price at the monopoly level. The obfuscation level increases the less bargaining power the manufacturer has and will be positive for any β smaller than 1. Therefore, this result supports the view that higher obfuscation levels are associated with higher bargaining power of retailers. The manufacturer's profit increases with an increase in the price he is able to sell to the retailers and a decrease in the obfuscation level faced by the final consumers in the downstream market, while the opposite holds true for the retailers. Therefore, unsurprisingly, the profit of the manufacturer increases in β , while the retailers' profits decrease in β . Figure 1 below depicts the equilibrium wholesale price and search cost levels for different values of the exogenous bargaining power parameter.

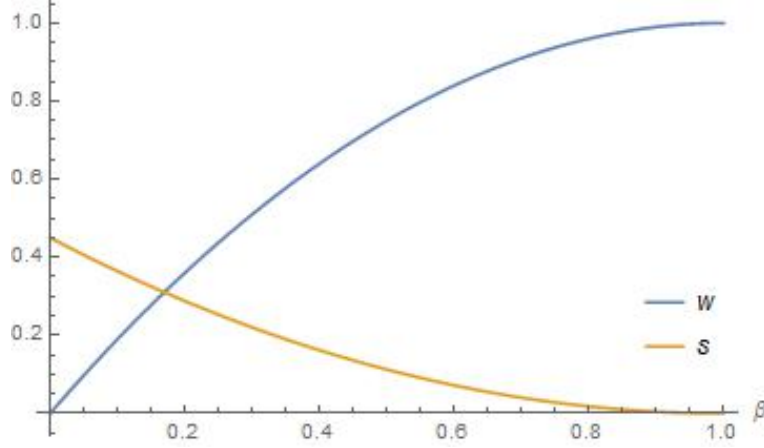


Figure 1: Wholesale price and search cost for different values of β , $v = 1$ and $\alpha = 0.55$

In our model, a decrease in the manufacturer’s bargaining power, denoted with β , has two different effects on the expected retail prices, those paid by the shoppers and those paid by the non-shoppers. First, it decreases the wholesale price charged by the manufacturer to the retailers, thus putting downward pressure on expected retail prices which makes consumers better off. We call this the *”input effect”*. Secondly, a decrease in β increases the search cost that the final consumers face. We call this the *”obfuscation effect”*. The following proposition shows that in our setting the *”input effect”* dominates the *”obfuscation effect”*. Thus, expected prices increase and consumer surplus decreases with an increase on the bargaining power of the manufacturer.

Proposition 3 *The expected price paid by the non-shoppers $E(p)$ and the expected price paid by the shoppers $E(p_i)$ are both increasing in β . Therefore, consumer surplus decreases in β . In the limit, as $\beta \rightarrow 1$, $E(p) \rightarrow E(p_i) \rightarrow w^* \rightarrow v$.*

Figure 2 below, depicts both expected prices and the consumer surplus for different values of β . Consumer surplus (CS) is calculated using the following expression:

$$CS = \lambda(v - E(p_i)) + (1 - \lambda)(v - E(p) - s)$$

When the bargaining power rests completely with the manufacturer, there will be no obfuscation and thus the downstream market will be perfectly competitive. However, while consumers will face no search cost, they will make no positive surplus. This since the manufacturer will act as a monopolist and set the wholesale price equal to the consumers’ valuation and retailers in turn will set retail prices equal to their marginal cost of v .

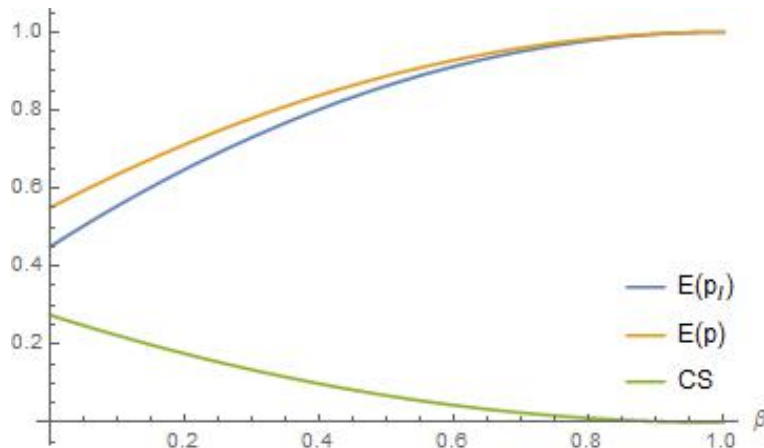


Figure 2: $E(p_l)$, $E(p)$ and CS for different values of β , $v = 1$, $\lambda = 0.5$ and $\alpha = 0.55$

4 Extensions

4.1 Two-part tariffs

Until now our model has worked under the crucial assumption that the vertical contracts between the manufacturer and the retailers are linear in wholesale prices. Once we have positive search costs in the downstream market, such contracts lead to double marginalization problems. Such types of contracts are used extensively in practice.⁶ However, there are also markets where firms engage in either optimal or sub-optimal non-linear contracts, which enable firms to maximize their joint profits.

In this section, we extend the model to two-part tariffs.

⁶For evidence on linear contracts see i.e., Crawford and Yurukoglu [2012] on arrangements between TV channels and cable TV distributors, Grennan [2013] on medical device manufacturers and hospitals, Gilbert [2015] on book publishers and resellers.

5 Discussion

5.1 The Bargaining Protocol

The bargaining protocol used in this paper relates to the "delegation approach" method used in the theoretical bargaining literature. In many applied fields of economics, such as labour, international, and financial economics, a group of individuals is considered as a single bargainer. This approach is suitable especially in settings where the group members are symmetric. Thus, in our case, given that we consider symmetric retailers in terms of marginal costs and in terms of their bargaining power, this seems to be a simplified and reasonable protocol to follow. If the retailers would differ in their bargaining powers, however, the issue of choosing the retailer with whom to negotiate would more subtle.

For instance, consider a case where there are two retailers which differ in their bargaining powers and have to negotiate with an upstream manufacturer. The retailers would prefer that the one with the stronger bargaining power is chosen, since better terms could be negotiated for both of them. On the other hand, the manufacturer would prefer to negotiate with the weaker retailer. Therefore, the choice of the negotiating retailer may be more ad hoc compared to settings with symmetric retailers. Furthermore, in such scenarios coordination issues may arise in case retailers are able to coordinate their actions and thus the weaker retailer could simply refuse to negotiate with the manufacturer.

As long as the bargaining protocol remains the same, where one retailer is chosen at random and the other receives a take-it or leave-it offer from the manufacturer, the results of this paper will be robust to different retailers having different bargaining powers. This since no matter which retailer is chosen as a representative, the tension between the manufacturer wanting higher wholesale prices and lower obfuscation levels and the retailers preferring the opposite does not disappear, and nor does it depend on differences in retailers' bargaining powers. The results are also robust to situations where the manufacturer bargains jointly with both retailers as well. A further step under consideration is to see the robustness of our results under the Nash-in-Nash Bargaining protocol.

6 Conclusion

In this paper, we have focused on analysing obfuscation practices that come from upstream manufacturers rather than downstream firms. Such practices, that increase consumers' costs of searching for prices, are widespread in many different markets. Manufacturers can obfuscate by imposing different vertical restraints that limit the information consumers can have on prices or products. Examples of such informational restraints include Minimum Advertised Prices (MAPs), limits to selling online or partaking in price comparison websites. Another form of obfuscation is product proliferation on characteristics that are not important to consumers with the aim of making price comparison more difficult.

We build a vertical bargaining framework between a monopolist manufacturer and downstream retailers over wholesale prices and obfuscation levels and provide a new rationale on the widespread use of such upstream obfuscation techniques. We show that obfuscation will arise once retailers have some bargaining power. On the other hand, when the bargaining power lies entirely with the monopolist manufacturer no obfuscation will occur in equilibrium and thus the downstream market will be perfectly competitive. The fact that there is no obfuscation does not imply, however, that the consumers are better-off. This since the manufacturer acts as a monopolist and charges monopoly prices to its retailers, which then charge monopoly prices to the final consumers.

There are several assumptions that can be altered in future studies. As a start, we have worked under the restriction of uniform wholesale and search cost levels. An interesting step would be to enable the possibility of price discrimination by the manufacturer. This can either be thought in terms of wholesale prices or in terms of search costs. In case of search cost discrimination, it would be interesting to know if equilibria with asymmetric obfuscation levels could arise in equilibrium, similar to Wilson [2010]. Furthermore, assuming away the observability of wholesale prices and search cost levels could potentially give rise to other interesting outcomes. Lastly, considering costly obfuscation and the issue of who pays the cost of obfuscating in such vertical structures would be a natural next step to consider.

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7 Appendix

Proof of Proposition 2: The first order conditions for (11) are:

$$2^{(-1+\beta)}\beta \left(\frac{s(1-\lambda)}{(1-\alpha)} \right)^{(1-\beta)} (w-\beta v)^{(-1+\beta)} - \mu = 0 \quad (14)$$

$$\frac{2\mu - 2^\beta(-1+\beta)(-1+\lambda) \left(\frac{s(-1+\lambda)}{(-1+\alpha)} \right)^{-\beta} (w-\beta v)^\beta}{2(-1+\alpha)} = 0 \quad (15)$$

$$\mu \geq 0, \quad \mu \left(v - w - \frac{s}{1-\alpha} \right) = 0 \quad (16)$$

where μ is the Lagrangian multiplier. We obtain (12) and (13) by solving (14), (15) and (16). The second order conditions for (11) are:

$$-2^{(-1+\beta)}\beta(1-\beta)\left(\frac{s(1-\lambda)}{(1-\alpha)}\right)^{(1-\beta)}(w-\beta v)^{(-2+\beta)} < 0$$

$$\frac{-2^{(-1+\beta)}\beta(1-\beta)\left(\frac{s(1-\lambda)}{(1-\alpha)}\right)^{(1-\beta)}(w-\beta v)^\beta}{s^2} < 0$$

We now derive the comparative static result. Taking the derivative of (12) wrt to β , we obtain:

$$\frac{\partial w^*}{\partial \beta} = 2v(1-\beta) > 0$$

On the other hand, taking the derivative of (13) wrt to β gives:

$$\frac{\partial s^*}{\partial \beta} = -2v(1-\alpha)(1-\beta) < 0$$

Substituting (12) and (13) into the manufacturer's profit function and into the retailer's profit functions gives: $\pi_M^* = \beta v(2-\beta)$ and $\pi_{R_i}^* = v(1-\beta)^2 \frac{(1-\lambda)}{2}$, where $i = 1, 2$. Taking the derivative wrt to β gives: $\frac{\partial \pi_M^*}{\partial \beta} = 2v(1-\beta) > 0$ and $\frac{\partial \pi_{R_i}^*}{\partial \beta} = -v(1-\alpha)(1-\beta) < 0$.

Proof of Proposition 3: Substituting the equilibrium wholesale price w^* given in (12) and the equilibrium search cost level s^* given in (13) into (5) and (6) gives:

$$E(p_l) = \beta v(2-\beta) + \frac{\lambda v(1-\alpha)(1-\beta)^2}{1-\lambda} \quad (17)$$

$$E(p) = \beta v(2-\beta) + \alpha v(1-\beta)^2 \quad (18)$$

Taking the derivative of (17) and (18) wrt to β , we obtain:

$$\frac{\partial E(p_l)}{\partial \beta} = \frac{2(1-\beta)[v-\lambda(1-\alpha+v)]}{(1-\lambda)} > 0$$

$$\frac{\partial E(p)}{\partial \beta} = 2v(1-\alpha)(1-\beta) > 0$$