WORKING PAPER NO. 573

Delegated Sales, Agency Costs and the Competitive Effects of List Price

Enrique Andreu, Damien Neven and Salvatore Piccolo

July 2020

University of Naples Federico II

University of Salerno

Bocconi University, Milan

CSEF - Centre for Studies in Economics and Finance
DEPARTMENT OF ECONOMICS – UNIVERSITY OF NAPLES
80126 NAPLES - ITALY
Tel. and fax +39 081 675372 – e-mail: csef@unina.it
ISSN: 2240-9696

WORKING PAPER NO. 565

Delegated Sales, Agency Costs and the Competitive Effects of List Price

Enrique Andreu[*], Damien Neven[**] and Salvatore Piccolo[***]

Abstract
We propose a simple agency framework in which although competing producers always find it optimal to share information about their list (undiscounted) prices, consumers are not necessarily harmed by these agreements. In particular, when sales are delegated to self-interested parties (such as salesmen or retailers), we find that expected discounts are higher with than without information sharing if and only if agency costs are sufficiently low. This shows that agreements according to which firms disclose list prices to their competitors should be presumed neither as anti-competitive nor as pro-competitive.

Acknowledgements: For many helpful comments, we would like to thank Michele Bisceglia and Raffaele Fiocco. The views expressed in this paper are the sole responsibility of the authors.

JEL classification: L42, L50, L81

Keywords: Agency Costs, Consumer Welfare, Information Sharing, List Prices.

[*] Compass Lexecon

[**] Graduate Institute of International and Development Studies, Geneva, CEPR and Compass Lexecon

[***] Università di Bergamo, Compass Lexecon, and CSEF. Email: salvatore.piccolo@unibg.it

Table of contents

1 Introduction

This paper considers a new motivation for sharing list prices among competitors.[1] We show that competitors who delegate the negotiation of rebates to distributors will have an incentive to agree on mutual exchange information on list prices. Distributors are assumed to pursue their own objective, which gives a higher weight to sales relative to the margin by comparison with what profit maximization would mandate. Sharing information on list prices allows the distributors to optimize their rebate policy according to the competitive environment that they face. Consumers tend to benefit from this policy: even if it leads to lower rebates when the list prices of competitors is revealed to be high, it leads to higher rebates when the list price is revealed to be low. In the context of our model, the second effect dominates when agency costs are not too high — i.e., when the objective of the distributors does not differ too much from profit maximization. When agency costs are high, distributors adopt competitive rebates even under a veil of ignorance about list prices. As a result, consumers do not gain much from a revelation that list prices are low so that the first effect dominates and consumers are worse off.

This paper thus shows that sharing information about list prices, which allows distributors to target rebates when they are most effective in terms of their own objective, is attractive and that this is also in the interest of consumers when agency costs are not too high. Like the exchange of private information about cost and demand (see, e.g., Khun and Vives, 1994, and Vives, 2006, for two surveys), the exchange of information about list prices when discounts are negotiated by distributors allows for more targeted competitive strategies, and there is no presumption that such exchange hurt consumers.[2]

A key feature of our model, compared to the extant literature, is that we consider a non-linear demand function. Specifically, we model competition as a Tullock contest. Two producers (principals) supply competing products and delegate their distribution to exclusive, self-interested agents (salesmen or retailers). Agents seek to persuade a single buyer into purchasing their product and compete by offering discounts on the random list prices announced by the producers at the

[1] Information sharing agreements on list prices have recently been the subject of greater scrutiny by competition authorities, as shown for instance by a recent decision of the Competition and Markets Authority (formerly the Office of Fair Trading) in the UK regarding the cement sector (see, e.g., Harrington and Ye, 2017, for a survey of recent cases and the report on the market and proposed decision to make a market investigation reference, Office of Fair Trading, 2011).

[2] Traditional models of information sharing in oligopoly consider several contexts in which firms pool demand and/or cost information. They show that firms often benefit from a mutual exchange of such private information; each firm gains from the information that it obtains from competitors as it allows for the deployment of a more targeted strategy and while, symmetrically, it may be hurt from the information that it reveals to competitors, there is often an incentive to agree on a mutual exchange. These information exchanges might or might not enhance consumer welfare (and welfare) depending on specific features of the information being exchanged.

outset of the game. The probability of winning the buyer for each agent is increasing in own discount and decreasing in that of the rival. We model agency costs in a stylized, but intuitive form: agents maximize a weighted sum of profits and sales. We interpret the sales component of their utility function as empire-building (Baumol, 1959, Williamson, 1974, Jensen and Meckling, 1976, among others). Producers decide whether or not pooling information about list prices. If they do so, each agent can condition its discount on the list price of the rival, otherwise, they take expectations.

We study the properties of the equilibrium of the game with and without information sharing: the equilibrium discount in both regimes is increasing in the agency costs (as measured by the weight that agents assign to sales). The reason is intuitive: the stronger their empire-building desire, the more willing agents to grant substantial discounts to maximize sales. When comparing equilibria across the two information regimes, we find that (on average) information sharing induces agents to offer more generous discounts for a low level of agency costs, and lower discounts for high agency costs.

Related Literature. Stemming from Chen and Rosenthal (1996), the literature studying the role of list price announcements on consumer search concludes that public announcements of list prices stimulate competition by reducing search costs. Myatt and Ronayne (2019), for example, consider an industry in which firms are heterogeneous with respect to their marginal cost of production, whereas consumers are uninformed about both list and transaction prices, and must pay a search cost to visit stores and discover their offers. Without information on list prices, consumers search too little and will not always find out the best price available on the market. Anticipating this behavior, firms will charge non-competitive prices. By contrast, when list prices are made public, efficient firms announce low list prices to enhance competition. In fact, by doing so, these firms commit to low transaction prices and attract consumers with low search costs who will search more intensively. This process reduces the market share of inefficient firms and overall enhances consumer surplus and total welfare. Nevertheless, in this model(s), firms do not provide discounts in equilibrium, a salient feature of our game.[3]

A recent literature examines the link between collusion and list prices. Traditionally, the prospect for secret discounting from list prices has been considered as a significant impediment

[3] Instead of considering search costs, Díaz et al. (2009) examine the relationship between list prices and capacity constraints and find a negative effect of list price announcements on transaction prices. They modify the standard Bertrand–Edgeworth duopoly model to include list pricing and a subsequent discounting stage. They show that list pricing works as a credible commitment device that induces a pure strategy outcome as opposed to non-competitive mixed strategy equilibria typically emerging in price-competition games with capacity constraints. Our model abstracts from capacity constraints, even though we find that disclosing list prices might still have a beneficial effect on consumers.

to effective coordination on list prices. Harrington and Ye (2017), however, develop a theory explaining how coordination on list prices can raise transaction prices even when all customers pay negotiated prices (see also Lubenski, 2017). In their model, sellers publicly disclose list prices to signal low production costs. Supra-competitive prices are attained in a pooling equilibrium where list prices do not transmit information. Hence, not being informed about sellers' costs, buyers negotiate prices that are, on average, too high.[4]

Mallucci et al. (2019) analyze a model where haggling (as induced by list price announcements) may soften competition. They study a bargaining framework where consumers are heterogeneous concerning their bargaining strength, and firms compete for both hagglers and non-hagglers. They assume that consumers anchor on posted list prices when forming expectations about the price of the outside option and solve for haggling firms' optimal pricing strategy. They find that in a duopoly where firms allow haggling (by publicly posting list prices), competing for hagglers can lead to higher profits and list prices as well as bargained prices than in a competitive or monopolistic market with fixed prices.

None of those models considers industries in which distribution is delegated to self-interested parties and the implied relationship between list price announcements and agency costs, which is the primary feature our paper. In addition, in these other strands of literature, consumers are assumed to observe list price. From this perspective, they are more concerned with the public announcement of list prices than information exchanges.

2 The model

Consider two producers (principals), each denoted by P_i (with $i = 1, 2$), selling to a single (representative) buyer. Assume, without loss of generality, linear production technologies with marginal costs being normalized to zero. List prices, which are posted by the producers at the outset of the game, determine final (transaction) prices paid by the buyer. Specifically, for given P_i's list price (hereafter l_i) the transaction (final) price paid by the buyer is $p_i = (1 - d_i)\, l_i$, with $d_i \in [0, 1]$ being an endogenous discount applied on the announced list price.

List prices are exogenous random variables. Specifically, we assume that each producer sets its list price competitively (equal to the marginal cost) with probability $\frac{1}{2}$ (i.e., $l_i = 0$)[5] whereas it charges a non-competitive price with probability $\frac{1}{2}$ (i.e., $l_i = 1 > 0$, with 1 being the normalized

[4] Gill and Thanassoulis (2016) also consider collusion but, in contrast to Harrington and Ye (2017), assume that firms can coordinate on both list and discounted prices because both are verifiable (see, also, Raskovich, 2007, and Lester et al., 2015).

[5] Recall that marginal costs have been normalized to zero.

willingness to pay of the buyer).

The assumption of random list prices reflects an un-modeled uncertainty related to firms' individual characteristics — e.g., their private information on demand that, in most cases, determines the competitive attitude when posting list prices. In fact, a firm's list price is often considered as the highest price the firm expects from any deal in the market — i.e., the so-called reference or aspirational price[6] — which may vary across firms depending, for example, on their past market experience.

Producers sell through exclusive agents (salesmen or distributors) to whom they delegate the negotiation with customers. Each agent, denoted by A_i, has the task of persuading the buyer into purchasing its product. To do so, it can apply a discount d_i on P_i's list price. In contrast to the previous literature on information sharing in oligopoly, we assume a non-linear demand. To this purpose, we model competition as a Tullock contest: the buyer decides randomly from whom to purchase and the probability of A_i winning the buyer is increasing with d_i and decreasing with d_j.[7] Specifically, P_i's demand $q_i \in \{0, 1\}$ is

$$\Pr\left[q_i = 1 | d_i, d_j\right] \triangleq \begin{cases} \frac{d_i}{d_1+d_2} & \text{if } d_1 + d_2 \neq 0, \\ \frac{1}{2} & \text{if } d_1 = d_2 = 0. \end{cases}$$

The larger d_i (resp. d_j), the more (resp. less) likely it is for A_i to win the market.[8]

Producers can collectively agree to share information about list prices. When they do so, each salesman can condition its discount on the rival's list price — i.e., d_i is set after A_i has observed l_j, but not d_j which is conjectured in equilibrium.

Players are risk neutral. A_i's utility is

$$u_i\left(d_i, d_j\right) \triangleq \phi \Pr\left[q_i = 1 | d_i, d_j\right] + (1 - \phi) \Pr\left[q_i = 1 | d_i, d_j\right] p_i.$$

This utility function reflects the conflict of interest between principals and agents in a reduced, but rather intuitive form. Specifically, each agent maximizes a weighted sum of quantity (probability of trade) and profits, with the parameter $\phi \in [0, 1]$ (common to both firms for simplicity) measuring the strength of the conflict of interest between principals and self-interested agents. The idea hinges on the agency theory of *empire building* according to which agents (managers) benefit from expanding the size of the business rather than choosing profit-maximizing

[6] See, e.g., https://wiglafjournal.com/what-exactly-is-target-pricing/

[7] See, e.g.,Tullock, (1980).

[8] This demand function is a simplified version of the demand generated by a CES utility function.

actions in order to expand their influence, authority and resource control in the organization.[9] At $\phi = 1$ the conflict of interest is maximized, whereas at $\phi = 0$ incentives are aligned.[10]

Principals maximize profits

$$\pi_i(\cdot) \triangleq \Pr[q_i = 1 | d_i, d_j] \, p_i,$$

with $p_i = 0$ (or $d_i = 1$) if $l_i = 0$ and $p_i = 1 - d_i$ if $l_i = 1$.

The timing is as follows:

1. Principals decide whether or not to share information.
2. List prices are posted and disclosed if principals committed to do so.
3. Agents offer discounts.
4. Demand realizes.

The equilibrium concept is Subgame Perfect Nash Equilibrium (SPNE). To rule out uninteresting corner solutions, we assume that the conflict of interest between principals and agents is not too extreme — i.e., $\phi \leq \frac{2}{3}$.[11]

3 Information sharing regime

Consider first information sharing. Agents do not face uncertainty at the contest stage. Focus on a symmetric equilibrium in which agent A_i offers a discount $d_S(l_j) \in [0, 1]$ contingent on the rival's list price l_j. Notice that learning l_j is relevant for A_i because it allows to understand whether A_j is forced to charge a competitive price ($l_j = 0$) or he can freely set its discount ($l_j = 1$).

[9] See, e.g., Baumol (1959) Williamson (1974) Jensen and Meckling (1976), among others.

[10] Interestingly, empire-building is coherent with more sophisticated theories based on asymmetric information (see, e.g., Laffont and Martimort, 2002). In adverse selection models, for example, agents obtain information rents increasing with sales, and ϕ may thus reflect the extent to which producers are less informed than salesmen about local demand conditions. Similarly, with moral hazard, projects with an inefficiently large scale typically yield higher private benefits to agents, and in this case, ϕ can be seen as the excessive scale of the project over and above the scale preferred by the principals. Hence, the interpretation of the parameter ϕ goes beyond empire building and can be seen as a reduced form for the severity of the asymmetry of information between principals and agents in the industry.

[11] Notice that when $l_i = 0$ principal P_i breaks even and its demand only depends on the rival's discount. For this reason, in the equilibrium analysis developed below we will focus without loss of insights on the case $l_i = 1$. Moreover, it is useful to highlight that from the consumer's perspective a list price equal to zero is equivalent to a full discount on a list price of 1.

For given l_j, A's maximization problem is

$$\max_{d_i \in [0,1]} \phi \Pr\left[q_i = 1 | d_i, d_j(l_j)\right] + (1-\phi)\Pr\left[q_i = 1 | d_i, d_j(l_j)\right] p_i = \max_{d_i \in [0,1]} \frac{d_i}{d_i + d_j(l_j)} \left(1 - (1-\phi) d_i\right). \tag{1}$$

with $d_j(l_j) \triangleq d_S(1)$ if $l_j = 1$ and $d_j(l_j) \triangleq 1$ if $l_j = 0$.

A_i maximizes profits when $\phi = 0$. Moreover, as ϕ grows large the discount chosen by A_i is distorted away from P_i's ideal profit-maximizing discount. The first-order condition, necessary and sufficient for a maximum, is

$$\underbrace{\left(1-(1-\phi)d_i\right)\frac{d_j(l_j)}{\left(d_i + d_j(l_j)\right)^2}}_{\text{Demand-enhancing effect}} - \underbrace{\frac{(1-\phi)d_i}{d_i + d_j(l_j)}}_{\text{Price-stifling effect}} = 0, \tag{2}$$

When both firms charge a unit list price, the individual best replies will reflect the usual trade-off between the probability of making a sale and the margin (with a greater weight given to the former if agency costs are high). The equilibrium discounts will also be higher if the agents care more about sales than profits (or margins). By contrast, when the rival has a low (zero) list price (zero discount), the equilibrium discount of the firm with a positive list price is then given by its best reply (which again reflects the sales-margins trade-off).

Hence, each agent (say A_i) sets:

$$d_S(l_j) \triangleq \begin{cases} \max\left\{0, 1 - \frac{2-3\phi}{3(1-\phi)}\right\} & \text{if } l_j = 1 \\ \max\left\{0, \min\left\{1, 1 - \frac{2(1-\phi) - \sqrt{(1-\phi)(2-\phi)}}{1-\phi}\right\}\right\} & \text{if } l_j = 0 \end{cases},$$

where, by assumption, $2 - 3\phi \geq 0$.

Figure 1 plots the above discounts as a function of ϕ.

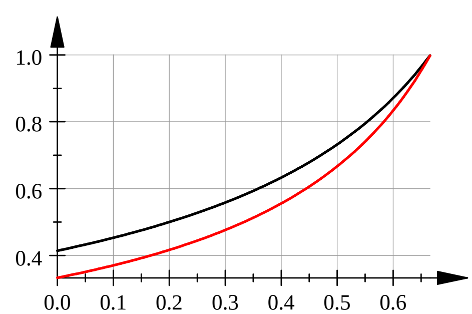

Figure 1: $d_S(0)$ (black) and $d_S(1)$ (red).

As intuition suggests, both discounts are increasing in ϕ and are equal to 1 (full discount) when the conflict of interest between principals and agents is strong enough ($\phi = \frac{2}{3}$). Moreover, $d_S(0) \geq d_S(1)$. The reason for this inequality is straightforward. The equilibrium discount when the rival has a zero list price is also the best reply to a maximum (unit) discount offered by a rival with a unit list price. This discount will be higher than the mutual best reply discounts offered by firms with unit list prices (as equilibrium involves some relaxation of price competition). Naturally, the difference between the equilibrium discounts when $l_j = 0$ and when $l_j = 1$ falls as ϕ increases. As firms seek to expand sales more aggressively, the relaxation of price competition that occurs when both firms have unit list prices becomes less significant. Therefore, the equilibrium discounts when firms have unit list prices converges to the best reply of either firm facing a competitor with a unit discount (or zero list price).[12]

Conditional on $l_i = 1$, A_i's expected discount is

$$\hat{d}_S = \mathrm{E}_{l_j}\left[d_S(l_j)\right] = 1 - \frac{8 - 9\phi - 3\sqrt{(1-\phi)(2-\phi)}}{6(1-\phi)},$$

which is plotted in Figure 2 together with $d_S(1)$ (black-dashed curve) and $d_S(0)$ (red-dashed curve).

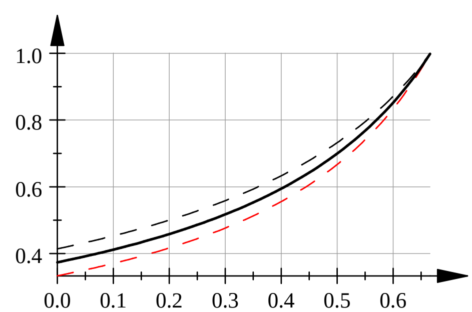

Figure 2: $\hat{d}_S$.

[12]This intuition is confirmed by considering how agents react to the rival's discount. The following expression looks at how the difference between the marginal profit and marginal sales (in terms of own discount) changes with the discount of the rival. We observe that marginal profits are more sensitive than marginal sales to the discount of competitors.

$$\frac{\partial^2}{\partial d_i \partial d_j}\left(\frac{d_i(1-d_i)}{d_i+d_j} - \frac{d_i}{d_i+d_j}\right) = 2\frac{d_i d_j}{(d_i+d_j)^3} > 0.$$

Equivalently, reactions functions are steeper when the profit is the objective function. Hence, for ϕ small, the softening of price competition that occurs when both list prices are high is more significant (as reaction functions are steep). When the motivation to expand sales dominates, there is little relaxation of price competition (the reaction functions become flatter).

Finally, conditional on $l_i = 1$, firm P_i's equilibrium (expected) profit is

$$\pi_S \triangleq \frac{1}{2}\left(\frac{1-d_S(1)}{2} + \frac{d_S(0)}{1+d_S(0)}(1-d_S(0))\right),$$

which is plotted in Figure 3.

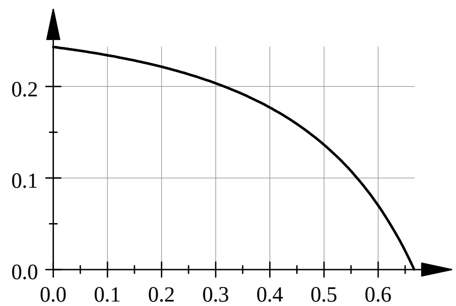

Figure 3: π_S.

Intuitively, the equilibrium profit is decreasing in ϕ. The stronger the agency problem, the more distorted the price is below its profit-maximizing level, and thus the lower is the firm's equilibrium profit.

4 No information sharing

Consider now the regime without information sharing. Focus on a symmetric equilibrium in which agents offer $d_N \in [0,1]$. A_i's maximization problem is

$$\max_{d_i \in [0,1]} \mathrm{E}_{l_j}\left[\Pr\left[q_i = 1 | d_i, d_j(l_j)\right](\phi + (1-\phi)(1-d_i))\right] = \max_{d_i \in [0,1]} \frac{(1-(1-\phi)d_i)}{2}\left(\frac{d_i}{d_i+d_N} + \frac{d_i}{1+d_i}\right)$$

with $d_j(1) \triangleq d_N$ and $d_j(0) \triangleq 1$.

The first-order condition, necessary and sufficient for an optimum, is

$$\underbrace{(1-(1-\phi)d_i)\left(\frac{d_N}{(d_N+d_i)^2} + \frac{1}{(1+d_i)^2}\right)}_{\text{Demand-enhancing effect}} - \underbrace{(1-\phi)\left(\frac{d_i}{d_i+d_N} + \frac{d_i}{1+d_i}\right)}_{\text{Price-stifling effect}} = 0.$$

The effects shaping the equilibrium discount under no information sharing are similar to those discussed in the previous section, with the difference being that, in this case, A_i does not know whether A_j sells at marginal cost or if it can choose the discount optimally. Assuming symmetry, the first-order condition becomes

$$(1-\phi)\,d_N^3 - (\phi - 13\,(1-\phi))\,d_N^2 - 3\,(1+\phi)\,d_N - 1 = 0. \tag{3}$$

This is a third degree polynomial, whose unique solution in $[0,1]$ is:

$$d_N \triangleq \max\left\{0, \min\left\{1, \frac{28\phi + \frac{\theta_0\theta_1}{\sqrt[3]{\theta_3+42\sqrt{3}\sqrt{\theta_4}+2764}} - \theta_2\sqrt[3]{\theta_3 + 42\sqrt{3}\sqrt{\theta_4} + 2764} - 26}{42(1-\phi)}\right\}\right\},$$

where $\theta_0 \triangleq (7\phi(19\phi - 52) + 232)$, $\theta_1 \triangleq i(\sqrt{3} - i)$, $\theta_2 \triangleq i(\sqrt{3} + i)$,

$$\theta_3 \triangleq -7\phi(\phi(203\phi - 822) + 1014),$$

and

$$\theta_4 \triangleq (2-\phi)(1-\phi)^2(\phi(7\phi(9\phi - 44) + 701) - 458).$$

Figure 4 plots d_N.

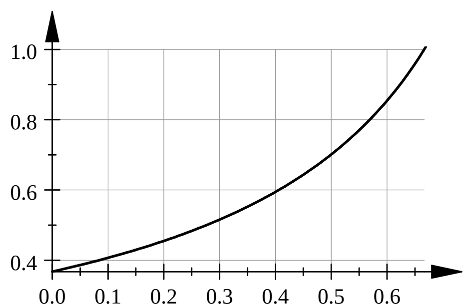

Figure 4: d_N.

The discount is increasing in ϕ and it is equal to 1 at $\phi = \frac{2}{3}$. The firms' equilibrium expected profit is

$$\pi_N \triangleq \frac{1-d_N}{2}\left(\frac{1}{2} + \frac{d_N}{1+d_N}\right),$$

which is decreasing in ϕ as shown in Figure 5.

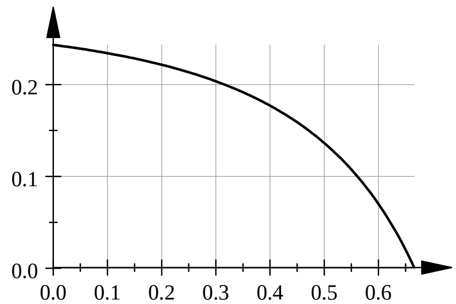

Figure 5: π_N.

5 Effects of list price announcements

We can now compare discount (prices) and expected profits with and without information sharing. To begin with, in Figure 6 we compare d_N with $d_S(l_j)$.

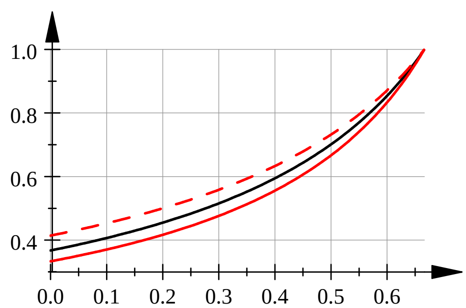

Figure 6: d^N (black), $d_S(0)$ (dashed-red), $d_S(1)$ (solid-red).

Figure 6 shows an intuitive result: relative to a situation in which the agents do not know the list price of competitors, they offer a higher discount when they know that the rival's list price is low — i.e., $d_S(0) > d_N$. By contrast, when they know that the rival sets a high list price, agents offers a lower discount as in this case, they fear less competition and do not need to sacrifice profits at the expense of sales. Notice also that for ϕ sufficiently large, agents offer a full discount in both regimes.

Hence, the effect of information sharing on consumer welfare depends on the realization of list prices. When both firms price non-competitively — i.e., if $l_i = 1$ for every $i = 1, 2$ — information sharing harms consumers; by contrast, when one firm prices competitively and the other does not — i.e., $l_i = 1$ and $l_j = 0$ — information sharing benefits consumers because it exacerbates competition.[13]

[13] Of course, when both firms price competitively — i.e., $l_i = 0$ for every $i = 1, 2$ — information sharing is irrelevant for consumer surplus.

To assess which effect dominates, we compare $\hat{d}_S$ with d_N (Figure 7).

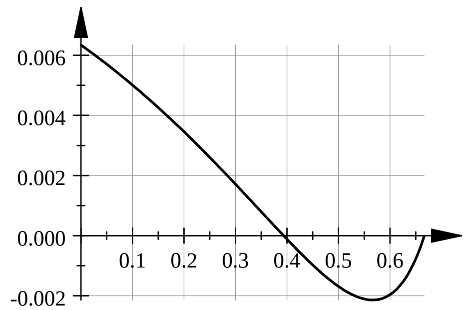

Figure 7: $\hat{d}_S - d_N$.

The figure shows that, on average, information sharing leads to higher (resp. lower) discounts for low (resp. high) ϕ. Two effects shape the difference $\hat{d}_S - d_N$. When $l_j = 0$, A_i has a stronger incentive to offer a high discount with information sharing. When $l_j = 1$, instead, A_i is less willing to offer a high discount. The first effect points in the direction of making information sharing pro-competitive, the second effect moves in the opposite direction. On average, information sharing is pro-competitive if and only if ϕ is not too large. The intuition is as follows. The first effect (which makes information sharing pro-competitive) becomes relatively weaker as ϕ increases because the equilibrium without information sharing becomes increasingly competitive. This in turn arise because (as discussed above) the objective functions that weight relatively more sales lead to flatter reaction functions. Hence, from the perspective of consumers, there is relatively little to gain from the revelation that the list price is competitive.

Figure 8 compares expected profits with and without information sharing.

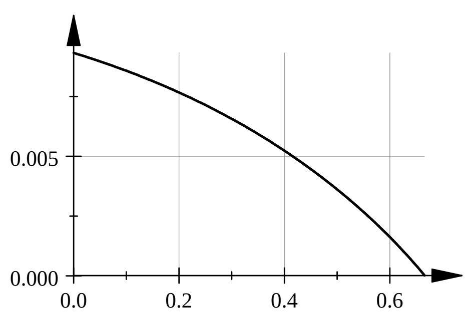

Figure 8: $\pi_S - \pi_N$.

When $\phi = 0$ sharing information increases profits because it allows salesmen, whose preferences are aligned with those of their principals, to take more accurate decisions. At $\phi = \frac{2}{3}$, in both regimes there is a competitive equilibrium with full discounts, hence profits must be equal to zero regardless of the information regime.

Do agents prefer to be informed? With information sharing, A_i's expected utility is

$$u_S \triangleq \underbrace{\frac{1}{2}\mathrm{E}_{l_j}\left[\frac{d_S\left(l_j\right)}{d_S\left(l_j\right)+d_j^S\left(l_j\right)}\left(1-\left(1-\phi\right)d_S\left(l_j\right)\right)\right]}_{l_i=1}+\underbrace{\frac{1}{2}\mathrm{E}_{l_j}\left[\frac{\phi}{1+d_j^S\left(l_j\right)}\right]}_{l_i=0},$$

with $d_j^S\left(l_j\right)=d_S\left(l_i\right)$ if $l_j=1$ and $d_j^S\left(l_j\right)=1$ otherwise.

Without information sharing, A_i's expected utility is

$$u_N \triangleq \underbrace{\frac{1}{2}\mathrm{E}_{l_j}\left[\frac{d_N}{d_N+d_j^N\left(l_j\right)}\left(1-\left(1-\phi\right)d_N\right)\right]}_{l_i=1}+\underbrace{\frac{1}{2}\mathrm{E}_{l_j}\left[\frac{\phi}{1+d_j\left(l_j\right)}\right]}_{l_i=0},$$

with $d_j^N\left(l_j\right)=d_N$ if $l_j=1$ and $d_j^N\left(l_j\right)=1$ otherwise.

Figure 9 compares u_S and u_N.

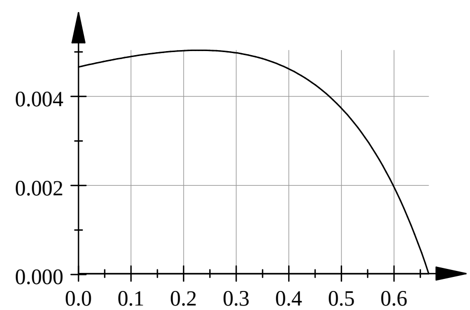

Figure 9: u_S-u_N.

Agents prefer to leanr list prices to make more accurate choices. Hence, joint profits are also higher under information sharing. Moreover, even if principals charge a fixed fee that fully extracts the agents' surplus — e.g., a royalty fee — information sharing is still the regime that they would collectively choose.

6 Conclusion

Our model suggests that the effect of list price announcements on consumer surplus is ambiguous and depends on the severity of the agency problems. Sharing information on list prices does hurt consumers when the conflict of interest between producers and salespeople is severe. This result is likely to emerge in industries where vertical contracts signal strong adverse selection and moral hazard problems — i.e., highly complex and non-linear contracts, frequent contract renegotiation, use of threat of termination and yardstick competition, retail price restrictions, etc. By contrast, sharing information on list prices benefits consumers for low agency problems. Hence, firms' incentive to share information about list prices and consumer surplus maximization are, in principle, not incompatible, especially in mature and established industries where information problems are typically less severe.

Appendix

Equilibrium with information sharing. In a symmetric equilibrium the first-order conditions with respect to d_i are

$$\frac{1-(1-\phi)\,d_S(1)}{2d_S(1)}-(1-\phi)=0,$$

and

$$\frac{1-(1-\phi)\,d_S(0)}{(d_S(0)+1)}-(1-\phi)=0,$$

which yields immediately $d_S(1)$ and $d_S(0)$.

Taking the second-order derivatives we have

$$-(1-(1-\phi)\,d_i)\,d_j(l_j)\,\frac{2}{(d_i+d_j(l_j))^3}-\frac{(1-\phi)\,d_j(l_j)}{(d_i+d_j(l_j))^2}\quad\forall l_j=0,1,$$

which are clearly negative. Hence, the first-order conditions are necessary and sufficient for an optimum.

Equilibrium without information sharing. In the regime without information sharing, the first-order condition with respect to d_i in a symmetric equilibrium is

$$(1-(1-\phi)\,d_N)\left(\frac{1}{4d_N}+\frac{1}{(1+d_N)^2}\right)-(1-\phi)\left(\frac{1}{2}+\frac{d_N}{d_N+1}\right)=0,$$

which boils down to (3), whose solutions are plotted in Figure 10 below.

$$(1-\phi)\,d^3-(\phi-13\,(1-\phi))\,d^2-3\,(1+\phi)\,d-1=0$$

whose unique solution in $[0,1]$ is d_N.

Taking the second-order derivative we have

$$-2\,(1-(1-\phi)\,d_i)\left(\frac{d_N}{(d_N+d_i)^3}+\frac{1}{(1+d_i)^3}\right)-(1-\phi)\left(\frac{d_N}{(d_i+d_N)}+\frac{1}{(1+d_i)^2}\right),$$

which is clearly negative. Hence, the first-order condition is necessary and sufficient for an optimum.

Welfare effects. All the graphical results illustrated in Section 4 are obtained by plugging the equilibrium discount values into the expected profits and expected utilities and then plot the differences.

References

[1] Baumol, W. J., (1959). *Business behavior, value and growth.*

[2] Chen, Yongmin, and Robert W. Rosenthal., (1996). "On the use of ceiling-price commitments by monopolists." *The RAND Journal of Economics,* 207-220.

[3] Díaz, A. G., González R. H., and Praveen K., (2009). "List pricing and discounting in a Bertrand–Edgeworth duopoly." *International Journal of Industrial Organization,* 27(6): 719-727.

[4] Gill, D., and Thanassoulis, J., (2016). "Competition in posted prices with stochastic discounts." *The Economic Journal,* 126(594): 1528-1570.

[5] Jensen, M. C., and Meckling. W. H., (1976). "Theory of the firm: managerial behavior, agency costs and ownership structure." *Journal of Finance*, 3.

[6] Kuhn, K., and Vives X., (1994). "Information exchanges among firms and their impact on competition." manuscript, Institut d'Analisi Economica, Barcelona.

[7] Harrington J. E., and Ye, L., (2017). "Coordination on list prices and collusion in negotiated prices." Working Paper: University of Pennsylvania and Ohio State University.

[8] Laffont, J. J., and Martimort, D., (2002). *The theory of incentives: the principal-agent model.* Princeton university press.

[9] Lester, B., Visschers, L., and Wolthoff, R. (2017). "Competing with asking prices." *Theoretical Economics* 12(2): 731-770.

[10] Lubensky, D. "A model of recommended retail prices." *The RAND Journal of Economics* 48(2) (2017): 358-386.

[11] Mallucci, P., Cui, T.H., and Zhang, J. Z., (2019). "Can Haggling Facilitate Price Collusion?." Mimeo.

[12] Myatt, D. P., and Ronayne, D., (2019). "A Theory of Stable Price Dispersion." Working Paper, 2019.

[13] Raskovich, A. (2007). "Competition or collusion? Negotiating discounts off posted prices." *International Journal of Industrial Organization,* 25.2: 341-354.

[14] Tirole, J. (1988). *Industrial organization.* The MIT Press.

[15] Tullock, G., Buchanan, J. and Tollison, R., (1980). "Efficient Rent Seeking". In *Toward a Theory of the Rentseeking Society.* Buchanan, R. Tollison and G. Tullock (eds.).

[16] Vives, X. "Information sharing: economics and antitrust." In the Pros and Cons of Information Sharing, (2006).

[17] Ziv, Amir (1993). "Information sharing in oligopoly: the truth-telling problem." *The RAND Journal of Economics*, 455-465.

[18] Williamson, Oliver E., (1974). "The economics of antitrust: Transaction cost considerations." *University of Pennsylvania Law Review,* 122(6): 1439-1496.