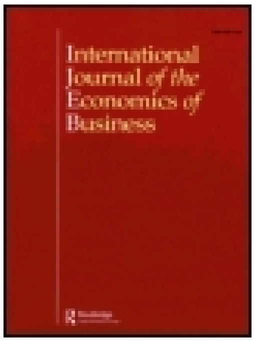

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ABSTRACT *Apple's choice of the agency model (i.e., Apple demands a share from the retail price set by the publishers) when entering the e-book market was surprising because: (i) the upstream firms can accrue all rents in a simultaneous move game if it determines the retail price; and (ii) the incumbent, Amazon, used wholesale pricing arrangements. This paper compares the two different contract types, pure and mixed: one retailer opts for wholesale, the other for the agency model. Departing from a standard and symmetric oligopolistic setup of Bertrand competing retailers and producers, the model accounts for retailers having (a) a significant contribution to the final value and (b) a strategic first-mover advantage. Both conditions combined are necessary (but not sufficient) in order to explain Apple's choice and the possibility of an asymmetric equilibrium.*

Key Words: Upstream-Downstream; E-Books; Agency Model or Wholesale Pricing; Promotion by Retailers; Asymmetric Outcome.

JEL Classifications: L11; L13; L81.

1. Introduction

This paper is motivated by Apple's choice of the agency model when entering the e-book market. According to Gilbert's (2015) survey of the e-book market, e-books cover above 20% (in terms of sales and revenues) of the entire book market, and this share seems to have stagnated recently around this level after years of triple-digit growth. Apple's choice is puzzling. First, Amazon, the incumbent, used a wholesale pricing arrangement. Second, the agency model may not allow for an interior Nash equilibrium because whoever is in the position to determine the split will appropriate the entire surplus. Therefore, the agency model would be disadvantageous to an entering retailer facing incumbent upstream oligopolists offering a share.

Apple's decision led to the price-fixing complaint – often associated with retail price maintenance (RPM) – that the US Department of Justice filed against Apple and five of the world's Big Six book publishers. Following the

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account in *The Economist* (14th April 2012, p. 62), 'Amazon enjoyed a monopoly over e-books until two years ago and remains the dominant player due to its Kindle e-reader and kept publishers on the wholesale model for e-books. This lets them set the wholesale price but let Amazon sell the books at a loss … When Apple launched the iPad in 2010 it offered the publishers an agency model, whereby they set the retail prices and give the retailer a fixed cut. Amazon later offered the same terms to big publishers, though not to smaller ones, and the prices of many e-books rose.'

This paper is motivated by this episode. However, the objectives are more general: to compare the different models of wholesale and agency and to analyze the possibility of an asymmetric choice of seller–buyer relations in a symmetric framework of upstream and downstream oligopolies. The price of such a general setup is that crucial features of the e-book market are ignored, such as Amazon's initial monopoly position in electronic and its dominant position in published book markets, which it may have used to exert monopsony power on the publishers (compare again Gilbert 2015). For further discussions of the Apple–Amazon case, see the excellent surveys in Foros, Kind, and Shaffer (2013), Johnson (2013), Gaudin and White (2014), and Gilbert (2015).

This is not the first paper about this case, but it adds complementary explanations. Johnson (2013) considers *lock in* at the retail level. In the first period, consumers choose between one of two retailers, having then unit demand for the upstream products that are equally distributed on Hotelling's circular city. The latter paper focuses on most favored nation clauses, that is, identical prices for both retailers. The major insight is that the agency model need not harm consumers as the US Department of Justice assumed when suing the publishers for price conspiracy. Gaudin and White (2014) investigate the antitrust economics of the e-books industry, assuming a bilateral monopoly (single publisher selling to a single retailer) and that the retailers determine their device (Kindle or iPad) prices. Again, the agency model need not be socially worse than wholesale pricing. This finding is confirmed in Abhishek, Jerath and Zhang (2016) for a single manufacturer selling a product through symmetric electronic retailers. Although neither mentioning the e-book market nor analyzing an asymmetric outcome, Liu and Shuai (2015) is related in its analysis of upstream and downstream oligopolies and retail prices that are set either upstream or downstream under revenue sharing or linear pricing. Closest is Foros, Kind, and Shaffer (2013) in its use of a similar demand model (based of Dobson and Waterson 2007) and its assumption of a duopoly of publishers and a duopoly of retailers, Amazon and Apple. The final version Foros, Kind, and Shaffer (2017) uses a general demand system that focuses on most-favored-nation clauses, that is, no publisher is allowed to sell the book at a lower price to another retailer, which can be crucial to ensure industry-wide adoption of the agency model. Johnson (2017) is another recent treatment of most-favored-nation clauses. A consumer can decide between four products differentiated between suppliers and retailers. In the motivating case of Amazon and Apple, the differentiation of otherwise identical products (say, a John Irving novel) is due to different hardware. Foros, Kind, and Shaffer (2013) shows that Apple's choice of the agency model increases prices and profits if downstream competition is stronger than upstream. However, given the different sets of hardware, it is questionable whether downstream competition is stronger than upstream between books.

The assumptions about demand and supply depart from Foros, Kind, and Shaffer (2013), and the extensions are as follows. First, retailers provide a value-enhancing task that is not contractible. This leads to moral hazard according to Romano (1994), who analyzed single firms downstream and upstream, with the latter dictating the terms of the contract. Recently, Gabrielsen and Johansen (2017) and Hagiu and Wright (2015) emphasized that retailing efforts are non-contractible. The first paper analyzed the consequence of retail price maintenance by an upstream monopoly selling to two retailers, while the second one investigated whether these efforts are better under the control upstream ('marketplace') or downstream ('reseller'). Second, while Foros, Kind, and Shaffer (2013) focus on price elasticities in order to explain different outcomes, I focus on how the costs of promotion affect the firms' interactions. It turns out that the costs of promotion significantly affect which arrangement the firms and, in particular, the retailers prefer, including the existence of a mixed outcome, one retailer using wholesale pricing and the other the agency model. Of course, price elasticities continue to play a crucial role in which mode the retailers and which the producers prefer. Third, different contracts – wholesale, agency model, and mixing both types – are investigated, while Foros, Kind, and Shaffer (2013) compare cases in which either downstream or upstream (retail price maintenance or agency model) firms set the retail price subject to a revenue split. That is, the standard wholesale pricing model – the retailer faces a wholesale price and adds a margin – is not considered. Fourth, and besides the topical case of the e-book market, the paper provides an explanation on how oligopolistic sellers and buyers may choose different arrangements – here, one retailer the wholesale and the other the agency model – in an entirely symmetric setup. This possibility also arises in Kopel and Löffler (2012) but in a different context and for a different reason in that one firm chooses the Stackelberg leadership.

2. Model

The model assumes an upstream oligopoly, for reasons of simplicity restricted to two firms, and a retail duopoly. Competition is in prices, and the goods are imperfect substitutes. This seems to be a good description of the e-book market, since books are imperfect substitutes (say, between a novel by Jonathan Franzen published by Harper & Collins and a novel by John Irving published by Simon & Schuster), and the hardware is different. Given the model setup, competition among retailers may be weaker or stronger than among products, depending on the specifics of products and retailers; retail competition is reduced by differences in hardware: a Kindle or an iPad.

2.1. *Demand*

The following linear demand framework is assumed:

$$q_i^j = A_i^j - p_i^j + dp_i^{-j} + up_{-i}^j - udp_{-i}^{-j},\ i = 1, 2,\ j = a, b \tag{1}$$

because it accounts for competition across products (i) and retailers (j) and remains tractable. The demand for product i sold at retailer j, q_i^j, depends on all prices, where p_i^j is the final consumer price for good i sold at retailer j. The parameter d captures downstream competition, that is, of identical goods sold at different retailers. The parameter u measures upstream competition, that is, how different the products are if sold at the same retailer. This suggests that d is small in the case of e-books due to the dependence on the hardware addressed above, but presumably large for conventional goods.

Demand framework (1) is a modification of Dobson and Waterson (2007):

$$\tilde{q}_i^j = \frac{\alpha_i^j(1-u)(1-d) - p_i^j + up_{-i}^j + d\left(p_i^{-j} - up_{-i}^{-j}\right)}{(1-u^2)(1-d^2)}, \; i = 1,2, \; j = a,b \tag{2}$$

which is widely used, including Foros, Kind, and Shaffer (2013). Gabrielsen and Johansen (2015) is another recent application of (2) in order to investigate incentives for exclusion. Although widely used, it has a few weak points. First, the demand for the 'first' product ($\tilde{q}_i^j$) decreases when the price of the 'fourth' product (–i, –j) increases. Second, it ignores the cannibalizing effects of e-books on regular books, although they are important for publishers. The extension for this second point is left for future research because including real books, even in a symmetric way, adds two further interdependent market segments. Fishwick (2008) investigated book prices in the UK and found empirically that they have not declined since the end of resale price maintenance (still the practice in German-speaking countries). Equation (1) results from (2) after two modifications: (1) from normalization $q_i^j := \tilde{q}_i^j\left(1-u^2\right)\left(1-d^2\right)$, and (2) from indexation of the demand intercepts in (1) in order to integrate retailers' efforts: $e_i^j \geq 0$ is the promotional effort of retailer j for the product of firm i,

$$A_i^j = A + e_i^j \tag{3}$$

The specification in (3) assumes that efforts are product and retailer specific; Gabrielsen and Johansen (2015) allow for positive or negative spillovers. However, allowing for, here presumably positive, spillovers:

$$A_i^j = A + e_i^j + \sigma e_i^{-j}, \sigma \geq 0$$

is not crucial because each retailer determines effort from equating own marginal costs to own marginal revenues and thus free rides on the competitor's effort. The term e_i^j includes all kinds of demand-increasing efforts, and the costs are assumed to be quadratic for reasons of analytical tractability:

$$C(e_i^j) = \frac{k}{2} e_i^{j2} \tag{4}$$

The following assumptions are made. First, own effects dominate:

$$1 > d, \, u > 0 \tag{5}$$

which ensure that demands are downward sloping and that revenues are concave in own prices. Second, promotion must be not too cheap, depending on the cross-price effects (d, u). More precisely:

$$k > \frac{1}{2(1-d)(1-u)} := \underline{k} \tag{6}$$

The lower bound $\underline{k}$ increases with respect to both cross-price elasticities, such that the parameter k cannot be chosen independent of (d, u). This assumption is necessary because if $k < \underline{k}$, then it is optimal to drive demand and thus profit beyond any limit in the cooperative solution that maximizes aggregate industry profits. The lower bound $\underline{k}$ in (6) is larger than the counterparts for duopolies (either downstream facing competitive supply or upstream, if directly delivering to the two platforms or markets, see Appendix). Implicit to the demand specification (1) is the third assumption that retailers must sell both products, and publishers must serve all retailers due to legal, regulatory, or institutional restrictions. Of course, the usual proviso applies that no one loses from this venture, including consumers (i.e., prices are not prohibitively high, such that all demands are positive).

2.2. *Contracts and Payoffs*

Two kinds of contracts are considered, with the objective of minimizing the differences between them to the strategic instruments available to the players. First, wholesale pricing: the upstream firms set their wholesale prices w_i^j. Retailer j adds the margins m_i^j so that the retail prices:

$$p_i^j = w_i^j + m_i^j, \; i = 1, 2, \; j = a, b \tag{7}$$

result, and chooses efforts e_i^j.

Second, the agency model: the upstream firms fix the retail prices p_i^j and retailer j earns $\left(1 - s_i^j\right)p_i^j$. Therefore, the effective upstream prices and downstream margins are:

$$w_i^j = s_i^j p_i^j \wedge m_i^j = \left(1 - s_i^j\right)p_i^j, \; i = 1, 2, \; j = a, b \tag{8}$$

and the retailer j's strategies are shares and efforts, $\left(s_i^j, \; e_i^j\right)$ $i = 1, 2$. This description of the agency model is similar to Foros, Kind, and Shaffer (2013), who compare it with an alternative different from the above conventional version of the wholesale model (7): retailers determine the retail price subject to a revenue split. A part of the RPM literature uses more general contracts but simplifies by giving all the bargaining power to the (often single) upstream manufacturer; Gabrielsen and Johansen (2015) is a recent example. The above setup minimizes the differences between the two contractual arrangements, as the margins (relative or absolute) are chosen in the first stage in both cases.

Letting w_i^j denote the respective revenue per unit sale for the upstream firm i sold at retailer j, and m_i^j the margin retained by retailer j for product i

(following the notation in (7) and (8)), then each of the two upstream firms will:

$$\max\ \pi_i := \sum_{j=a}^{b} w_i^j q_i^j,\ i = 1, 2 \tag{9}$$

because the unit production cost are normalized to 0. The retailers $j = a$ and b will

$$\max\ \pi^j := \sum_{i=1}^{2} m_i^j q_i^j - C(e_i^j),\ j = a, b \tag{10}$$

2.3. *Timing*

The non-cooperative, simultaneous move game – all four players choose in total 4 × 3 = 12 strategies simultaneously – is the reference and often the only case considered in the related IO literature. Therefore, it was also the starting point for the analysis of the Apple/Amazon case. However, this approach cannot reproduce Apple's move because the agency model allows then only for corner solutions (the party in control of the sharing parameter will grab the entire surplus; see Appendix and compare Wirl 2015) and thus not something like the 30/70 split that Apple demanded. Furthermore, a non-cooperative, simultaneous move game does not reflect the strategic advantage that the retailers (Apple and Amazon) have in the e-book market. Due to this dominant position of retailers, it is assumed that they have the strategic advantage of a first move. This requires their ability to commit. While markups and shares are contractible (leaving antitrust issues about price fixing aside), promotional efforts involve non-verifiable elements and seem therefore impossible to commit to *ex ante*. Therefore, the following sequence of actions is assumed:

(1) Retailer j demands either its markups $\left(m_i^j\right)$ or its shares $\left(1 - s_i^j\right)$, depending on the type of contract. As indicated by the double indexation, this includes the possibility of different demands with respect to the two upstream firms.
(2) The upstream firm i sets its prices, either wholesale $\left(w_i^j\right)$ or retail $\left(p_i^j\right)$, depending on the assumed type of contract, and it is allowed to differentiate across retailers.
(3) Retailers choose their efforts $\left(e_i^j\right)$ individually for each publisher.

Firms compete simultaneously at the respective three stages. As indicated above, retailers and publishers are free to differentiate their offers with respect to their contract partners. This degree of freedom is necessary at least when retailers choose different business models, but it is assumed in all cases. However, the analysis is confined to symmetric equilibria, including the asymmetric case (one retailer using wholesale and the other the agency model). Finally, there is a pre-game stage, in which the retailers choose simultaneously either a wholesale or an agency contract. And it is at this stage that Apple's (and Amazon's) choice can be rationalized or not or, respectively, which outcome is an equilibrium under which conditions.

Of course, one may characterize wholesale pricing and the agency model differently. For example, wholesale pricing may render the first move to the publishers setting their wholesale price, to which retailers add their margins and then determine their efforts. In contrast, the timing in the agency model is most likely to be as above, at least in the motivating case, because Apple was able to ask ahead for its 30% share. The purpose of the above-described timing – first, retailers fix their downstream margins (absolute under wholesale, relative under agency), then the upstream firms set prices (either wholesale or retail in the agency model), and finally retailers choose their efforts – is to minimize the differences between the two contractual arrangements to the sets of instruments. Only this allows the effect of moving from wholesale to the agency model to be isolated. Otherwise, it is hard to determine which factor, the type of contract or the difference in timing, drives different outcomes.

3. Wholesale Pricing

In this section, it is assumed that both retailers opt for a wholesale pricing arrangement. The last stage of their profit maximization objective (10) concerns the question of how to promote the products. The corresponding first-order conditions:

$$\frac{\partial \pi^j}{\partial e_i} = m_i^j - k e_i^j = 0 \Rightarrow e_i^j = e = \frac{m}{k} \tag{11}$$

equate the marginal cost to the marginal benefit. Although I allow for different efforts (this applies to all players and their actions as outlined above), the analysis focuses on symmetric equilibria in symmetric games. Applying this assumption of symmetry yields the effort implied in (11) with the following consequences: first, spillovers are ignored when retailers choose their efforts, and second, effort is fixed by the first stage's choice of the margin and thus independent of the upstream decisions.

As a consequence, the upstream firms cannot incentivize the retailers directly. Therefore, they maximize their profits:

$$\pi_i = \sum_{j=a}^{b} w_i^j \left(A + \frac{m_i^j}{k} - \left(w_i^j + m_i^j \right) + d\left(w_i^{-j} + m_i^{-j} \right) + u\left(w_{-i}^j + m_{-i}^j \right) - ud\left(w_{-i}^{-j} + m_{-i}^{-j} \right) \right) \tag{12}$$

accounting for the demand intercepts $\left(A + e_i^j\right)$ that are, according to (11), increased, depending on the margins chosen in the first stage. Solving the first-order condition from the maximization of (12) for the symmetric outcome yields the wholesale price (w):

$$\frac{\partial \pi_i}{\partial w_i^j}\Big|_{w_i^j = w} = 0 \Rightarrow w = \frac{Ak + [1 - (1-d)(1-u)k]m}{(1-d)(2-u)k} \tag{13}$$

Since

$$\frac{\partial w}{\partial m} = \frac{1-(1-d)(1-u)k}{(1-d)(2-u)k}$$

the upstream price reaction is surprisingly a complement, $\partial w/\partial m > 0$, *for small promotion costs (more precisely* $k < 2\underline{k}$*) and a substitute otherwise, as in the usual standard model of double marginalization.* The economic reason is that low promotion costs allow the upstream price to be raised because a higher margin goes hand-in-hand with a large increase in demand due to triggering substantial promotion efforts due to (11).

Finally, in the first stage, the decision has to be determined. Both retailers choose their margins for the two publishers, simultaneously substituting the *ex-post* optimal choices of effort (11) and of the upstream firms' wholesale prices (13) into their profit maximization problems (10). This yields the (symmetric) margin:

$$m = \frac{Ak}{(2-d)(1-u)k-u} > 0 \tag{14}$$

which substituted into (13) and (11) determines wholesale price and effort:

$$w = \frac{A(1-u)(1+k)}{(1-d)(2-u)[(2-d)(1-u)k-u]} \tag{15}$$

$$e = \frac{A}{(2-d)(1-u)k-u} \tag{16}$$

Proposition 1. *The perfect sequential and symmetric (thus all indexes are dropped) Nash equilibrium is given by strategies (14), (15), and (16). Therefore, effort, wholesale, margin, and thus retail price as well promotion are declining if the costs of promotion increase.*

The claims follow from elementary differentiation.

In order to determine which of the possible equilibria, both retailers either choose the wholesale or the agency model or a mixed outcome (one the wholesale, the other the agency model), results, it is necessary to compute the retailers' profits:

$$\pi^j = \frac{A^2k(2k(1-u)-u)}{(2-u)[(2-d)(1-u)k-u]^2} \tag{17}$$

For completeness, the upstream profits are also reported:

$$\pi^i = \frac{2A^2(1-u)^2(1+k)^2}{(1-d)(2-u)^2[(2-d)(1-u)k-u]^2} \tag{18}$$

Proposition 2. *The Nash equilibrium profits decrease with respect to k for retailers as well as suppliers.*

The qualitative claims follow more or less directly from the explicit solutions in (17) and (18). In the derivative:

$$\frac{\partial \pi^j}{\partial k} = -\frac{A^2 u((2+d)(1-u)k-u)}{(2-u)[(2-d)(1-u)k-u]^3}$$

the numerator and the denominator are both positive for $k > \underline{k}$, since the numerator turns positive at

$$\frac{u}{(2+d)(1-u)} < \underline{k}$$

and the denominator at

$$\frac{u}{(2-d)(1-u)} < \underline{k}$$

Figures 2 and 4 highlight the qualitative properties of the strategies (small dashed lines) in comparison with the agency model and the mixed outcome, one retailer on wholesale and the other on agency contracts. Effort declines with respect to costs, which corresponds to economic efficiency and thus to intuition. Retail prices decline because higher costs lower downstream promotion and thus also demand. This qualitative relation and its economic explanation extend to wholesale prices, retailers' margins, and profits, as expressed in Proposition 2. The retailers' demands for their margin show the weakest response to increase in costs, as the retailer is able to accrue a partial compensation for higher costs.

4. Agency Model

The right to fix shares induces the party in control of s_i^j, whether upstream or downstream, to appropriate the entire surplus in a simultaneous move game (see Appendix). Therefore, an interior outcome requires either some kind of sharing agreement between upstream and downstream or strategic advantages on one side. A number of papers, in particular Romano (1994) and recently Gabrielsen and Johansen (2017), assume that the upstream firms have a strategic advantage. However, given dominant positions of downstream players such as Amazon and Apple in the e-book market, it seems more plausible that the retailers can demand their shares and can do this ahead of all other decisions. In their analysis of the Amazon–Apple case, Foros, Kind, and Shaffer (2013) assume first an exogenously fixed share and then a first-mover advantage of retailers. Indeed, Apple asked for 30%, when entering the e-book market with its iPad (Gilbert 2015).

Starting again from the back, the retailers' choices of efforts must satisfy the usual condition – marginal revenue equals marginal cost:

$$p_i^j\left(1-s_i^j\right)=ke_i^j \Rightarrow e_i^j=\frac{p_i^j\left(1-s_i^j\right)}{k} \tag{19}$$

Therefore, the upstream strategy of setting the retail price affects the downstream efforts directly in contrast to wholesale pricing.

As a consequence, an upstream firm must account for the implicit incentives offered to the retailers when setting the retail price. Substitution of the retailers' optimal *ex-post* efforts (19) into the upstream profit from (9):

$$\pi_i=\sum_{j=a}^{b} s_i^j p_i^j\left(A-\left(1-\frac{\left(1-s_i^j\right)}{k}\right)p_i^j+dp_i^{-j}+up_{-i}^j-udp_{-i}^{-j}\right) \tag{20}$$

amounts to a reduction of the own price sensitivity from –1 to $\left(-1+\left(1-s_i^j\right)/k\right)$ for i selling its product at retailer j. Since s_i^j is already given at this stage, maximization of (20) with respect to p_i^j and then imposing symmetry yields:

$$\frac{\partial \pi_i}{\partial p_i^j}\Big|_{p_i^j=p}=0 \Rightarrow p=\frac{Ak}{(1-d)(2-u)k-2(1-s)}>p^0:=\frac{A}{(1-d)(2-u)} \tag{21}$$

Therefore, the higher the share the retailers ask for, $(1-s)$, the higher the retail price is, since the upstream firms try to be compensated by higher prices for a decline in their share. Setting $s = 1/2$ in (21) yields the retail price that corresponds to upstream duopolists, each distributing its own product on two platforms (necessary for a consistent accounting of the promotion efforts; see Appendix), and p^0 is the price, if promotion is infeasible. If $s < 1/2$, a larger markup results, although the agency model seemed to avoid double marginalization and to incentivize the retailers at the same time. Holding s constant, the price declines with respect to k:

$$\frac{\partial p}{\partial k}=-\frac{2A(1-s)}{[(1-d)(2-u)k-2(1-s)]^2}<0$$

and converges for large values of k to $\lim_{k\to\infty} p=p^0$ due to (21) and $s\in[0,1]$.

Maximizing retailer j's profit:

$$\pi^j=\sum_{i=1}^{2} p_i^j\left(1-s_i^j\right)\left(A+e_i^j-p_i^j+up_{-i}^j+dp_i^{-j}-dup_{-i}^{-j}\right)-\frac{k}{2}e_i^{j2} \tag{22}$$

with respect to the share $s_i^j\in[0,1]$, after substituting the upstream price reaction (21) and the *ex-post* optimal choice of effort (19) and then imposing symmetry in the first-order condition, $\partial\pi^j/\partial s_i^j=0$, leads to a third-order polynomial in s. This clumsy expression is suppressed here. Furthermore, a boundary solution may be optimal. Clearly, the upper bound, $s \le 1$, cannot bind, as $s = 1$ surrenders all profits to the upstream firms. However, one must account for the other natural constraint, $s \geq 0$, given the retailer's strategic advantage. In order that an interior solution $(0 < s < 1)$ maximizes a retailer's profit in (22) requires first that the sufficiency condition – the Hessian:

$$\left[\frac{\partial^2 \pi^j}{\partial s_i^j \partial s_{-i}^j}\right]$$

is negative definite – is met. Second, it must not be profitable to set $s_i^j = 0$, when all others play the interior Nash outcome. Therefore, one has to check these two conditions for the interior equilibrium. This is done in the following examples (numerically). Furthermore, the boundary $s = 0$ applies if the interior solution of the first-order condition is negative.

If the constraint $s \geq 0$ is binding for any of the above-mentioned reasons, the retailers are able to appropriate all profits, and such cases can happen (see examples below). Foros, Kind, and Shaffer (2013), which is the special case $k \to \infty$ that eliminates the last stage, argue that 'the upstream firm would then choose to sell only to the downstream firm that gave them a positive surplus.' If the upstream firms were left without a rent, then they would be indifferent about the retail price. However, as long as their share is strictly positive, they choose the profit-maximizing prices accounting for the thereby induced efforts. Therefore, the downstream firms offer in this boundary case only token shares in order to incentivize the upstream firms to choose the profit-maximizing retail price. This requires an additional lower bound of the cost parameter in order that the upstream firms charge a finite price.

Proposition 3. *Assuming that the constraint $s \geq 0$ is binding and that*

$$k > \frac{2}{(1-d)(2-u)}$$

the sequential agency model has the following equilibrium:

$$s \approx 0,\ p \approx \frac{A}{(1-d)(2-u) - \frac{2}{k}},\ e \approx \frac{A}{(1-d)(2-u)k - 2} \tag{23}$$

Hence, price and effort decline with respect to k *until they converge,* $\mathrm{p} \to \mathrm{p}^0$ *and* $\mathrm{e} \to 0$ *for* $\mathrm{k} \to \infty$. *Retailer* j*'s profit along this boundary strategy is:*

$$\pi^j \approx \frac{A^2 k(2(1-d)k - 3)}{((1-d)(2-u)k - 2)^2},\ j = a, b$$

while for the upstream firms, $\pi_i \approx 0$, $i = 1, 2$.

In Figure 1, the different outcomes under retail and wholesale pricing (identified by dashed lines) are compared with respect to retailers' profits and in Figures 2 and 4 with respect to the strategies. All cases reported in Figure 1 allow for an interior solution, except for the one at the bottom left-hand side, characterized by high cross-price effects between products and low ones between retailers and if promotion costs are sufficiently high. Considering the

Figure 1. Retailers' profits versus promotion costs (k) for different sets of demand elasticities and strategies: both opting for wholesale pricing or agency model (dashed) and mixed, Amazon – wholesale, Apple – agency

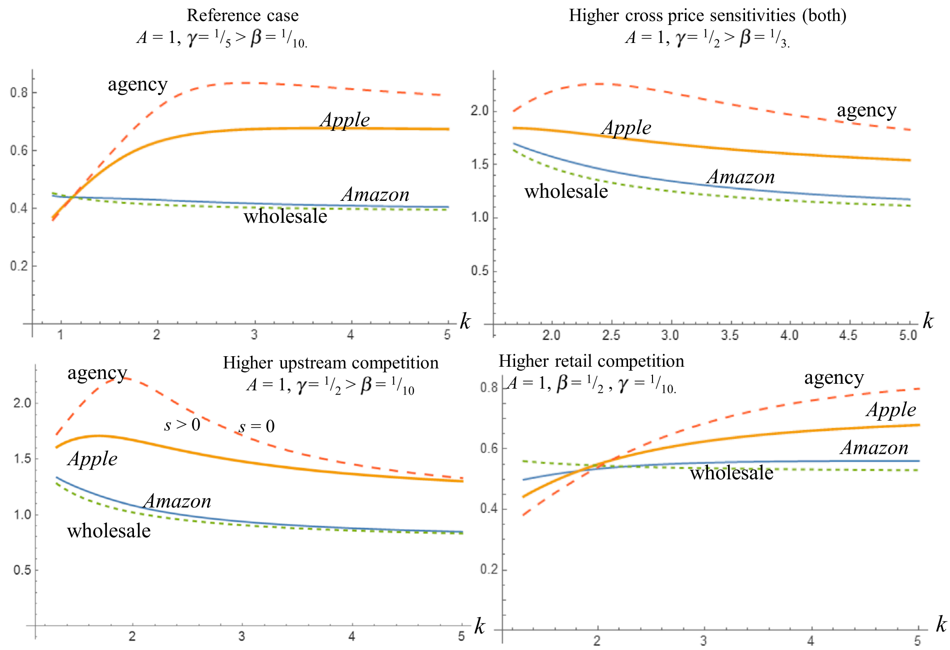
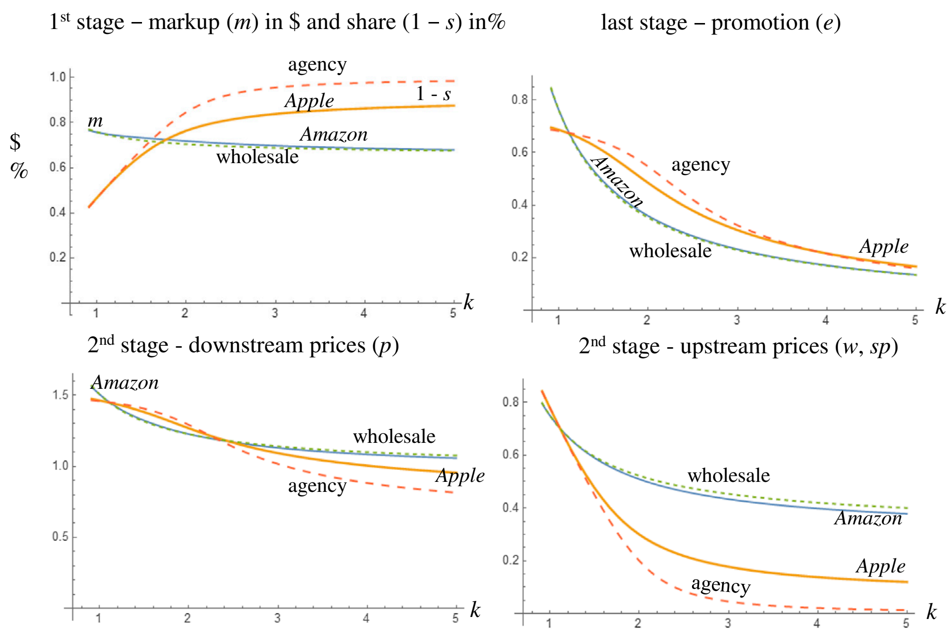


Figure 2. Strategies under wholesale pricing and the agency model versus promotion costs (k), *little downstream competition*, $A = 1$, $g = {}^1/_5 > b = {}^1/_{10}$, dashing = both retailers choose the same type of contract



reference case of low competition (i.e., small cross-price sensitivities d and u and even less competition between retailers, $d = 0.1 < u = 0.2$; the chart in Figure 1 at the top, left-hand side), the most crucial observation is that the agency model dominates the wholesale arrangement from a retailer's point of view, except for very low costs of promotion. The agency model dominates even globally for sufficiently strong upstream competition (Figure 1 top right and bottom left). Furthermore, the retailers' profits decline with respect to the costs of promotion, facing a wholesale arrangement (as claimed), but can increase under the agency model. The reason is (see Figure 2) that higher promotion costs allow the retailers to increase their share. In the case of high product competition ($u = 1/2$; chart at the bottom left-hand side) and the agency model, the retailers drive the upstream producers' shares to zero if $k > 2.852$, such that the boundary solution $s = 0$ results.

5. One Retailer (Apple) Opts for the Agency Model, the Other (Amazon) for Wholesale Pricing

Timing is as in the wholesale pricing and the agency model: in the first stage, retailer b demands shares $\left(1 - s_i^b\right)$, and retailer a demands margins m_i^a, both simultaneously. This scenario in which the retailers choose different types of contracts is identified by the superscripts:

$$^a = \text{Amazon(wholesale) and}^b = \text{Apple(agency)}$$

The first stage is followed by simultaneous price setting upstream: retail to b and wholesale to a. Then, both retailers respond by choosing their efforts (again simultaneously).

The solution of the last stage is the same as in (11) for the retailer a operating under the wholesale arrangement, and as in (19) for retailer b using the agency model. Substituting these outcomes into stage 2 allows for closed-form solutions of the upstream price reactions w_i^a and p_i^b (see Appendix). Then, substituting the prices set upstream and the implied efforts (11) and (19) into the retailers' different objectives, the corresponding first-order conditions are two simultaneous equations in m and s after imposing symmetry. Of these two, the one determining the margin of player, a, can be solved given the competitor's b demand of its share (see Appendix). Substituting all explicit analytical solutions into the first-order condition of retailer's b demand for its shares and then assuming symmetry yields a high-order polynomial in s, which has to be solved numerically.

Therefore, numerical examples must compensate this lack of a closed-form solution. A comparison of the retailers' profits under the different scenarios (see Figure 1) is necessary in order to rationalize which equilibrium emerges and, in particular, if at all, and if yes then under which conditions an asymmetric one. According to the reference example of low retail competition, $d = 0.1 < u = 0.2$, wholesale pricing by both retailers is the equilibrium, if promotion costs are low. At larger promotion costs, Apple's choice of the agency model makes sense. This choice is to the benefit of Amazon, even if it retained the wholesale model. More important, Apple's move should induce Amazon to adapt the agency model too. This last characterization, dominance of the agency model at least for k sufficiently large, extends to all the other cases shown in Figure 1. Indeed, this is what Amazon then did, albeit after some time (for details, see the account in Gilbert 2015)! In this sense, the model and its parameterization (low competition upstream and downstream and significant promotion costs) reproduce the real-world outcome.

Figure 2 compares the strategies for the reference case of overall low competition that is even lower at the retail level. The purpose is to show graphically some of the analytical characteristics stated in Propositions 1 and 2 and to highlight how promotions and their costs affect profits and strategies; this complements the focus in Foros, Kind, and Shaffer (2013) on the effect of price elasticities. The discussion focuses on sufficiently high promotion costs that can rationalize Apple's move according to the comparison of profits in Figure 1. Therefore, the ability to promote and the corresponding costs are both crucial for the choice of contractual arrangements. In Figure 2 (as in Figure 1), the label *Apple* identifies the retailer using the agency model, and *Amazon* does it using wholesale contracts. The downstream prices reveal again the importance of promotion costs and how these costs can change results. While Liu and Shuai (2015) find that retail prices are higher, if they are chosen by the side facing more competition (this is upstream in the case of Figure 2, since $u > d$), retail prices are higher under the wholesale pricing regime (it is the retailer that sets the retail price) if k is either very small or sufficiently large (see bottom left-hand side of Figure 2). Hence, the agency model does not need to harm consumers compared to wholesale arrangements, in particular if one also accounts for the associated increase in retailers' efforts. That is, higher values are delivered at lower prices. Therefore, the suspicion of the US DoJ that the agency model must increases retail prices does not hold globally if promotion and its costs matter, but it holds in this reference example for values of k between 1.2 and 2.4. Indeed, prices rose in spite of a new competitor according to Gilbert (2015). The downside of the potential gain in consumer surplus due to the agency model is that the revenues of the upstream firms are reduced, at least for k sufficiently large.

Excluding very low costs (k very small), the major consequences of only one party choosing the agency model are: promotion is increased for both above the level, if Apple had opted for wholesale pricing as Amazon did; for intermediate values of k, the promotion is the highest, only if Apple chose the agency model. Upstream firms are harmed compared to a wholesale arrangement and are harmed further if both retailers opt for the agency model. Increasing the crucial cost parameter (k) has the following consequences: retail margins (m), effort (e), upstream prices (w, sp), and downstream prices (p) decline. Only the share that the retailers can appropriate under the agency model $(1 - s)$ increases with respect to the cost parameter k.

It is easy to find parameters where the choice of the agency model is profitable, but it is harder to find an asymmetric equilibrium in which it is optimal for the other one (Amazon) to continue its wholesale relationship. From the cases in Figure 1, it is the one at the bottom left-hand side that is characterized by high competition between products but low competition between retailers that leads to a complexity in the sense of a boundary solution for the agency model. After increasing the competition between products and reducing the competition between retailers further, $d = 0.05$, $u = 0.75$, Apple's choice of the agency model makes sense. Moreover, it is optimal for Amazon to

Figure 3. Retailers' profits versus promotion costs (k) – mixed outcome (Amazon –wholesale, Apple – agency) for A = 1, $b = {}^{1}/_{20}$, $g = {}^{3}/_{4}$, that is, high sensitivity between products

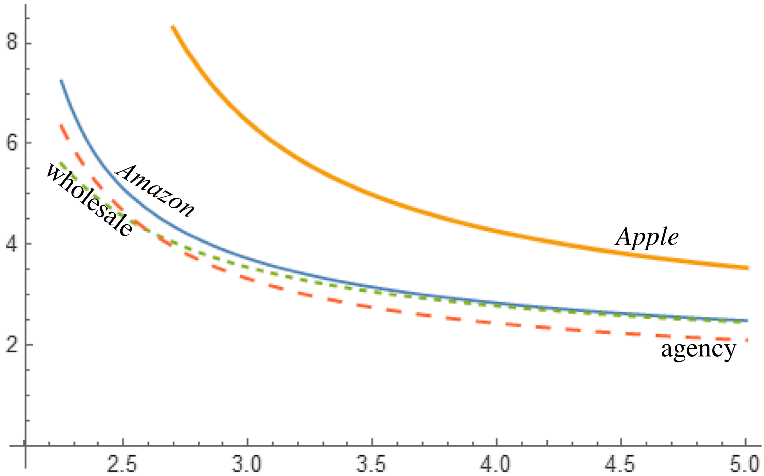
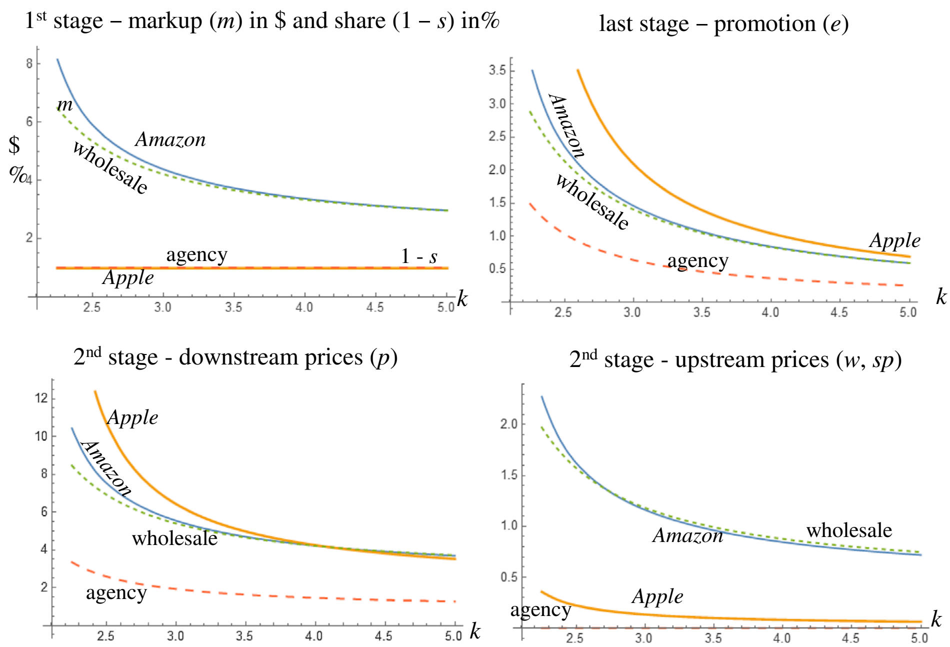


Figure 4. Strategies under wholesale pricing and the agency model versus promotion costs (k), A = 1, $g = {}^{3}/_{4} > b = {}^{1}/_{20}$ = > *mixed outcome* (Amazon – wholesale, Apple – agency)



continue with the wholesale arrangement (see Figure 3). Hence, this asymmetric outcome is an equilibrium for all cost levels shown in Figure 3. Although Amazon benefits from Apple adopting the agency model, its profit falls short of its competitor's profit. Figure 4 compares the strategies for this asymmetric case. Given the high cross-price sensitivity between products and the low one between retailers, double marginalization under wholesale pricing leads to large margins and thereby to downstream prices that are much larger than under the agency model. Hence, the agency model may be beneficial for consumers (maybe because of lower promotion). Consumer prices are even higher under the asymmetric outcome and are highest for Apple for low-cost parameters. A similar picture emerges for promotion, that is, the asymmetric equilibrium increases promotion. Upstream revenues are high under wholesale pricing, but they fall to zero under the agency model, as the boundary solution $s = 0$ holds globally in this case. The asymmetric case leads to even significantly higher wholesale prices for Amazon at low costs of promotion. In contrast to the case if all retailers chose the agency model, Apple leaves some rents to the upstream firms, that is, $s > 0$. In this sense, there is even no need to cut off supplies to Apple. The reason is that double marginalization coupled with the high margins added by Amazon allows for high retail prices and thereby large profits for Apple in this asymmetric arrangement.

6. Concluding Remarks

This paper is motivated by the entry of Apple into the e-book market and in particular its choice of an agency model: the publishers fix the retail price, and the retailer (Apple) keeps a share. This choice contrasts with the wholesale pricing arrangement that was used before between the publishers and the incumbent, Amazon. The objectives of the paper were to understand Apple's choice and to investigate the possibility of an asymmetric equilibrium – one retailer chooses a wholesale and the other an agency relationship – within a symmetric framework. For this purpose, a familiar representation of upstream and downstream oligopolies is extended by allowing the retailers to increase demand by non-contractible and costly effort and by investigating a sequential game, in which retailers can demand their margin or share ahead of all other decisions.

It turns out that both extensions – a sequential game and costly promotion – are crucial. For example, in the reference case describing the e-book market – low competition between retailers due to system incompatibilities and also between publishers – Apple's choice of the agency model only makes sense if promotion costs are significant because universal wholesale pricing arrangements were more profitable (for both retailers) at low costs. Given sufficiently high costs, it is optimal for both retailers to choose the agency model. This case reproduces the real-world outcome, as Amazon adopted the agency model too. However, this case does not address the second question: whether an asymmetric equilibrium – one retailer chooses the agency model and the other wholesale pricing – exists. The existence of such an asymmetric equilibrium is confirmed but requires strong competition upstream.

There are many extensions possible. An obvious but not an easy one is to move from linear to general demand structures. Due to the assumption that efforts are retailer and product specific, one may include externalities between retailers' efforts; for example, if a retailer promotes a certain e-book, then this may increase the sales on the other platform too. Another variation is to move strategic advantages to the upstream firms and to investigate how this affects their choices accounting for the need to incentivize retailers. This is implicitly the case in most of the RPM literature, including the recent paper of Gabrielsen and Johansen (2017) but assuming simultaneous moves. A further extension is to allow for more general contracts such as two-part tariffs, which require sufficient strategic leverage upstream (unlikely for e-books). Interesting but difficult is the extension for private information, for example about the costs of promotion. More crucial for an application to e-books is an extension that accounts for the cannibalizing effects of e-books on the sales of books and/or for the potential monopsony power by Amazon (not only concerning e-books but printed books with shares above 30% or 40%; Gilbert 2015, p. 172). Another topical issue is Google's entry and its current contest with publishers (in particular in Germany, given the strict retail price regulation of books).

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Appendix 1.

A.1. Derivation of the Equilibrium Strategies

A.1.1. Wholesale

Maximization of (12) with respect to the wholesale price w_i^j implies the first-order conditions:

$$A + \frac{m_i^j}{k} - \left(2w_i^j + m_i^j\right) + d\left(2w_i^{-j} + m_i^{-j}\right) + u\left(w_{-i}^j + m_{-i}^j\right) - ud\left(w_{-i}^{-j} + m_{-i}^{-j}\right) = 0$$

that is, four equations for the four unknowns w_i^j, contingent on the efforts and thus on the different margins, m_i^j, $i = 1, 2$ and $j = a, b$. Assuming symmetry, $m_i^j = m$ and $w_i^j = w$ in the above first-order condition implies (13).

Finally, substituting effort $e_i^j = m_i^j/k$ and the wholesale price relations (suppressed)

$$w_i^j = w_i^j\left(m_i^j, m_i^{-j}, m_{-i}^j, m_{-i}^{-j}\right)$$

into retailer j's profit yields

$$\pi^j = \sum_{i=1}^{2} m_i^j\left(A + \frac{m_i^j}{k} - \left(w_i^j + m_i^j\right) + d\left(w_i^{-j} + m_i^{-j}\right) + u\left(w_{-i}^j + m_{-i}^j\right) - ud\left(w_{-i}^{-j} + m_{-i}^{-j}\right)\right)$$

and differentiating with respect to m_i^j yields (for $i = 1$ and $j = a$ as example)

$$\frac{\partial \pi^a}{\partial m_1^a} = \frac{m_1^a\left(u^2 + 2k\left(u^2 - 2\right)\right) + A(2+u)k + dkm_1^b\left(2 - u^2\right) + um_2^b(2(1+k) - dk)}{\left(4 - u^2\right)}$$

Assuming symmetry and solving for m yields (14). Substitution into price (13) and efforts (11) verifies the remaining claims.

A.1.2. Agency Model

Differentiating of π_i from (20) with respect to p_i^j:

$$\frac{\partial \pi_i}{\partial p_i^j} = s_i^j\left(A - \left(1 - \frac{\left(1 - s_i^j\right)}{k}\right)p_i^j + dp_i^{-j} + up_{-i}^j - udp_{-i}^{-j}\right) - s_i^j p_i^j\left(1 - \frac{\left(1 - s_i^j\right)}{k}\right)$$
$$+ s_i^{-j} p_i^{-j} d,$$

setting this partial derivative equal to zero and solving the resulting equation under the assumption of symmetry for the retail price yields (21).

Finally, substituting this upstream price strategy (21), this expression is suppressed below, and the *ex-post* choice of efforts into the retailer's decision in the first stage yields:

$$\pi^j = \sum_{i=1}^{2} \left(1 - s_i^j\right) p_i^j \left(A - \left(1 - \frac{\left(1 - s_i^j\right)}{k} \right) p_i^j + dp_i^{-j} + up_{-i}^j - udp_{-i}^{-j} \right) - \frac{\left(1 - s_i^j\right)^2}{2k}$$

The corresponding first-order condition

$$\frac{\partial \pi^j}{\partial s_i^j} = 0$$

yields a cubic polynomial with an analytical but cumbersome (symmetric, $s_i^j = s,\ i = 1, 2,\ j = a, b$) solution, which is here suppressed.

A.1.3. Mixed: One Retailer Uses the Wholesale, the Other the Agency Model

The retailers have now different objectives. First, for the retailer choosing the wholesale arrangement:

$$\pi^a = \sum_{i=1}^{2} m_i^j \left(A + e_i^a - \left(w_i^a + m_i^a\right) + dp_i^b + u\left(w_{-i}^a + m_{-i}^a\right) - udp_{-i}^b\right) - C(e_i^a) \tag{24}$$

and the other one choosing the agency model:

$$\pi^b = \sum_{i=1}^{2} \left(1 - s_i^b\right)\left(A + e_i^b - p_i^b + d\left(w_i^a + m_i^a\right) + up_{-i}^b - ud\left(w_{-i}^a + m_{-i}^a\right)\right) - C(e_i^b) \tag{25}$$

Substituting the outcomes of the last stage:

$$e_i^a = \frac{m_i^a}{k},\ i = 1, 2$$
$$e_i^b = \frac{p_i^b\left(1 - s_i^b\right)}{k},\ i = 1, 2$$

into the second stage 2 yields for the profit of the upstream firm i:

$$\pi_i = w_i^a \left(A + \frac{m_i^a}{k} - \left(w_i^a + m_i^a\right) + dp_i^b + u\left(w_{-i}^a + m_{-i}^a\right) - udp_{-i}^b\right)$$
$$+ s_i^b p_i^b \left(A + \frac{p_i^b\left(1 - s_i^b\right)}{k} - p_i^b + d\left(w_i^a + m_i^a\right) + up_{-i}^b - ud\left(w_{-i}^a + m_{-i}^a\right)\right)$$

Differentiating with respect to upstream firm i's two instruments:

$$\frac{\partial \pi_i}{\partial w_i^a} = A - 2w_i^a + \frac{1-k}{k} m_i^a + d\left(1 + s_i^b\right)p_i^b + u\left(m_{-i}^a + w_{-i}^a\right) - dup_{-i}^b,$$

$$\frac{\partial \pi_i}{\partial p_i^b} = d\left[(m_i^a - u(m_{-i}^a + w_{-i}^a))s_i^b + w_i^a(1+s_i^b)\right] + As_i^a + \frac{s_i^a(ukp_{-i}^b + 2p_i^b(1-k-s_i^a))}{k}$$

equating to zero, assuming symmetry and then solving the resulting pair of equations, allows for closed form solutions of the upstream price reactions:

$$w = \frac{s}{kN}\{Ak(k((2-u)+(1-u)d+ds)-2(1-s)) \\ + m\left[(1-u)k^2\left((1+s-u)d^2-(2-u)\right)-2(1-s)+(2(1-s)(1-u)-u)\right]\}$$

$$p = \frac{Ak[(2-u)s+d(1+(1-u)s)]+dm[1+(1-u)(k+(1-k)s)]}{N}$$

where

$$N := (2-u)((2-u)k-2(1-s))s - d^2k\left((1-u)(1+s)^2 + u^2 s\right)$$

Substituting the above prices and the implied efforts (11) and (19) into the retailer's different objectives (24) and (25), the corresponding first-order conditions are four simultaneous equations and two after imposing symmetry. Of these two, the one determining the margin set by player a can be solved, given the competitor's b choice (of the share, again dropping index i due to upstream symmetry):

$$m = \frac{Aks[(1+d)k((2-u)-d(1+(1-u)s))-2(1-s)]}{(u-(2-u)k)(2(1-s)-(2-u)k)s+d^2k[(1-u)(1-s^2)+(4k-2u-6uk)s]}$$

Substituting all so far explicit analytical solutions into the first-order condition of retailer's b demand for its share yields a high-order polynomial that has to be solved numerically.

A.2. No Interior Solution $(0 < s < 1)$ *Under Simultaneous Moves*

Consider the simultaneous move version of the game, with retailer j choosing its shares $\left(1-s_i^j\right)$ subject to the constraints $s_i^j \geq 0$ (the upper constraint, $s_i^j \leq 1$ cannot bind). Defining the Lagrangian:

$$L = \pi^j + \sum_{i=1}^{2} \mu_i^j s_i^j \tag{26}$$

leads to the following necessary optimality conditions (assuming symmetry for the expressions on the right-hand side):

$$\frac{\partial \pi_i}{\partial e_i} = p_i^j\left(1-s_i^j\right) - ke_i^j = (1-s)p - ke = 0 \tag{27}$$

$$\frac{\partial \pi^j}{\partial s_i^j} = -p_i^j q_i^j + \mu_i^j = -p(A + e - (1-d)(1-u)p) + \mu = 0 \tag{28}$$

$$\mu_i^j s_i^j = 0,\ \mu_i^j \geq 0,\ s_i^j \geq 0 \tag{29}$$

Substituting the implied optimal effort, $e = (1-s)p/k$, and symmetry in prices into the share equation (29) yields:

$$-p(A + \frac{(1-s)p}{k} - (1-d)(1-u)p) + \mu = 0 \tag{30}$$

Therefore, the Kuhn–Tucker multiplier μ is positive iff sales are positive, that is, the constraint must be binding. Therefore, the retailer's best reply to any upstream choices of retail prices is to offer only the shares $s_i^j = 0$. This is not surprising, given the pure transfer nature of the shares. The retailer's ability to fix them suggests that it surrenders nothing, that is, $s = 0$, but supports this by choosing the optimal promotion effort.

Letting upstream firms offer shares requires adding the constraint, $s_i^j \leq 1$, since the derivative of its profit

$$\frac{\partial \pi_i}{\partial s_i^j} = q_i^j p_i^j > 0$$

is positive if demand is positive. Hence, they appropriate the entire surplus, $s = 1$, which of course deters all downstream efforts. Therefore, they choose the price that maximizes the profit as if the upstream firms were vertically integrated and no promotion effort takes place at the retail level:

$$\max_{p_i^j} \sum_{j=a}^{b} q_i^j p_i^j \Rightarrow p = \frac{A}{(2-u)(1-d)}$$

The outcome of this maximization avoids double marginalization but at the price of no promotion by retailers. Hence, retailers always prefer wholesale pricing, which is also preferred by the upstream firms if k small because then the incentive to promote outweighs the loss from double marginalization.

A.3. Reference Cases: Monopoly and Duopolies

The setup of a duopoly upstream and duopoly downstream implies four markets in each of which promotion efforts can increase sales. Therefore, for reasons of consistency, in these four markets, the necessary promotion efforts and costs remain (at four), even if the number of players is reduced (to two).

The first reference case is the one of an integrated monopoly that maximizes the entire industry's profits. As explained above, even a monopoly must serve the four markets i times j and incurs the corresponding promotion costs, that is:

$$\max_{p_i^j, e_i^j} \sum_{j=a}^{b} \sum_{i=1}^{2} q_i^j p_i^j - C\left(e_i^j\right)$$

which yields the symmetric solution:

$$p = \frac{Ak}{2(1-d)(1-u)k-1}, \; e = \frac{A}{2(1-d)(1-u)k-1}$$

Considering a downstream duopoly supplied by competitive upstream firms and serving two markets or platforms (to ensure consistency as above), then each retailer j

$$\max_{p_i^j, e_i^j} \sum_{i=1}^{2} q_i^j p_i^j - C\left(e_i^j\right)$$

which leads to the symmetric equilibrium:

$$p = \frac{Ak}{(2-d)(1-u)-k}, \; e = \frac{A}{(2-d)(1-u)-k}$$

Finally, consider an upstream duopoly, each owning a retail outlet distributing its own product. However, for consistency with promotion costs, the retail outlet consists of two platforms, regions, and so on. In this case, publisher i

$$\max_{p_i^j, e_i^j} \sum_{j=a}^{b} q_i^j p_i^j - C\left(e_i^j\right)$$

with the symmetric equilibrium:

$$p = \frac{Ak}{(1-d)(2-u)k-1}, \; e = \frac{A}{(1-d)(2-u)k-1}$$

Therefore, the critical value of k assumed in (6) is larger than those implied by duopolies, that is:

$$\underline{k} > \frac{1}{(2-d)(1-u)} \wedge \underline{k} > \frac{1}{(1-d)(2-u)}$$

in order that positive (and finite) prices and efforts result. However, the condition mentioned in (3) is twice the minimal level (the second inequality above) and this exceeds $\underline{k}$ for $u < 2/3$.