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# Content-Distribution Strategies in Markets With Locked-in Customers

Joeffrey Drouard\*

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## Abstract

We study how the presence of locked-in customers in a downstream market affects the distribution choice of an upstream content provider. Two asymmetric distributors compete in a mature market and the content provider sells its rights using lump-sum fees. A higher number of locked-in customers reduces the need to resort to exclusivity to relax downstream competition. The content provider therefore sells its rights to both distributors when there is a sufficiently-high proportion of locked-in customers. We show that an exclusive affiliation with the smaller rather than the larger distributor facilitates distributors' rent-extraction, in particular for low-quality content. When there are few locked-in customers, the content provider sells low-quality content to the smaller distributor and high-quality content to the larger distributor. Our results suggest that competition authorities should cautiously evaluate the effects of lower switching costs on consumer welfare. By encouraging exclusive distribution, a lower proportion of locked-in customers may reduce consumer welfare.

*Keywords:* Distribution of content, Exclusivity, Switching costs, Locked-in customers, Customer base.

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# 1 Introduction

Digital-content distributors need to acquire premium content as a way of increasing the value of their services. They in particular would like to acquire this content on an exclusive basis in order to strengthen their market position. Distributors can be thought of as pay-TV, telecom or over-the-top providers that compete for sports and movie rights or premium channels. Apart from the distributors' need to sign exclusive deals in order to differentiate their product from that of their rivals, these markets are also characterized by switching costs that can produce "consumer lock-in". These costs can be represented in monetary terms but also include time, effort and psychological hurdles. This lock-in effect partly explains why switching rates are relatively low in these industries.<sup>1</sup>

The size of the customer base and the extent of consumer lock-in are drivers of profitability in content-distribution markets (Chen and Hitt, 2006). However, with the exception of Weeds (2016), the existing theoretical work analyzing the determinants of content exclusivity make no reference to switching costs. We here analyze the content-distribution strategies employed in markets with locked-in customers. We consider a mature market with two asymmetric downstream distributors and one upstream content provider. The upstream provider sells the rights for its content using lump-sum fees, and can be exclusive to one distributor or multi-home (Stage I). Distributors then compete on price (Stage II). While some consumers are fully locked-in due to prohibitively-high switching costs, others can switch supplier at no cost.

The allocation of content across distributors that emerges from Stage I is the one that maximizes the sum of distributors' profits in Stage II. The effect of Stage-I exclusive distribution on these profits is as follows. On the one hand, some customers will be denied access to the content if the content provider affiliates exclusively with one distributor. Consumers' average willingness-to-pay for distributors' services is therefore greater when the content provider multi-homes rather than affiliating exclusively with one distributor. On the other hand, exclusivity allows for verti-

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<sup>1</sup>See, for instance, Grzybowski (2008), Grzybowski and Pereira (2011) and Grzybowski and Nicolle (2021) for mobile telecoms, Krafft and Salies (2008) for fixed telecoms and Shcherbakov (2016) for the pay-TV market.

cal differentiation among distributors, which can facilitate distributors' rent-extraction. Whether content is exclusive to one distributor or present on both distributors depends fundamentally on the proportion of locked-in customers. A higher percentage of locked-in customers increases the market power of each distributor, and thus reduces the need to resort to exclusive distribution to avoid the dissipation of surplus in favor of customers. The content provider therefore multi-homes when there is a sufficiently-high proportion of locked-in customers; for intermediate values of the percentage of locked-in customers, the content provider multi-homes if content quality is not too high and otherwise affiliates exclusively with the larger distributor.

When few customers are locked-in, the content provider sells its rights on an exclusive basis. Since it can supply the content on a larger scale, the distributor with the larger customer base may more easily take advantage of the content than its smaller rival. However, this does not always follow. As the fraction of locked-in customers falls, the demand served by an *exclusive* distributor becomes less contingent on whether it has a large or small customer base; moreover, competition among distributors is fiercer if the content provider affiliates exclusively with the larger rather than the smaller distributor. Thus, the initial disadvantage of a smaller customer base can be overcome if there is a sufficiently-low proportion of locked-in customers. We in particular show that the content provider affiliates exclusively with the smaller distributor if the mass of locked-in customers and content quality are not too high.

At the end of the game, distributors are left with their individual *excluded* Stage-II profit regardless of the content-distribution outcome. The value of a large customer base is therefore equal to the Stage-II profit of a *large excluded* distributor minus the Stage-II profit of a *small excluded* distributor. With a larger customer base, a distributor can guarantee itself a higher minimum profit and thus limit the harmful effects of competition against a rival of higher quality. It follows that the value of a large customer base is positive and greater than if there were no content provider.

Our results bear two interesting policy implications. They first suggest that competition authorities may face a trade-off between increasing consumer mobility to bring about tougher price

competition in the downstream market and a less-restrictive policy on switching costs in order to promote non-exclusive distribution. By encouraging exclusive distribution, a lower number of locked-in customers may reduce consumer welfare. Second, they underline that an initially-small distributor can overcome its larger competitor by acquiring exclusive content.

The remainder of the paper is organized as follows. Section 2 presents the relevant literature. Section 3 introduces the model. Section 4 characterizes the equilibrium pricing and content-distribution strategies and determines the value of a large customer base. Section 5 discusses the relationship between welfare and the number of locked-in customers. Section 6 provides extensions to and robustness checks of the baseline model. The detailed analysis and proofs of this section are set out in the Online Supplementary Material. Section 7 concludes.

## 2 Related Literature

To the best of our knowledge, Weeds (2016) is the only contribution to formally address the determinants of content exclusivity in the presence of switching costs. Weeds (2016) considers a form of wholesale content supply, via per-subscriber fees, which entails non-exclusivity when there are no switching costs. She then emphasizes the way in which the dynamic aspect of competition affects incentives towards exclusivity. More specifically, she studies a downstream market with low switching costs and looks at the trade-off a vertically-integrated distributor faces between increasing its subscriber base and supplying its rival using a per-subscriber fee. After consumer switching costs have been built up, the vertically-integrated operator always supplies its content to the rival distributor.<sup>2</sup> However, when consumers are not yet attached to a distributor, a higher current market share leads to both a higher price and a larger market share in the future. This future benefit can outweigh the loss of revenue on the wholesale market, so that the vertically-integrated distributor may choose exclusivity in the initial phase of market development. Our model differs in some key aspects from that in Weeds (2016). We study the incentives of an independent

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<sup>2</sup>Selling its rights on a per-subscriber basis allows the integrated distributor to extract surplus from additional consumers and raises the marginal cost of its rival. This reduces the integrated-distributor's incentive to price undercut its rival and limits downstream competition.

upstream provider to deal exclusively or non-exclusively with two asymmetric distributors in a mature market. Distributors have a base of captive customers and adopt non-discriminatory pricing strategies. Last, the upstream provider sells the rights for its content using lump-sum fees.

Several papers examine the distribution choice of a content provider selling its rights on a lump-sum basis. They commonly adopt a *Hotelling-based* approach to model downstream competition. In such a setting, when the market is covered and no customer is captive, pricing equilibrium depends on the difference between the quality levels of the firms (not on their absolute value). This in turn implies that the value of content is entirely competed away if both distributors have content access. By promoting vertical differentiation, exclusivity facilitates distributors' rent-extraction and maximizes the sum of the distributors' profits. Exclusivity therefore emerges as the equilibrium outcome when contracts are efficient<sup>3</sup> and the content provider's revenue stems only from the lump-sum fee(s) collected from distributors (Armstrong, 1999; D'Annunzio, 2017). Multi-homing may, however, arise in equilibrium because of contracting inefficiency (Jiang et al., 2019) or if the content provider collects additional revenue from end users (Hagiu and Lee, 2011; Weeds, 2012; Stennek, 2014).<sup>4</sup> We explore a new motive that can promote multi-homing, namely the presence of locked-in customers. In our model, distributors compete in a covered market and

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<sup>3</sup>Following Segal (1999), we define a contract as efficient if the allocation of content that arises in equilibrium is the one that maximizes industry profits subject to the pricing game.

<sup>4</sup>Armstrong (1999) shows that exclusivity (resp., multi-homing) occurs if the content provider sells its rights on a lump-sum (resp., per-subscriber) basis. The other articles assume that content rights are sold on a lump-sum basis. D'Annunzio (2017) studies the effects of vertical integration on investment in content quality. Exclusivity is always the preferred choice of the content provider, regardless of the vertical structure of the industry. Hagiu and Lee (2011), Weeds (2012) and Stennek (2014) show that the content is provided non-exclusively if the upstream provider collects sufficiently high revenue from end users. For instance, the content provider can receive additional revenue from selling its goods directly to consumers or from advertising. Jiang et al. (2019) demonstrate that consumer's multi-purchase promotes exclusivity. In Armstrong (1999), Weeds (2012) and D'Annunzio (2017), the content provider has all the bargaining power and makes sequential take-it-or-leave-it offers to the distributors. In case the distributor that receives the former offer rejects it, the content provider grants the exclusive rights to the other distributor. As it may not be in its interests to do so, a strong commitment power by the content provider is required. In Hagiu and Lee (2011), distributors offer exclusivity-contingent contracts to the content provider. Distributors face a coordination problem, and both exclusive and non-exclusive equilibria exist when multi-homing maximizes industry profits. They select among multiple equilibria via the Pareto-undominated solution. Stennek (2014) analyzes a bargaining game with alternating offers in which contracting parties have outside options. In Jiang et al. (2019), the content provider sells its rights with a fixed-fee contract. At the exclusive equilibrium point, only one of the distributors accepts the offer. This distributor knows that if it rejects the offer, the content rights will not be allocated to any distributor. This selling format reduces the bargaining power of the content provider when it wants to induce exclusivity, and may lead to inefficient allocation of content.

enjoy monopolistic power over some customers. Even if they both have content access, distributors extract part of the surplus created by the content and to a larger extent if the mass of locked-in customers is high. When there is a sufficient number of locked-in customers, multi-homing yields both full content exposure and high rent-extraction and thus maximizes the sum of the distributors' profits.

Our result highlights that increased competition in the downstream market – measured as a lower number of locked-in customers – promotes exclusivity. Bagchi (2008) and De Bettignies et al. (2018) examine the effect of downstream competition on licensing strategies when licenses are sold on a lump-sum basis.<sup>5</sup> They both show that the number of licenses falls with the degree of downstream competition. In addition, using a large panel of traded U.S. firms, De Bettignies et al. (2018) provide empirical evidence supporting that downstream competition encourages exclusive licensing. The theoretical result in De Bettignies et al. (2018) relies on allocative inefficiency and is sensitive to small changes in the licensing-environment assumptions.<sup>6</sup> In contrast with the present article, Bagchi (2008) considers a downstream market in which the sum of the firms' demands is elastic. The overall consumer demand therefore rises with the number of licenses granted. The magnitude of this demand effect, which increases with the degree of product differentiation, encourages the innovator to grant more licenses.<sup>7</sup> Muto (1993), Poddar and Sinha (2004) and Stamatopoulos and Tauman (2008) study various types of price competition settings with little to no effect of market expansion. They show that a single license is granted when contracts do not include a per-unit royalty.

Most of previous work on content distribution and patent licensing shows that exclusivity never occurs with the firm at a disadvantage in the downstream market (e.g., Armstrong, 1999;

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<sup>5</sup>Licensing an innovation is akin to selling the rights to a value-added product. The literature on patent licensing mostly deals with cost-reducing innovation. However, cost-reducing and quality-enhancing innovations can be seen as two sides of the same coin, as they both provide a competitive advantage to the licensee.

<sup>6</sup>De Bettignies et al. (2018) assume that, when the patentee chooses to sell an exclusive license, it makes the innovation specific to one firm and afterward determines the level of the exclusive fee. This commitment weakens the bargaining power of the innovator as it can no longer threaten to sell the content to the other firm, and hence reduces the value of an exclusive licensing strategy. However, with other selling mechanisms that can sustain an efficient allocation outcome, exclusivity will always be the preferred choice of the patentee.

<sup>7</sup>This suggests that multi-homing could maximize the sum of the distributors' profits if content-distributors were competing in uncovered markets.

Wang and Yang, 2004; D'Annunzio, 2017; Jiang et al., 2019). Two noteworthy exceptions include Stamatopoulos and Tauman (2009) and Schmidt (2013). Stamatopoulos and Tauman (2009) study the licensing of an innovation that only reduces the marginal cost of the less efficient firm. Under a fixed-fee policy, the efficient firm has no incentive to buy a license as it cannot prevent its rival from buying one, and hence the less efficient firm acquires the innovation exclusively. Schmidt (2013) analyzes firms' incentives to invest in a cost-reducing innovation in a market with locked-in customers. The firm with the smallest customer base is the most eager to obtain a *marginal* innovation when there are few locked-in customers. We find a similar result: the distributor with the smallest customer base secures exclusive content rights when the mass of locked-in customers and content quality are not too high. Our setup differs from that in Schmidt (2013) in one key way. He measures the firms' incentives to innovate by comparing the partial derivatives of their profit with respect to their marginal cost, and therefore neglects the possibility that both firms simultaneously innovate. In our framework, the distributors' willingness-to-pay for content is contingent on the type of allocation (exclusive or not).

Finally, Hagi (2006) examines how commitment by platforms affects the existence of both exclusive and multi-homing equilibria in two-sided markets with locked-in buyers. Sellers are assumed to enter the market before buyers, and platforms can potentially commit to the price for buyers from the beginning. Platforms charge access prices to the buyers and sellers, and a transaction fee on each buyer-seller transaction. However, they cannot charge different prices to sellers who are exclusive from those who multi-home. In addition, the affiliation decision of sellers is exogenously given, not endogenously determined. He shows that commitment makes the existence of exclusive equilibria less likely, but does not affect multi-homing equilibria if these exist.

### 3 The model

We consider a market with two downstream distributors and one upstream content provider - denoted by C. The content provider may be thought of as a movie studio or a sports organization,



and the distributors as two fixed-network operators, over-the-top providers, mobile internet service providers or pay-TV operators. At the start of the game, distributors may be asymmetric with respect to the size of their customer base (reflecting the distribution of previous market shares). The subscript "s" is used to refer to the smaller distributor, while the larger distributor is designated by subscript "l". We denote by  $\sigma \in [0.5, 1)$  the customer base of the larger distributor. Firms are assumed to be risk neutral and to have marginal production costs of zero.

**Demand side.** There is a unit mass of consumers. They have a common utility,  $v > 0$ , generated from access to a distributor, and purchase access to (at most) one distributor. Consumers value the distributor's package more highly when the content is included: their utility rises by  $\tau \geq 0$  when the distributor's offer includes the content (where  $\tau$  can be interpreted as a measure of content quality). Due to sufficiently high switching costs, some consumers are fully locked-in, while other consumers can switch at no cost. We denote by  $\alpha \in (0, 1)$  the mass of locked-in customers.<sup>8</sup>

**Timing.** We study the subgame-perfect equilibrium of the following two-stage game.

- Stage I: the upstream provider sells the rights for its content using lump-sum fees. It makes sequential offers to the distributors, and either affiliates with one distributor exclusively or multi-homes.
- Stage II: distributors set their price simultaneously and consumers decide from which distributor to buy. Locked-in customers continue to buy from the same distributor (as long as the distributor price lies below the consumer's reservation value). Price-sensitive customers buy from the distributor offering them the higher net utility.

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<sup>8</sup>This setup, where some consumers have sufficiently high switching costs such that they are locked-in, is commonly used in the literature (e.g., Padilla, 1992; Hagi, 2006; Schmidt, 2013; Villas-Boas, 2015).

## 4 The equilibrium

We solve our model by backward induction. We start by deriving the equilibrium pricing in Stage II given the content-distribution strategy (Section 4.1), and then go back to Stage I to determine the content provider's distribution choice (Section 4.2). Finally, we analyze how the contracting stage alters the value of a large customer base in the distribution market (Section 4.3).

### 4.1 Stage II: The pricing game

At the start of Stage II, the content-distribution strategy is given. We use the superscript  $c$  to refer to the content-distribution strategy:  $c = m$  if  $C$  multi-homes,  $c = l$  if  $C$  is exclusive to the larger distributor, and  $c = s$  if  $C$  is exclusive to the smaller distributor. We occasionally use the superscript 0 to refer to the situation where none of the distributors has content access (e.g., if the content provider did not reach any agreement with the distributors). We denote by  $u_i^c$  the consumer's reservation value for distributor  $i$ :  $u_i^c = v + \tau$  if  $c \in \{m, i\}$  and  $u_i^j = u_i^0 = v$  with  $i \neq j \in \{l, s\}$ . The net utility offered to consumers by distributor  $i$  is  $w_i^c = u_i^c - p_i^c$  with  $p_i^c$  the price of distributor  $i$ ,  $i \in \{l, s\}$  and  $c \in \{m, l, s\}$ . To simplify the presentation, we assume that distributors compete in terms of net utility rather than price. This makes it easier to compare and discuss the distributors' pricing strategies. Provided that they offer positive net utility, both smaller and larger distributors have a captive-customer segment of size  $K_s = \alpha(1 - \sigma)$  and  $K_l = \alpha\sigma$  respectively. Price-sensitive customers, of mass  $1 - K_l - K_s$ , buy from distributor  $i$  if  $w_i^c > w_j^c$ , with  $i \neq j \in \{l, s\}$ . Distributors attract one-half of the price-sensitive customers whenever they offer the same net utility.

By focusing on its locked-in customers and setting the monopoly price (i.e. that with net utility of 0), distributor  $i$  can guarantee itself a profit equal to  $u_i^c K_i$ . Distributor  $i$  can however attract the group of price-sensitive customers and make a profit slightly lower than  $(u_i^c - w_j^c)(1 - K_j)$  by quoting a net utility slightly higher than  $w_j^c$ . The presence of price-sensitive customers therefore produces tension between the distributors' incentives to i) reduce net utility in order to extract rents

from locked-in customers and ii) increase net utility to attract price-sensitive customers. As such, no equilibrium exists in pure strategies. However, there is a mixed-strategy Nash equilibrium, the existence of which is proved by construction (Appendix A of the Online Supplementary Material provides the complete formal proof).<sup>9</sup> Before providing the intuition for the derivation of this equilibrium, we introduce one piece of additional notation. Let  $\hat{w}_i^c$  be the highest net utility distributor  $i$  is willing to offer to attract price-sensitive customers;  $\hat{w}_i^c$  is such that  $u_i^c K_i = (u_i^c - \hat{w}_i^c)(1 - K_j)$ , and thus  $\hat{w}_i^c = \frac{(1-K_i-K_j)u_i^c}{1-K_j}$  with  $i \neq j \in \{l, s\}$  and  $c \in \{m, l, s\}$ .

Suppose now that distributors  $i$  and  $j$  assign a net utility no higher than  $w$  with probabilities  $F_i^c(w)$  and  $F_j^c(w)$  and that

$$\hat{w}_i^c \leq \hat{w}_j^c. \quad (1)$$

Condition (1) means that distributor  $j$  is willing to offer a higher net utility to attract price-sensitive customers than distributor  $i$ . Put differently, distributor  $j$  gives relatively greater prominence to price-sensitive customers than distributor  $i$  does. Let  $\underline{w}^c = 0$  and  $\bar{w}^c$  be the lower and upper bounds of the support of the equilibrium pricing strategies. Assume that distributor  $j$  has no mass point at  $\underline{w}^c$  and that neither distributor has a mass point at  $w \in (\underline{w}^c, \bar{w}^c]$ . By quoting the monopoly price, distributor  $i$  can guarantee itself a profit  $u_i^c K_i$ .  $\hat{w}_i^c$  insures distributor  $i$  a similar profit when it succeeds in attracting the price-sensitive customers. Since distributor  $i$  must be indifferent between all values in its support,  $\bar{w}^c = \hat{w}_i^c$  and the equilibrium expected profit of distributor  $i$  is  $\pi_i^c = u_i^c K_i$ . By choosing  $\bar{w}^c$ , distributor  $j$  obtains a profit of  $\pi_j^c = (u_j^c - \bar{w}^c)(1 - K_i) = (u_j^c K_i + (u_j^c - u_i^c)(1 - K_j)) \times \frac{1-K_i}{1-K_j}$ , which is its equilibrium expected profit since it must be indifferent between all values in its support. In equilibrium, the following condition

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<sup>9</sup>The use of mixed strategies for economic modeling is somewhat controversial, but does not necessarily mean that distributors choose their price by a coin toss. A mixed strategy can also be viewed as a representation of a pure strategy in a larger (unmodeled) game with incomplete information (Harsanyi, 1973). The idea here is that a firm's mixed-strategy expresses the uncertainty of the other firms about that firm's pure strategy choice. Besides, in reality, content-distributors offer catalogs of movies or services that change over time due to new content acquisition, new home productions or losses in distribution exclusivity. As content-distributors do not necessarily adjust their price when they add new content or remove former content, consumers' net utility may vary with changes in service quality.

must be satisfied

$$(u_k^c - w)(1 - K_q)F_q^c(w) + (u_k^c - w)K_k(1 - F_q^c(w)) = \pi_k^c \quad (2)$$

for  $k \neq q \in \{i, j\}$  and  $c \in \{m, i, j\}$ . From condition (2), it follows that  $F_j^c(w) = \frac{wK_i}{(1-K_i-K_j)(u_i^c-w)}$  and  $F_i^c(w) = \frac{wK_j(1-K_j)+(1-K_i-K_j)((1-K_j)u_j^c-(1-K_i)u_i^c)}{(1-K_j)(1-K_i-K_j)(u_j^c-w)}$ , with  $F_j^c(\bar{w}^c) = F_i^c(\bar{w}^c) = 1$  and  $F_j^c(0) = 0$ . Condition (1) implies that  $F_i^c(0) \geq 0$  and thus  $F_i^c$  and  $F_j^c$  are proper cumulative distribution functions. When we replace subscript  $i$  by  $l$  and  $j$  by  $s$ , condition (1) holds if (i)  $c = m$ , (ii)  $c = s$  or (iii)  $c = l$  and  $\tau \leq \frac{(K_l-K_s)v}{1-K_l} \equiv \hat{\tau}$ . Replacing the subscript  $i$  by  $s$  and  $j$  by  $l$ , condition (1) holds if  $c = l$  and  $\tau \geq \hat{\tau}$ . Lemma 1 characterizes the mixed-strategy Nash equilibrium in Stage II.

**Lemma 1** *Given the content-distribution strategy  $c$ , with  $c \in \{m, l, s\}$ , there is a mixed-strategy Nash equilibrium in Stage II where the larger and smaller distributors propose net utility no higher than  $w$  with probabilities  $F_l^c(w)$  and  $F_s^c(w)$  with supports in which the lower bound is 0 and the upper bound is  $\bar{w}^c = \min\{\hat{w}_l^c, \hat{w}_s^c\}$ .*

- When  $c \in \{m, s\}$  or when  $c = l$  and  $\tau < \hat{\tau}$ :

$$F_l^c(w) = \frac{wK_s(1 - K_s) + (1 - K_l - K_s)((1 - K_s)u_s^c - (1 - K_l)u_l^c)}{(1 - K_s)(1 - K_l - K_s)(u_s^c - w)}$$

$$F_s^c(w) = \frac{wK_l}{(1 - K_l - K_s)(u_l^c - w)} \text{ and } \bar{w}^c = \frac{(1 - K_l - K_s)u_l^c}{1 - K_s} \equiv \hat{w}_l^c.$$

- When  $c = l$  and  $\tau \geq \hat{\tau}$ :

$$F_s^l(w) = \frac{wK_l(1 - K_l) + (1 - K_l - K_s)((1 - K_l)u_l^l - (1 - K_s)u_s^l)}{(1 - K_l)(1 - K_l - K_s)(u_l^l - w)}$$

$$F_l^l(w) = \frac{wK_s}{(1 - K_l - K_s)(u_s^l - w)} \text{ and } \bar{w}^l = \frac{(1 - K_l - K_s)u_s^l}{1 - K_l} \equiv \hat{w}_s^l.$$

Distributors' pricing strategies are affected by two (potential) sources of asymmetry: those in quality and market shares. Recall that the best reply for distributor  $i$  is either to fully exploit its

locked-in customers or to offer a net utility slightly higher than  $w_j^c$ . Distributor  $i$  can guarantee itself a profit equal to  $u_i^c K_i$  if it quotes the monopoly price, and obtain a profit slightly lower than  $(u_i^c - w_j^c)(1 - K_j)$  if it undercuts its rival. Since  $K_i < 1 - K_j$ , distributor  $i$  finds it relatively more profitable to undercut its rival as  $u_i^c$  rises. A distributor therefore gives greater prominence to price-sensitive customers if it has content access (exclusively or not) than if it does not. Then, greater asymmetry in market shares affects the base of locked-in customers of both distributors in an opposing way. Other things being equal, the larger distributor has more incentive to exploit its locked-in customers with more unevenly-distributed market shares. At the same time, as it has less to lose by cutting price, the smaller distributor is willing to offer higher net utility to attract price-sensitive customers when  $\sigma$  rises.

As a result, in equilibrium, the smaller distributor competes more fiercely than its larger rival when the content provider multi-homes. Both effects, the asymmetries in market shares and quality, make the smaller distributor more aggressive in terms of price undercutting when the content provider affiliates exclusively with the smaller distributor. It follows that a *small exclusive* distributor competes more fiercely than a *large excluded* distributor. The two effects will be opposing if the content provider affiliates exclusively with the larger distributor. The asymmetry in quality offsets that in market shares, and a *large exclusive* distributor competes more fiercely than a *small excluded* distributor if content quality is sufficiently high. This leads to the following proposition.

**Proposition 1** *Equilibrium pricing strategies have the following characteristics:*

- (i)  $F_s^m(w) \leq F_l^m(w)$  and  $F_l^m(w)$  has a mass point at 0 if  $\sigma \neq 0.5$ ;
- (ii)  $F_s^s(w) \leq F_l^s(w)$  and  $F_l^s(w)$  has a mass point at 0 if  $\sigma \neq 0.5$  or  $\tau \neq 0$ ;
- (iii)  $F_l^l(w) \leq F_s^l(w)$  and  $F_s^l(w)$  has a mass point at 0 if  $\tau > \hat{\tau}$ .
- (iv)  $F_l^l(w)$  has a mass point at 0 if  $\tau < \hat{\tau}$ .

**Proof.** See Appendix A ■

It is worth bearing in mind that competition takes place in terms of net utility. A lower value of  $F$  corresponds to a distributor that more frequently offers high net utilities, or stated differently, to a distributor that offers higher net utilities in a stochastic sense.<sup>10</sup> A sufficient condition for price-sensitive customers to be more likely to buy from distributor  $i$  rather than distributor  $j$  is that  $F_i^c(w) \leq F_j^c(w)$ , with  $i \neq j \in \{l, s\}$  and  $c \in \{m, l, s\}$ . Items (i) and (ii) in Proposition 1 show that the larger distributor quotes the monopoly price with positive probability when the smaller distributor has content access (exclusively or not). In this case, the smaller distributor offers higher net utilities and is more likely to attract price-sensitive customers than its larger rival. Item (iii) shows that the reverse comes about when the larger distributor has exclusive high-quality content ( $\tau > \hat{\tau}$ ): a *small excluded* distributor charges the monopoly price with positive probability and offers high net utilities with a lower probability than does a *large exclusive* distributor. The situation in which the larger distributor has exclusive low-quality content is less clear-cut: the *large exclusive* distributor quotes the monopoly price with positive probability but there is no stochastic dominance (item (iv)). Since the probability that a *large exclusive* distributor attracts price-sensitive customers rises with  $\tau$ , there exists a value  $\bar{\tau} \in (0, \hat{\tau})$  such that price-sensitive customers are more likely to purchase from a *small excluded* distributor if  $\tau < \bar{\tau}$  and from a *large exclusive* distributor otherwise.

We now discuss how content quality and asymmetry in market shares affect the intensity of competition according to the type of content distribution. We prove the following proposition.

**Proposition 2** *Content quality and initial market split affect the equilibrium pricing strategies as follows:*

(i) *Equilibrium pricing strategies & content quality*

- $F_l^m$  and  $F_s^m$  decrease with  $\tau$ ;
- $F_l^l$  and  $F_s^l$  decrease with  $\tau$  if  $\tau < \hat{\tau}$ , otherwise  $F_l^l$  is independent of  $\tau$  and  $F_s^l$  rises with  $\tau$ ;
- $F_s^s$  is independent of  $\tau$  and  $F_l^s$  rises with  $\tau$ .

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<sup>10</sup>For the sake of brevity, the precision “in a stochastic sense” will not be specified anymore hereafter.

(ii) *Equilibrium pricing strategies & initial market split*

- $\forall c \in \{m, s\}$ ,  $F_l^c$  and  $F_s^c$  increase with  $\sigma$ ;
- $F_l^l$  and  $F_s^l$  increase with  $\sigma$  if  $\tau < \hat{\tau}$ , otherwise  $F_l^l$  and  $F_s^l$  decrease with  $\sigma$ .

**Proof.** See Appendix B ■

Two elements are particularly relevant for understanding the results of Proposition 2. The first element is the identity of the distributor that places the least emphasis on price-sensitive customers. Assume that  $\hat{w}_i^c \leq \hat{w}_j^c$ , meaning that distributor  $i$  is not willing to offer such a high net utility as its rival to attract price-sensitive customers. The upper bound of the support of the equilibrium pricing strategies is then equal to  $\hat{w}_i^c$ . When distributor  $i$ 's interest in attracting price-sensitive customers rises, the support of the equilibrium pricing strategies becomes wider. Inversely, the upper bound of this support decreases when distributor  $i$  places even less emphasis on attracting price-sensitive customers. The second element is that the pricing game exhibits strategic complementarity.

Item (i) in Proposition 2 highlights the relationship between the intensity of competition and content quality. Greater content quality raises the benefit for a distributor that has content access (exclusively or not) to undercut its rival, but does not affect the best response of an *excluded* distributor. In other words, the highest net utility a distributor is willing to offer to attract price-sensitive customers rises with  $\tau$  only if it has content access. When the content provider multi-homes, both distributors have more incentive to compete for price-sensitive customers as  $\tau$  rises. They both increase their price but not as much as the rise in content quality, and thus offer higher net utilities as  $\tau$  rises. As a result, part of the surplus from content-quality improvement is captured by customers if content is present on both distributors. Whenever the smaller distributor has exclusivity or the larger distributor has exclusive high-quality content ( $\tau \geq \hat{\tau}$ ), the upper bound of the support of the equilibrium pricing strategies is equal to the highest net utility the *excluded* distributor is willing to offer to attract price-sensitive customers. The support of the equilibrium pricing strategies is therefore independent of content quality. However, higher content

quality reduces the possibility for the *excluded* distributor to win price-sensitive customers, which in turn focuses more on its captive customers and thus offers more frequently low net utilities. The *exclusive* distributor, meanwhile, offers a similar level of net utility as  $\tau$  rises.<sup>11</sup> This means that the *exclusive* distributor appropriates the entire surplus from content-quality improvement and becomes *relatively* more aggressive than its rival as  $\tau$  rises. Otherwise, when the larger distributor has exclusive low-quality content, the upper bound of the support of the equilibrium pricing strategies is equal to the highest net utility the *exclusive* distributor is willing to offer to attract price-sensitive customers. It follows that the support of the equilibrium pricing strategies becomes wider as  $\tau$  rises. Because the pricing game exhibits strategic complements, both distributors offer higher net utilities as  $\tau$  rises. Several lessons can be drawn from the above discussion. First, an increase in content quality reduces competition and harms consumers, unless the content is present on both distributors or the larger distributor has exclusive low-quality content. Second, an exclusive affiliation with the smaller rather than the larger distributor facilitates distributors' rent-extraction.<sup>12</sup> In particular, price-sensitive customers enjoy, on average, lower net utility if the content provider affiliates exclusively with the smaller rather than the larger distributor (see Appendix C). Third, once content quality is above  $\hat{\tau}$ , the relative difference in competition intensity between the two types of exclusive allocation vanishes as content quality rises. Indeed, when  $\tau \geq \hat{\tau}$ ,  $\mathbb{E}(p_s^s)/\mathbb{E}(p_l^l)$  and  $\mathbb{E}(p_l^s)/\mathbb{E}(p_s^l)$  are greater than one but decrease with  $\tau$ : the rent extracted by the distributors, according to whether the content provider affiliates exclusively with the smaller or the larger distributor, becomes (relatively) more similar as content quality rises (see Appendix

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<sup>11</sup>This follows from the characteristics of the mixed-strategy Nash equilibrium. Assume that distributor  $j$  has exclusivity and  $\hat{w}_i^j \leq \hat{w}_j^j$ : distributor  $i$  quotes the monopoly price with positive probability and can guarantee itself a profit  $vK_i$ . Since distributor  $i$  must be indifferent between all values in its support,  $F_j^j$  must be such that  $(v-w)(1-K_j)F_j^j(w) + (v-w)K_j(1-F_j^j(w)) = vK_i$ ;  $\tau$  is not part of this expression, and hence,  $F_j^j$  is independent of  $\tau$ .

<sup>12</sup>The intuition is as follows: the upper bound of the support of an *exclusive* equilibrium pricing is determined by the highest net utility the *exclusive* distributor is willing to offer to attract price-sensitive customers if the content provider is exclusive to the larger distributor and  $\tau$  is lower than  $\hat{\tau}$ . Otherwise, the upper bound is equal to the highest net utility the *excluded* distributor is willing to offer to attract price-sensitive customers. Recall that  $\hat{w}_i^j$  is independent of  $\tau$  and  $\hat{w}_i^i$  increases with  $\tau$ , with  $i \neq j \in \{l, s\}$ . Thus, the upper bound of the support of the equilibrium pricing strategies is independent of  $\tau$  if the smaller distributor has exclusivity. By contrast, when the larger distributor has exclusivity, the upper bound increases with  $\tau$  as long as  $\tau$  is lower than  $\hat{\tau}$ , and is independent of  $\tau$  otherwise. It follows that  $\bar{w}^l \geq \bar{w}^s$ . The support of the equilibrium pricing strategies is wider, and thus competition fiercer, if the content provider is exclusive to the larger rather than the smaller distributor.



D).

Item (ii) in Proposition 2 shows the relationship between the intensity of competition and the asymmetry in market shares. Recall that a distributor places more weight on exploiting locked-in customers than on attracting new ones when its customer base increases. It follows that  $\hat{w}_i^c$  falls in  $\sigma$ , while  $\hat{w}_s^c$  increases with  $\sigma$ , with  $c \in \{m, l, s\}$ . When the larger distributor has exclusive high-quality content, the smaller distributor is the least inclined to offer a high net utility to attract price-sensitive customers. Hence, the upper bound of the support of the equilibrium pricing strategies is equal to  $\hat{w}_s^l$  and increases with  $\sigma$ . To withstand the increased competitive pressure exerted by its rival, the larger distributor reacts likewise by offering higher net utilities. As a result, more unevenly-distributed market shares strengthen competition if the content provider is exclusive to the larger distributor and  $\tau \geq \hat{\tau}$ . Otherwise, the larger distributor is the least inclined to offer a high net utility to attract price-sensitive customers. The larger distributor's interest in attracting price-sensitive customers and thus the upper bound of the support of the equilibrium pricing strategies decrease with  $\sigma$ . Because of strategic complementarity, the smaller distributor reacts by offering lower net utilities and greater asymmetry in market shares weakens competition. To summarize, increased asymmetry between distributors' market shares softens competition unless the larger distributor has exclusive high-quality content.

**Equilibrium expected profits in Stage II.** Given the content-distribution strategy  $c \in \{m, l, s\}$ , the equilibrium expected profits in Stage II are:<sup>13</sup>

- $\pi_s^c = (u_l^c K_l + (u_s^c - u_l^c)(1 - K_s)) \times \frac{1-K_l}{1-K_s}$  and  $\pi_l^c = u_l^c K_l$  if  $c \in \{m, s\}$  or if  $c = l$  and  $\tau < \hat{\tau}$
- $\pi_s^l = u_s^l K_s$  and  $\pi_l^l = (u_s^l K_s + (u_l^l - u_s^l)(1 - K_l)) \times \frac{1-K_s}{1-K_l}$  if  $\tau \geq \hat{\tau}$

We show that the following condition holds:

$$\pi_i^i \geq \pi_i^m \geq \pi_i^0 \geq \pi_i^j \tag{3}$$

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<sup>13</sup>Depending on the mass of locked-in customers, equilibrium expected profits in Stage II are between those from full collusion and competition. Collusive-type outcomes come about as  $\alpha$  approaches one and the equilibrium converges to *Bertrand* competition as  $\alpha$  approaches zero.

with  $i \neq j \in \{l, s\}$ . Condition (3) implies that a distributor in Stage II prefers to have content exclusivity rather than  $C$  to multi-home, and prefers  $C$  to multi-home rather than have  $C$  exclusive to its rival. It is important to stress that these expressions are the expected payments collected in Stage II; the expected total profits for each industry participant also include the payments made between distributors and the content provider in Stage I.

## 4.2 Stage I: Content distribution

We now move back to Stage I to determine the outcome of the contracting game. Following Armstrong (1999), we assume that the content provider makes sequential offers. It faces three possibilities: sell the rights to both distributors, sell the rights exclusively to the larger distributor, or sell the rights exclusively to the smaller distributor. The negotiations are such that the content provider tries each of these possibilities one after the other, in an order that it has previously defined. Negotiations cease when a contract is accepted or, at the end of these three stages, if no agreement is reached.

We denote by  $T_i^i$  and  $T_i^m$ , with  $i \in \{l, s\}$ , the lump-sum payments required by the content provider from distributor  $i$  in exchange for exclusive and non-exclusive affiliation respectively. The content provider can affiliate exclusively with one of the distributors only if this distributor accepts the lump-sum payment required for exclusive distribution; and multi-home only if they both accept the lump-sum payments required for non-exclusive distribution. Without loss of generality, we assume that distributors accept an offer when they are indifferent between accepting or refusing it. Clearly, the content provider could lower the relevant fee by some  $\varepsilon > 0$  so that distributors will strictly prefer to accept the offer.

The maximum tariff the upstream provider can ask of a distributor depends on both the profit this distributor can gain from the content (according to the type of distribution under negotiation) and on its outside option. By threatening to give the exclusive rights to its rival, the content provider minimizes the value of a distributor's outside option and can thus obtain the maximum payoff for each of the different forms of distribution. We discuss below the way of doing this

according to whether the content provider prefers exclusive or non-exclusive distribution.

- Assume that the content provider wants to induce exclusivity with distributor  $i$ . First, the content provider offers non-exclusive contracts to both distributors at prohibitive prices, which are rejected. Distributor  $i$  then receives an exclusive offer. It knows that if it rejects the exclusive offer, its rival will be granted the content exclusively. Indeed, as a last resort, the content provider can induce distributor  $j$  to accept an exclusive offer by setting an exclusive fee lower than or equal to  $\pi_j^j - \pi_j^0$ . Distributor  $i$  is therefore better off accepting the exclusive contract if  $\pi_i^i - T_i^i \geq \pi_i^j$ . It follows that the content provider can induce distributor  $i$  to pay a lump-sum fee  $T_i^i = \pi_i^i - \pi_i^j$  for exclusivity.
- Assume that the content provider wants to induce non-exclusive distribution. First, the content provider offers non-exclusive contracts to both distributors. Each distributor knows that if it rejects the non-exclusive offer, the content provider will then make an exclusive offer to one of the distributors. In that case, and following the same arguments as above, the distributor receiving the exclusive offer will accept it and both distributors will end up with their *excluded* Stage-II profit. The larger and smaller distributors are therefore better off accepting the non-exclusive offer submitted to them in the first place if  $\pi_l^m - T_l^m \geq \pi_l^s$  and  $\pi_s^m - T_s^m \geq \pi_s^l$ . It follows that the content provider can induce both distributors to accept a non-exclusive contract by setting  $T_l^m = \pi_l^m - \pi_l^s$  and  $T_s^m = \pi_s^m - \pi_s^l$ .

To summarize, the content provider's revenue is  $\pi_l^m + \pi_s^m - (\pi_l^s + \pi_s^l)$  if it sells the rights to both distributors and  $\max\{\pi_l^l - \pi_l^s, \pi_s^s - \pi_s^l\}$  if it sells the rights exclusively to one distributor. The content provider therefore opts for a non-exclusive distribution if  $\pi_l^m + \pi_s^m \geq \max\{\pi_l^l + \pi_s^l, \pi_l^s + \pi_s^s\}$  and for an exclusive affiliation with distributor  $i$  if  $\pi_i^i + \pi_s^i > \max\{\pi_l^m + \pi_s^m, \pi_l^j + \pi_s^j\}$ , with  $i \neq j \in \{l, s\}$ . We can now state the following lemma.

**Lemma 2** *The industry structure that emerges from Stage I is that which maximizes expected industry profits in Stage II. Distributor  $i$  will pay  $T_i^i = \pi_i^i - \pi_i^j$  in exchange for exclusive content and  $T_i^m = \pi_i^m - \pi_i^j$  for non-exclusive content, with  $i \neq j \in \{l, s\}$ .*

Lemma 2 shows that the content provider chooses the content-distribution strategy that maximizes expected industry profits in Stage II. As the content provider makes no revenue in Stage II, expected industry profits are simply the sum of distributors' profits in Stage II. The next lemma characterizes the content-distribution strategy that maximizes expected industry profits in Stage II.

**Lemma 3** *Multi-homing maximizes expected industry profits if  $\alpha \geq \bar{\alpha}$  or if  $\alpha \in [\underline{\alpha}, \bar{\alpha})$  and  $\tau \leq \tau_2^d$ . Expected industry profits are maximized when the content provider affiliates exclusively with the larger distributor if  $\alpha \in [\underline{\alpha}, \bar{\alpha})$  and  $\tau > \tau_2^d$  or if  $\alpha \in (0, \bar{\alpha})$  and  $\tau > \tau_1^d$ ; and when the content provider affiliates exclusively with the smaller distributor if  $\alpha \in (0, \underline{\alpha})$  and  $\tau \leq \tau_1^d$ .*

**Proof.** See Appendix E ■

The threshold values in Lemma 3 are such that  $\underline{\alpha} = \frac{2\sigma+1-\sqrt{8\sigma^2-4\sigma+1}}{2\sigma(2-\sigma)}$ ,  $\bar{\alpha} = \frac{1-\sqrt{\sigma(1-\sigma)}}{1+\sigma^2-\sigma}$ ,  $\tau_1^d = \frac{2-3\alpha+\alpha^2}{1-\alpha+\alpha^2\sigma-\alpha^2\sigma^2} \times v$  and  $\tau_2^d = \frac{\alpha(2-\alpha)(\sigma(1-\alpha\sigma)-(1-\sigma)(1-\alpha+\alpha\sigma))}{(1-\alpha\sigma)((1-\sigma+\sigma^2)\alpha^2-2\alpha+1)} \times v$ . They have the following properties:  $0 < \underline{\alpha} \leq \bar{\alpha} < 1$ ,  $\tau_1^d$  falls in  $\alpha$  and is higher than  $\hat{\tau}$  over the interval  $(0, \underline{\alpha})$ ,  $\tau_2^d$  rises with  $\alpha$  and is higher than  $\hat{\tau}$  over the interval  $(\underline{\alpha}, \bar{\alpha})$ ,  $\tau_1^d = \tau_2^d$  if  $\alpha = \underline{\alpha}$ ,  $\tau_1^d \xrightarrow{\alpha \rightarrow 0} 2v$ ,  $\tau_2^d \xrightarrow{\alpha \rightarrow \bar{\alpha}} \infty$ .

When choosing its distribution strategy, the upstream provider faces a trade-off between ensuring that a large number of customers have access to the content and that distributors have sufficient market power to extract the surplus created by the content. On the one hand, multi-homing guarantees that every customer has access to the content. Total surplus is therefore greater when the content provider multi-homes rather than affiliating exclusively with one distributor. On the other hand, exclusivity allows for vertical differentiation among distributors and can facilitate distributors' rent-extraction.<sup>14</sup> Indeed, whenever the smaller distributor has exclusivity or the larger distributor has exclusive high-quality content, an increase in content quality reduces competition and harms consumers. By contrast, under multi-homing, customers always capture part of the surplus resulting from an increase in content quality. To provide the intuition for Lemma 3, we distinguish three different situations according to the fraction of locked-in customers. In each

<sup>14</sup>A well-known principle in economics is that differentiation is needed to relax price competition (e.g., Shaked and Sutton, 1982; Champsaur and Rochet, 1989).

case, we then discuss how distributors appropriate the surplus from content-quality improvement according to the type of content distribution.

(i)  $\alpha \geq \bar{\alpha}$ . When there is a high proportion of locked-in customers, distributors mostly quote net utility close to 0 and extract a large fraction of consumer surplus - regardless of whether the content provider is exclusive or not. Indeed, a greater number of locked-in customers makes the demand faced by distributors more inelastic, thereby strengthening distributors' market power. The need to resort to exclusivity to relax downstream competition is therefore limited. To obtain broader content exposure, the upstream provider has to supply its content non-exclusively. It follows that multi-homing maximizes expected industry profits.<sup>15</sup>

(ii)  $\alpha \in [\underline{\alpha}, \bar{\alpha})$ . As the number of locked-in customers falls, distributors adopt more aggressive pricing strategies. Vertical differentiation through exclusivity may be necessary to avoid that customers capture a too large part of the value created by the content. The mass of locked-in customers is nevertheless not negligible, and an exclusive affiliation with the smaller distributor will prevent a large fraction of the consumers (at least those who are locked-in with the larger distributor) from having access to the content. When the smaller distributor has exclusivity, the loss of content exposure is too large and cannot be offset by the fact that downstream competition is less intense. As a result, expected industry profits are greater if the content provider multi-homes rather than affiliating exclusively with the smaller distributor. When the content is of low-quality, an exclusive affiliation with the larger distributor also results in a significant loss of content exposure,<sup>16</sup> without mitigating downstream competition.<sup>17</sup> However, the probability that the *exclusive* distributor attracts price-sensitive customers rises with  $\tau$ : a *large exclusive* distributor will serve a significant part of the demand if content is of high-quality. In addition, once content

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<sup>15</sup>The value of non-exclusive distribution is obvious when we consider the limiting case as the mass of locked-in customers approaches one: expected industry profits tend to  $v + \tau$  if content is present on both distributors and are below  $v + \sigma\tau$  if content is exclusive to one distributor.

<sup>16</sup>For instance, with poor content quality, price-sensitive customers are more likely to purchase from a *small excluded* distributor rather than from a *large exclusive* distributor.

<sup>17</sup>As long as  $\tau$  is lower than  $\hat{\tau}$ , a *large exclusive* distributor and a *small excluded* distributor offer higher net utilities as  $\tau$  rises.

quality is above  $\hat{\tau}$ , a *large exclusive* distributor appropriates the entire surplus from content-quality improvement ( $d\mathbb{E}(p_i^l)/d\tau = 1$  if  $\tau \geq \hat{\tau}$ ). A *small excluded* distributor, meanwhile, makes less attractive offers as  $\tau$  rises. As such, for high-quality content, an exclusive affiliation with the larger distributor guarantees both high rent-extraction and a broad content diffusion (albeit incomplete). By contrast, under multi-homing, part of the surplus from content-quality improvement is always captured by customers. Overall, higher content quality increases the appeal of exclusivity to the larger distributor relative to non-exclusivity. There is thus a cutoff value of content quality,  $\tau_2^d$ , above which exclusivity to the larger distributor maximizes expected industry profits, and below which multi-homing maximizes expected industry profits. Consistent with multi-homing being more likely to maximize expected industry profits as the number of locked-in customers rises, the content quality threshold  $\tau_2^d$  increases with  $\alpha$  if  $\alpha \in [\underline{\alpha}, \bar{\alpha})$ .

(iii)  $\alpha < \underline{\alpha}$ . When few customers are locked-in and both distributors have content access, better content quality very partially translates into higher prices and mostly benefits consumers. Although every customer has access to the content, expected industry profits weakly increase with  $\tau$  if the content provider multi-homes. Vertical differentiation is necessary to relax downstream competition and prevent distributors from dissipating most of the surplus through fierce competition. Thus, either exclusivity to the larger or to the smaller distributor maximizes expected industry profits.<sup>18</sup> The segment of the market of price-sensitive customers being large, the demand served by a distributor mainly depends on its ability to attract those customers, and relies less on whether it has a large or small customer base. The difference in content exposure, according to whether the upstream provider is exclusive to the larger or the smaller distributor, is therefore of small magnitude (especially for low-quality content).<sup>19</sup> In addition, an exclusive affiliation with the smaller

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<sup>18</sup>This appears clearly when the mass of locked-in customers approaches zero: expected industry profits tend to zero if the content is present on both distributors and to  $\tau$  if the content is exclusive to one distributor.

<sup>19</sup>With poor quality content, a *large exclusive* distributor places relatively little importance on attracting price-sensitive customers. Price-sensitive customers are more likely to purchase from a *small excluded* distributor, and the advantage of having a large customer base to insure a wide distribution of content is therefore undermined. On the other extreme, when  $\tau$  is really high, the *exclusive* distributor attracts price-sensitive customers with a probability close to 1, regardless of whether it has a large or small customer base. In Appendix B of the Online Supplementary Material, we depict the expected market share of the *exclusive* distributor, according to whether it has a large or small customer base, as a function of content quality, for different levels of the initial market split and of the mass

rather than the larger distributor significantly softens downstream competition if  $\tau < \hat{\tau}$ .<sup>20</sup> This explains why, even if content exposure is slightly lower, expected industry profits are higher when the upstream provider sells low-quality content to the smaller rather than the larger distributor. However, once content quality is above  $\hat{\tau}$ , the relative difference in competition intensity between these two types of exclusive allocation vanishes as content quality rises. In particular, regardless of whether the content provider is exclusive to the larger or the smaller distributor, an increase in content quality is fully passed on in the *exclusive* distributor's price ( $dE(p_l^l)/d\tau = dE(p_s^s)/d\tau = 1$  if  $\tau \geq \hat{\tau}$ ). An increase in content quality being monetized over a larger number of customers, expected industry profits will increase more sharply with  $\tau$  if the content provider is exclusive to the larger rather than the smaller distributor. Consequently, there exists a threshold quality level  $\tau_1^d$ , strictly higher than  $\hat{\tau}$ , above which an exclusive affiliation with the larger distributor will yield higher expected industry profits than an exclusive affiliation with the smaller distributor. To summarize, exclusivity to the smaller distributor maximizes expected industry profits if content quality is lower than  $\tau_1^d$ . Otherwise, exclusivity to the larger distributor maximizes expected industry profits. Lastly, a rise in the mass of locked-in customers positively affects the base of locked-in customers of both distributors, but to a greater extent that of the larger distributor. As a result,  $\tau_1^d$  falls in  $\alpha$  if  $\alpha < \underline{\alpha}$ : an exclusive affiliation with the smaller distributor is less likely to maximize expected industry profits as  $\alpha$  rises.

We now discuss how greater asymmetry in market shares affects expected industry profits according to the type of content distribution. More unevenly-distributed market shares generate two conflicting effects. On the one hand, greater asymmetry in market shares broadens the base of the larger distributor's locked-in customers at the expense of the smaller distributor. The distributor with the larger customer base can more easily insure a broad content diffusion with more unevenly-distributed market shares. Thus, other things being equal, it would reduce the need to resort to multi-homing to guarantee broad content diffusion and make exclusivity with

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of locked-in customers. These numerical examples illustrate that the loss of content exposure that comes with an exclusive affiliation with the smaller rather than the larger distributor is lower when content is of low-quality.

<sup>20</sup>Indeed, when  $\tau < \hat{\tau}$ ,  $F_l^l$  and  $F_s^l$  decrease with  $\tau$ , while  $F_s^s$  is independent of  $\tau$  and  $F_l^s$  rises with  $\tau$ .

the smaller distributor less valuable. On the other hand, greater asymmetry in market shares strengthens competition when the larger distributor has exclusive high-quality content (higher than  $\hat{\tau}$ ), and undermines competition otherwise. Contrary to the former effect, the latter reduces the value of an exclusive affiliation with the larger distributor.<sup>21</sup> Overall, the latter effect is likely to prevail over the former. The threshold values identified in Lemma 3 vary with the market-share asymmetry as follows: (i)  $\underline{\alpha}$  falls with  $\sigma$  and  $\bar{\alpha}$  rises with  $\sigma$ , (ii)  $\tau_1^d$  and  $\tau_2^d$  increase with  $\sigma$ , except when  $\alpha$  is close to  $\bar{\alpha}$ .<sup>22</sup> Unless  $\tau$  is very high, multi-homing is more likely to maximize expected industry profits with more unevenly-distributed market shares. Exclusivity with the smaller distributor maximizes expected industry profits within a tighter interval of  $\alpha$  when  $\sigma$  rises. Within this interval, however, there is a wider range of content-quality levels for which exclusivity with the smaller distributor maximizes expected industry profits. When there are few locked-in customers, exclusivity with the smaller distributor is therefore more likely to maximize expected industry profits with more unevenly-distributed market shares. Finally, note that  $\underline{\alpha} = \bar{\alpha} = \frac{2}{3}$  if  $\sigma = 0.5$ : in case the market split is symmetric, multi-homing maximizes expected industry profits if there are two thirds or more locked-in customers, otherwise exclusivity maximizes expected industry profits.

We define  $\tau^d$  such that  $\tau^d = \tau_1^d$  if  $\alpha \in (0, \underline{\alpha})$  and  $\tau^d = \tau_2^d$  if  $\alpha \in [\underline{\alpha}, \bar{\alpha})$ . As we know from Lemma 2, the upstream provider chooses the content-distribution strategy that maximizes expected industry profits. Hence, we can state the following:

**Proposition 3** *There exist values  $0 < \underline{\alpha} \leq \bar{\alpha} < 1$  and  $\tau^d$  such that if:*

- $\alpha \in (0, \bar{\alpha})$  and  $\tau > \tau^d$ ,  $C$  will affiliate exclusively with the larger distributor in equilibrium;
- $\alpha \in (0, \underline{\alpha})$  and  $\tau \leq \tau^d$ ,  $C$  will affiliate exclusively with the smaller distributor in equilibrium;
- $\alpha \in [\underline{\alpha}, \bar{\alpha})$  and  $\tau \leq \tau^d$  or  $\alpha \geq \bar{\alpha}$ ,  $C$  will multi-home in equilibrium.

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<sup>21</sup>When content is of low-quality, exclusivity with the larger distributor never maximizes expected industry profits. The case where the larger distributor has exclusive low-quality content (lower than  $\hat{\tau}$ ) is therefore of no importance.

<sup>22</sup>Since  $\bar{\alpha}$  rises with  $\sigma$  and  $\tau_2^d$  tends to infinity as  $\alpha$  approaches  $\bar{\alpha}$ , there exists  $\alpha^*$  such that  $d\tau_2^d/d\alpha < 0$  if  $\alpha \in (\alpha^*, \bar{\alpha})$ .



Proposition 3 shows that a low level of content quality or of downstream competition is less conducive to exclusivity. Bagchi (2008) and De Bettignies et al. (2018) point to a similar link between competition and licensing strategies. In Bagchi (2008), exclusivity reduces overall consumer demand and is less likely to occur when products are more differentiated in the downstream market. In De Bettignies et al. (2018), the business stealing effect from which an exclusive licensee benefits is undermined by the degree of horizontal product differentiation. A higher degree of horizontal differentiation therefore decreases the appeal of exclusivity relative to non-exclusivity. Weeds (2016) studies the trade-off a vertically-integrated distributor faces between supplying its retail rival and increasing its subscriber base. Exclusivity allows the integrated distributor to increase its current market share, but leads to a loss of wholesale revenue. Poor content quality and more differentiated distributors make consumers harder to attract, and therefore dissuade the integrated distributor from choosing exclusivity in the initial phase of market development.

When there are few locked-in customers, Proposition 3 shows that the content provider opts for an exclusive distribution. It sells high-quality content to the larger distributor and low-quality content to the smaller distributor. This result contrasts with Armstrong (1999), D'Annunzio (2017) and Jiang et al. (2019), which find that the content provider never affiliates exclusively with the distributor who has an ex-ante competitive disadvantage.

To illustrate our results, we propose a numerical example for four different levels of the initial market split,  $\sigma \in \{0.55, 0.70, 0.85, 0.99\}$  and  $v = 1$ . Figure 1 depicts the equilibrium outcome in Stage I as a function of the mass of locked-in customers  $\alpha$  (on the horizontal axis) and the level of content quality  $\tau$  (on the vertical axis). The dashed line represents  $\bar{\alpha}$ .  $L$ ,  $S$  and  $M$  correspond to exclusivity with the larger distributor, exclusivity with the smaller distributor and multi-homing, respectively.

Figure 1: The equilibrium outcome in Stage I

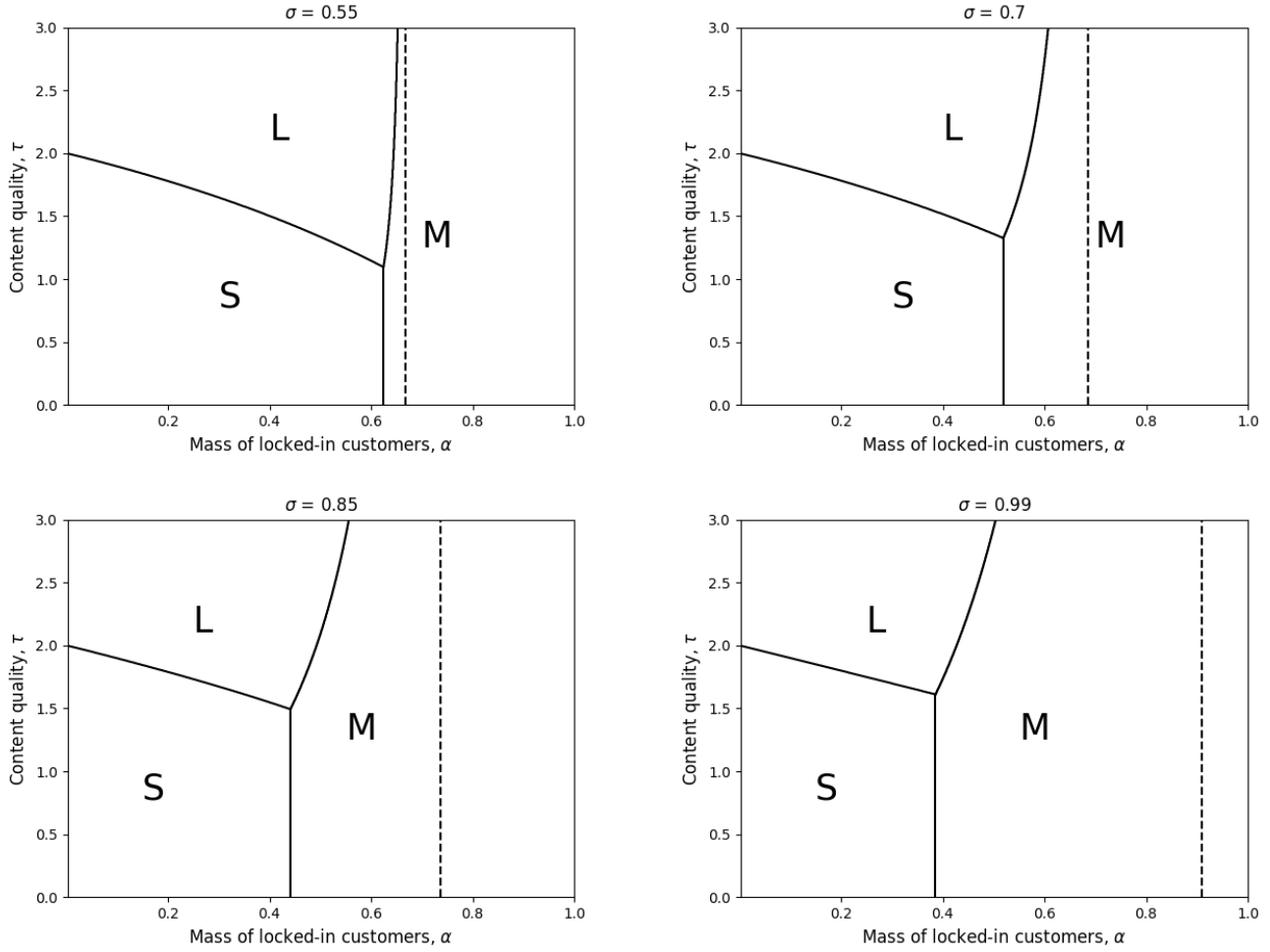


Figure 1 clearly illustrates the results presented in Proposition 3. In addition, we see that greater asymmetry in market shares promotes multi-homing rather than exclusivity.<sup>23</sup> When there are few locked-in customers, greater asymmetry in market shares slightly encourages exclusivity with the smaller rather than the larger distributor.

Our results are consistent with many of the contractual agreements in digital markets. For instance, broadband providers offer internet access with a bundle of television channels and services. “Basic” channels are mostly made available via non-exclusive agreements, and are therefore proposed by all broadband providers. However, some of the latter also acquire exclusive content, mainly premium channels, popular movies or major sports events. While switching from one

<sup>23</sup>In the exceptional case where  $\tau$  is very high, a rise in  $\sigma$  promotes exclusivity over multi-homing.

broadband provider to another can be a laborious and costly process, subscription and cancellation are usually easier for over-the-top streaming platforms, almost via a single click and with no termination fee.<sup>24</sup> These streaming platforms offer catalogs of films and TV-series that are mainly exclusive content.<sup>25</sup> This is in line with our results that multi-homing is less likely in markets with low switching costs, and that when customers face high switching costs mostly high-quality content is sold on an exclusive basis. Finally, a number of examples confirm that the dominant players do not monopolize all the content items. For instance, *beIN Sports USA* (a global network of sports channels), which was launched in 2012 in the United States, acquired the exclusive rights to broadcast sport events such as Soccer, Women’s Tennis and Motorsports road racing (which are secondary sports in the United States). This strategy of exclusive content acquisition has allowed *beIN Sports USA* to progressively catch up with its competitors. In mobile telecommunications markets, providers often offer exclusive content delivered through carrier-specific Apps. Leading mobile internet service providers secure most of the exclusive high-quality content rights, they however do not monopolize all of the content.<sup>26</sup>

### 4.3 The value of a large customer base

Let  $\Pi_i^c$  be the equilibrium expected total profit of distributor  $i \in \{l, s\}$ , where  $c \in \{m, l, s\}$  is the content-distribution strategy.  $\Pi_i^c$  is composed of the payments collected from consumers in Stage II and (potentially) the lump-sum fee paid in Stage I to have access to the content. We define

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<sup>24</sup>Switching from one broadband provider to another can be costly due to minimum contract periods or the payment of a cancellation fee, contacting a customer-service representative, and having to return the internet box. Streaming platforms do not lock customers into long-term contracts, but employ other strategies to retain customers, by for example constantly refining their algorithms to offer a list of recommendations specifically tailored to each user. Keeping users watching prevents them from switching.

<sup>25</sup>The data from *Reelgood* provides good descriptive evidence. *Reelgood* gives information on the catalog of movies and TV-series available on the main streaming platforms. In addition, *Reelgood* ranks films and TV-series, using a score that takes into account audience, critical reviews, recent popularity and other quality criteria such as the actors’ reputation. Among the top 1000 films listed by *Reelgood* and that are available on *Amazon Prime Video*, *Disney+*, *HBOmax*, *Hulu* or *Netflix*, more than 90% of them are available on only one of these platforms in the United States. Similarly, among the top 500 TV-series listed by *Reelgood* and that are available on these streaming platforms, more than 85% of them are available on only one of these platforms. We collected the data from *reelgood.com* in May, 2020.

<sup>26</sup>For instance, in 2019, *Verizon* holds exclusive deals with major U.S. Sports Leagues (e.g. the *NFL* and the *NBA*), while *T-mobile*, the third-largest wireless carrier in the United States (with a customer base only half that of *Verizon* or *AT&T*), has signed a content-distribution deal with *Viacom Media Networks*.

the value of having a large customer base as  $\Delta^c = \Pi_l^c - \Pi_s^c$ . Distributors are better off with the largest customer base if  $\Delta^c \geq 0$ . Since the content provider can threaten distributors to award the content rights to their rival if they reject the offer submitted to them, distributors are left with their individual *excluded* Stage-II profit regardless of the content-distribution outcome. It follows that  $\Pi_i^c = \pi_i^j$  for  $i \neq j \in \{l, s\}$  and  $c \in \{m, l, s\}$ . The value of a large customer base is therefore equal to the Stage II profit of a *large excluded* distributor minus the Stage II profit of a *small excluded* distributor,  $\Delta^c = \pi_l^s - \pi_s^l \equiv \Delta$ . We can decompose the value of a large customer base as follows:

$$\Delta = \Delta^0 + \bar{\Sigma} \quad (4)$$

with  $\Delta^0 = \frac{vK_l(K_l - K_s)}{1 - K_s}$ ,  $\bar{\Sigma} = (1 - K_l)\tau$  if  $\tau < \hat{\tau}$  and  $\bar{\Sigma} = \frac{(1 - K_l - K_s)(K_l - K_s)v}{1 - K_s}$  if  $\tau \geq \hat{\tau}$ . The first term in (4) is the value of a large customer base if there were no content provider. Since  $\Delta^0 \geq 0$ , distributors would be better off with the largest customer base if there were no content provider. The second term in (4) expresses the way competition for content access alters the value of a large customer base.  $\bar{\Sigma} \geq 0$  and therefore the presence of a content provider, which has all the bargaining power, further deteriorates a distributor's situation if it has a small customer base. With a larger customer base, a distributor can guarantee itself a higher minimum profit and thus limit the harmful effects of competition against a rival of higher quality. The value of a large customer base is therefore greater than if there were no content provider. More specifically,  $\Delta$  increases with  $\tau$  up to  $v(K_l - K_s)$  and then stays constant at this level.<sup>27</sup>

## 5 Locked-in customers and welfare

Switching costs, which are often perceived as producing less-intense competition and being detrimental to consumers, have raised strong regulatory concerns. For instance, in November 2009 the European Commission adopted a directive that (among other things) facilitated the change

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<sup>27</sup>Once content quality is above  $\hat{\tau}$ ,  $\pi_i^j = vK_i$  with  $i \neq j \in \{l, s\}$ . In this case,  $\pi_i^j$  corresponds to the profit the *excluded* distributor can guarantee itself by charging the monopoly price and is independent of  $\tau$ . Thus  $\Delta = v(K_l - K_s)$  if  $\tau \geq \hat{\tau}$ .

of provider.<sup>28</sup> More recently, the former Federal Communications Commission Chairman Tom Wheeler conceded that “once consumers choose a broadband provider, they face high switching costs” and as a result “even though there may be competition, the market place may not be offering consumers competitive opportunities to change providers”.<sup>29</sup> In the following, we discuss the effect of a fall in the mass of locked-in customers on consumer and total welfare.

**Locked-in customers and consumer welfare.** In our model, captive customers who are locked-in with the larger or smaller distributor obtain net utility of  $w_l^c$  and  $w_s^c$  respectively. Price-sensitive customers buy from the distributor offering higher net utility, and obtain a net utility of  $w_h^c = \max\{w_l^c, w_s^c\}$ . Consumer welfare is  $CW^c = K_l \int_0^{\bar{w}^c} w dF_l^c(w) + K_s \int_0^{\bar{w}^c} w dF_s^c(w) + (1 - K_l - K_s) \int_0^{\bar{w}^c} w dJ^c(w)$ , where  $J^c = F_l^c \times F_s^c$  is the cumulative distribution function of  $w_h^c$  and  $c \in \{m, l, s\}$ . As long as the content provider’s distribution choice remains unchanged, consumer welfare falls with the proportion of locked-in customers. Exclusivity is however more likely to come about when there is only a small proportion of locked-in customers. This produces a dilemma for competition authorities between reducing switching costs so as to stimulate price competition, and a less-restrictive switching-costs policy to encourage multi-homing. By promoting exclusive distribution, lower switching costs may reduce consumer welfare.

To illustrate this dilemma, we propose a numerical example in which we compare consumer welfare with a low and high percentage of locked-in customers. More specifically, we study the consumer-welfare effect of a fall in  $\alpha$  (from 0.6 to 0.4), which we will henceforth refer to as “lower  $\alpha$ ”. For the sake of clarity and ease of comprehension, we first depict in Figure 2 the equilibrium outcome in Stage I as a function of market-share asymmetry (on the horizontal axis) and the level of content quality (on the vertical axis) for  $\alpha \in \{0.4, 0.6\}$  and  $v = 1$ :  $L$ ,  $S$  and  $M$  correspond to exclusivity with the larger distributor, exclusivity with the smaller distributor and multi-homing, respectively. Then, Figure 3 shows the consumer-welfare effect of a fall in  $\alpha$ , as a function of market-share asymmetry (on the horizontal axis) and the level of content quality (on the vertical

<sup>28</sup>See Directive 2009/136/EC, Article 30.

<sup>29</sup>See [https://apps.fcc.gov/edocs\\_public/attachmatch/DOC-329161A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/DOC-329161A1.pdf) for the full formal speech from September 2014.

axis), with  $v = 1$ .

Figure 2: The equilibrium outcome in Stage I for  $\alpha = 0.4$  and  $\alpha = 0.6$

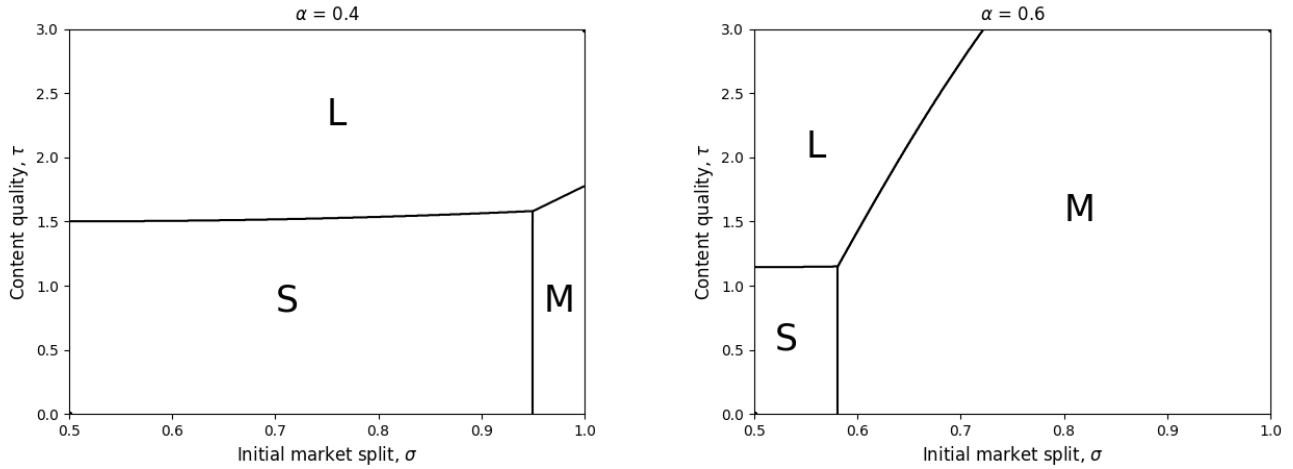
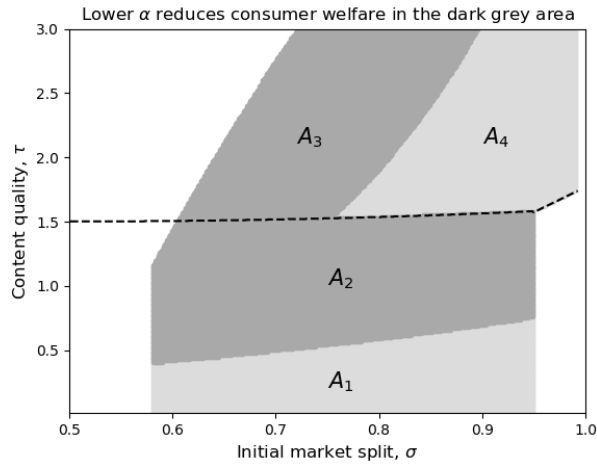


Figure 3: Comparison of consumer welfare for  $\alpha = 0.4$  and  $\alpha = 0.6$ .



There are three areas in Figure 3. In the white area, lower  $\alpha$  strengthens competition without affecting the content-provider choice to be exclusive or non-exclusive, and so is consumer-welfare enhancing. In the dark- and light-grey areas, lower  $\alpha$  encourages the content provider to choose exclusive rather than non-exclusive distribution. Lower  $\alpha$  increases consumer welfare in the light-grey area, but reduces it in the dark-grey area. When  $\alpha = 0.4$  and the market split is not too asymmetric, the content provider is exclusive to the smaller distributor if  $\tau$  is below  $\tau_1^{d,0.4}$  (which

is represented by the dashed line), and otherwise to the larger distributor.

In the following discussion, we focus on the scenario in which lower  $\alpha$  induces the content provider to switch from multi-homing to exclusivity. Lower  $\alpha$  reduces the distributors' market power over locked-in customers, but promotes vertical differentiation (through exclusivity). Whether lower  $\alpha$  reduces or increases consumer welfare depends on content quality, and also on the initial market split. When exclusivity produces little vertical differentiation among distributors, the intensity of price competition is mostly affected by  $\alpha$ : lower  $\alpha$  increases consumer welfare when content quality is low (this corresponds to  $A_1$  in Figure 3). For mid-quality content, the benefits of lower  $\alpha$  for consumers are more than offset by the higher rent-extraction power of distributors induced by exclusivity, and hence lower  $\alpha$  reduces consumer welfare (see  $A_2$  in Figure 3). Once content quality is above  $\tau_1^{d,0.4}$ , lower  $\alpha$  leads to exclusive affiliation with the larger distributor. Although the transition from multi-homing to exclusivity generates high vertical differentiation among distributors, lower  $\alpha$  may benefit consumers (see  $A_3$  and  $A_4$  in Figure 3). In particular, lower  $\alpha$  enhances consumer welfare if the initial market split is sufficiently asymmetric. This is because greater asymmetry in market shares strengthens competition and thus limits the rent-extraction power of distributors when the content provider is exclusive to the larger distributor.

**Locked-in customers and total welfare.** We now turn to the analysis of total welfare, which is much simpler. Total welfare, defined as the sum of consumer surplus and industry profits, is  $TW^c = CS^c + \pi_l^c + \pi_s^c$ . Since the market is fully covered and switching does not induce any costs (either customers are fully locked-in or can switch at no cost), total welfare only depends on the average value of the services offered by both distributors. Total welfare is therefore maximized when the mass of locked-in customers is sufficiently high to bring about multi-homing.

To summarize, a decrease in  $\alpha$  improves consumer welfare without changing total welfare when the content provider does not switch from multi-homing to exclusivity. However, when it induces the content provider to switch from multi-homing to exclusivity, a decrease in  $\alpha$  deteriorates total welfare, and can either benefit or harm consumers. In this latter case, a fall in switching costs is

less likely to be consumer-welfare enhancing with high-quality content.

## 6 Extensions and robustness checks

We now relax some of the assumptions and consider a number of extensions of the baseline model. We below summarize the main results displayed in the Online Supplementary Material.

### 6.1 Price discrimination

The baseline model assumes that distributors adopt non-discriminatory pricing strategies. In this section, distributors can price discriminate between their loyal customers and the others (see Section I of the Online Supplementary Material for the proof). The trade-off between setting a high price to extract surplus from locked-in customers and a discounted price to win price-sensitive customers disappears when distributors can price discriminate. Indeed, distributors compete *à la Bertrand* in the segment of the market of price-sensitive customers and extract the full amount of surplus from their locked-in customers. As a result, the intensity of competition does not depend anymore on the initial market split. It follows that the content provider can no longer soften competition in the downstream market by affiliating exclusively with the smaller rather than the larger distributor. Since an exclusive affiliation with the larger distributor guarantees that a larger number of consumers have access to the content, the upstream provider never affiliates exclusively with the smaller distributor. Finally, price discrimination hurts industry profitability more strongly when the content provider multi-homes and makes multi-homing less likely.

### 6.2 Alternative contracting games

In the baseline model, the content provider has all the bargaining power and makes take-it-or-leave-it offers to the distributors. In addition, the contract specifies whether the agreement is exclusive or not. We here study two alternative contracting games.



### 6.2.1 Bidding game

In this section, we consider a “bidding game” similar to that used in Hagiu and Lee (2011) (see Section II of the Online Supplementary Material for the proof). Distributors compete for content access by offering menus of prices contingent on whether content rights are sold on an exclusive or non-exclusive basis. Since each of them can unilaterally rule out multi-homing, distributors face a coordination problem; both exclusive and non-exclusive equilibria exist when multi-homing maximizes expected industry profits. We select among the multiple equilibria via the Pareto-undominated solution (for the distributors) and show that the allocation of content across distributors is similar to that of the baseline model. However, the lump-sum transfers, and hence the benefit from being the *dominant* distributor, are different. We show that the value of a large customer base is equal to the Stage II expected profit of a *large exclusive* distributor minus the Stage II expected profit of a *small exclusive* distributor. Since an *exclusive* distributor faces more intense competition when it has a larger customer base, the larger distributor may value the exclusivity less. Competition over content access can therefore reduce the value of having a large customer base. This negative effect can be strong enough for the largest customer-base distributor to be worse off. Specifically, we show that distributors are better off with the smallest customer base when the captive-customer base of the larger distributor is not too large and the content is of low-quality. Klemperer (1987) and Schmidt (2010) have already pointed out several reasons to explain why firms can be made worse off having a larger customer base.<sup>30</sup> Our result stems purely from the type of competition over content rights. Indeed, a larger customer base is always beneficial when the content provider makes the initial offers to the distributors. However, the reverse can be true when it is the distributors who initiate contract offers.

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<sup>30</sup>Klemperer (1987) shows that it can be profitable for an incumbent to reduce the size of its customer base in order to deter entry. Schmidt (2010) underlines that, as a firm’s customer base grows, its rival competes more fiercely in order to attract new customers. As prices are strategic complements, the intensity of competition rises when the ex-ante market split is more skewed. A firm may therefore have less interest in building up its customer base, as a way of moderating its rival’s pricing behavior.

### 6.2.2 Discriminatory fixed-fee policy

In this section, content rights are sold using a discriminatory fixed-fee policy (see Section III of the Online Supplementary Material for the proof). The content provider announces two fees  $(T_l, T_s)$ , which do not specify whether the agreement is exclusive or not. Distributor  $i$  obtains the content rights if it is willing to pay the fee  $T_i$ , with  $i \in \{l, s\}$ . When it unilaterally deviates from a non-exclusive equilibrium, a distributor will be left with its individual *excluded* Stage-II profit. In that case, the cost of rejecting an offer is similar to that in the baseline model. By contrast, any exclusive equilibrium must be such that only one of the distributors accepts the offer. Given that distributor  $j$  rejects the offer  $T_j$ , distributor  $i$  will make a profit  $\pi_i^0$  and no content will then be distributed if it also rejects the offer. Since  $\pi_l^0 = \pi_l^s$  and  $\pi_s^0 \geq \pi_s^l$ , this selling format reduces the bargaining power of the content provider only when it wants to affiliate exclusively with the smaller distributor. Indeed, the cost of a deviation from an exclusive equilibrium for the smaller distributor is now lower. Compared to the baseline model, the smaller distributor is therefore less likely to obtain exclusive rights to content.

## 6.3 Advertising revenues

In the baseline model, neither the content provider nor distributors collect advertising revenue from end users. Advertising is, however, an important source of revenue for entertainment and media-content providers. For instance, sports organizations earn revenues from advertisements placed directly in arenas or through mobile App advertising. Movie studios and channel networks have prolifically used product placements to target consumers. In addition, even with considerable heterogeneity across pay-TV networks, most distributors earn a combination of affiliation and advertising revenues. We here study two extensions, allowing for either the content provider or the distributors to earn revenue from advertising.<sup>31</sup> To simplify the analysis, the per-user advertising revenue is assumed to be constant.

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<sup>31</sup>Bagwell (2007) provides a survey on the economics of advertising.

### **6.3.1 Advertising revenue collected by the content provider**

In this section, the content provider receives advertising revenue depending on exposure to end users (see Section IV of the Online Supplementary Material for the proof). Its advertising revenue increases (linearly) with the number of customers with access to the content. When choosing its content-distribution strategy, the upstream provider must now take account of the relative loss in terms of market exposure to some end users. Higher per-user advertising revenue raises the value of reaching the entire market, and therefore promotes multi-homing. Since content exposure is greater if the upstream provider is exclusive to the larger rather than the smaller distributor, higher per-user advertising revenue fosters exclusive affiliation with the larger rather than the smaller distributor.

### **6.3.2 Advertising revenue collected by the distributors**

In this section, distributors finance themselves through subscription fees and advertising (see Section V of the Online Supplementary Material for the proof). Since the market is fully covered, aggregate advertising revenues are independent of the form of distribution. However, distributors have more incentive to compete for price-sensitive customers as the per-user advertising revenue increases. We show that this competition-enhancing effect is stronger when the larger distributor has exclusivity. It follows that expected industry profits increase with the per-user advertising revenue, but to a lower extent when the content provider is exclusive to the larger distributor. Greater per-user advertising revenue therefore makes exclusivity with the larger distributor less likely.

## **6.4 Vertical Integration**

The baseline model studies the incentives for an independent content provider to deal exclusively or non-exclusively with distributors. In this section, a vertically-integrated distributor chooses whether to supply its content to its downstream rival (see Section VI of the Online Supplementary Material for the proof). The vertically-integrated distributor can deny access to its content, sell its

content non-exclusively (i.e., retaining the rights for itself as well) or give up its content rights. In the latter case, its rival becomes the *exclusive* distributor. The industry structure that emerges is still that which maximizes expected industry profits. The allocation of content across distributors is therefore unaffected by the vertical structure of the industry.

## 6.5 Alternative consumer demand specifications

We here consider alternative demand specifications, assuming that distributors are symmetric with respect to their initial market share.

### 6.5.1 Multi-homing consumers

In the baseline model, consumers purchase from exactly one of the two distributors. Consumers, however, frequently buy multiple competing services or products. In this section, consumers can purchase from both distributors (see Section VII of the Online Supplementary Material for the proof). Under non-exclusive distribution, joint consumption does not provide any incremental surplus and expected industry profits are unchanged compared to the baseline model. By contrast, an *exclusive* distributor can now induce consumers that are locked-in with its rival to purchase its service. It can then serve the entire demand by offering a sufficiently high net utility. Indeed, the locked-in customers of the *excluded* distributor multi-home if the *exclusive* distributor offers a net utility of  $v$  (or more). In this case, there is no opportunity for its rival to attract price-sensitive customers, which in turn competes less fiercely. Compared to the baseline model, the *excluded* distributor offers more frequently low net utility, while the demand served by the *exclusive* distributor is likely to be greater. Exclusivity can therefore yield higher expected industry profits when consumer multi-purchase. In line with Jiang et al. (2019), consumer multi-purchase promotes exclusivity.

### 6.5.2 Small switching costs

In the baseline model, consumers are either fully locked-in or free to switch supplier at no cost. In this section, we consider an alternative approach in which some consumers may pay to switch in equilibrium (see Section VIII of the Online Supplementary Material for the proof). Distributors still offer homogeneous products but the switching costs are now continuously distributed over a range including zero. Consistent with the baseline model, increased competition in the downstream market – measured as a lower average switching cost – promotes exclusivity.

## 6.6 Heterogeneity in the value of “regular” content

In the baseline model, excluding content, distributors offer services of similar quality. In this section, we consider distributors with different values of “regular” content (see Section IX of the Online Supplementary Material for the proof). A rise in  $v_i$  has a greater effect on expected industry profits when distributor  $i$  can monetize this quality improvement over more customers. Since exclusive content access strengthens the distributor’s ability to reach more customers, distributor  $i$  can more easily monetize this quality improvement if it has exclusivity. It follows that a rise in  $v_i$  positively affects expected industry profits to a greater extent when distributor  $i$  has exclusivity, and thus promotes exclusivity with distributor  $i$ .

## 6.7 Independent captive-customer bases

In the baseline model, a distributor increases its base of locked-in customers either if its initial market share or if the mass of locked-in customers rises. In both cases, the base of locked-in customers of its rival is also altered. In other words,  $K_l$  and  $K_s$  are interdependent. However, in reality, a distributor could increase its base of locked-in customers without affecting that of its rival. In this section, we characterize the equilibrium outcome in Stage I as a function of  $K_l$  and  $K_s$ , assuming that the bases of locked-in customers are not interdependent (see Section X of the Online Supplementary Material for the proof). This extension can encompass two different

scenarios.

- *Heterogeneity in lock-in efficiency.* Distributors can differ in their efficiency in retaining customers (i.e.,  $\alpha_i \neq \alpha_j$ ). Greater efficiency in retaining customers allows a distributor to broaden its own base of locked-in customers without affecting that of its rival.
- *New uncommitted consumers.* There is a unit mass of consumers, but with an inflow of new uncommitted consumers,  $\mu$ , such that  $\mu = 1 - (\sigma_i + \sigma_j)$  and  $\sigma_i + \sigma_j \leq 1$ . An increase in the initial market share of one of the distributors no longer necessarily reduces the base of locked-in customers of its rival.

The main findings of the baseline model are qualitatively unchanged. The comparative statics analysis is, however, slightly different. In the baseline model, greater asymmetry in market shares strengthens competition when the larger distributor has exclusive high-quality content, which in turn encourages exclusivity with the smaller rather than the larger distributor. Here, an increase in the base of locked-in customers of one distributor reduces the number of price-sensitive customers, without affecting the base of locked-in customers of its rival. When the base of locked-in customers of the larger distributor rises, the smaller distributor has therefore less incentive to compete for price-sensitive customers. In this case, the larger distributor can more easily supply the content on a larger scale, without facing stiffer competition. As a result, when there are few locked-in customers, the larger distributor is more likely to obtain exclusive rights to content if its base of locked-in customers rises.

## 6.8 Initial Period - competition for market share.

In this section, we study an emerging-market phase in which there is no content provider and distributors are symmetric (see Section XI of the Online Supplementary Material for the proof). Distributors anticipate the future entry of a content provider and its content-distribution strategy. In equilibrium, first-period prices decrease with the value of having a large customer base in the mature market phase. When distributors benefit from being the *dominant* player in the mature

market, prices and profits in the initial phase of market development are expected to be lower than they would be in a market without switching costs. The reverse holds when competition for content exclusivity in the mature market makes the value of a large customer base negative.

## 7 Conclusion

This paper has analyzed content-distribution strategies in the presence of locked-in customers in the downstream market. An upstream provider sells the rights for its content using lump-sum fees and either affiliates with one distributor exclusively or multi-homes. We have shown that the content provider multi-homes if there is a sufficiently-high proportion of locked-in customers. For intermediate values of the percentage of locked-in customers, the content provider multi-homes if content quality is not too high and otherwise affiliates exclusively with the larger distributor. When few customers are locked-in, the content provider sells its rights on an exclusive basis. Because competition among distributors is fiercer when the content provider affiliates exclusively with the larger rather than the smaller distributor, exclusivity to the smaller distributor may arise in equilibrium. More specifically, the content provider affiliates exclusively with the smaller distributor if the mass of locked-in customers and content quality are not too high. Finally, we have also shown that the value of a large customer base is positive and greater than if there were no content provider.

From a policy perspective, our results bear two policy implications. They first suggest that lower switching costs will not necessarily be consumer-welfare enhancing. Indeed, lowering switching costs may harm consumers by inducing the content provider to switch from non-exclusive to exclusive distribution. Second, they underline that a *dominant* player will not necessarily monopolize all the content items.

The finding that a greater number of locked-in customers promotes multi-homing is robust to a number of changes in our baseline model, but other results crucially rely on specific assumptions. In particular, in the baseline model, distributors adopt uniform pricing and the content provider makes

the offers to the distributors in the contracting stage. When distributors can price-discriminate between their loyal customers and the others, exclusivity with the smaller distributor never occurs. In addition, distributors can be worse off with the largest customer base if they are bidding and competing for content access in the contracting stage.

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# Appendix

## A Proposition 1

Let  $F_{s-l}^c(w) = F_s^c(w) - F_l^c(w)$ , with  $c \in \{m, l, s\}$ .

**Item (i).**  $F_l^m(0) > 0$  if  $\sigma \neq 0.5$  and  $F_l^m(0) = 0$  if  $\sigma = 0.5$ . Hence, the larger distributor has a mass point at 0 if  $\sigma \neq 0.5$ .  $F_{s-l}^m(w) = -\frac{(K_l-K_s)((v+\tau)(1-K_l-K_s)-w(1-K_s))}{(1-K_l-K_s)(v+\tau-w)(1-K_s)} \equiv F_1$  if  $w \in (0, \bar{w}^m]$ . Since  $w \leq \frac{(1-K_l-K_s)(v+\tau)}{1-K_s} \equiv \bar{w}^m < v + \tau$ ,  $F_1$  is negative. It follows that  $F_s^m(w) \leq F_l^m(w)$ .

**Item (ii).**  $F_l^s(0) > 0$  if  $\sigma \neq 0.5$  or  $\tau \neq 0$  and  $F_l^s(0) = 0$  otherwise. Hence, the larger distributor has a mass point at 0 if  $\sigma \neq 0.5$  or  $\tau \neq 0$ . Assume that  $w \in (0, \bar{w}^s]$ :  $\frac{dF_{s-l}^s(w)}{d\tau} = -\frac{(1-K_l)((1-K_l-K_s)v-(1-K_s)w)}{(1-K_l-K_s)(1-K_s)(v+\tau-w)^2}$  and  $F_{s-l}^{s,\tau=0}(w) = -\frac{(K_l-K_s)((1-K_l-K_s)v-(1-K_s)w)}{(1-K_l-K_s)(v-w)(1-K_s)}$ . Since  $w \leq \bar{w}^s < v$ ,  $\frac{dF_{s-l}^s(w)}{d\tau}$  and  $F_{s-l}^{s,\tau=0}$  are negative. It follows that  $F_s^s(w) \leq F_l^s(w)$ .

**Item (iii).** Assume that  $\tau \geq \hat{\tau}$ .  $F_s^l(0) > 0$  if  $\tau > \hat{\tau}$  and  $F_s^l(0) = 0$  if  $\tau = \hat{\tau}$ . Hence, the smaller distributor has a mass point at 0 if  $\tau > \hat{\tau}$ . Assume that  $w \in (0, \bar{w}^l]$ :  $F_{s-l}^l(w) = \frac{\chi_N(\tau)}{\chi_D(\tau)}$  with  $\chi_N(\tau) = \tau(1-K_l)(v(1-K_l-K_s)-w(1-K_l)) - (K_l-K_s)(v-w)(v(1-K_l-K_s)-w(1-K_l))$  and  $\chi_D(\tau) = (1-K_l-K_s)(1-K_l)(v-w)(v+\tau-w)$ . Since  $w \leq \bar{w}^l < v$ ,  $\chi_D$  is positive and  $\chi_N$  increases in  $\tau$ .  $\chi_N(\hat{\tau}) > 0$  is a sufficient condition to guarantee that  $F_{s-l}^l$  is positive. We can show that  $\chi_N(\hat{\tau}) = w(K_l-K_s)(v(1-K_l-K_s)-w(1-K_l)) \geq 0$  when  $w \leq \bar{w}^l$ . It follows that  $F_l^l(w) \leq F_s^l(w)$  if  $\tau \geq \hat{\tau}$ .

**Item (iv).**  $F_l^l(0) > 0$  and the larger distributor has a mass point at 0 if  $\tau < \hat{\tau}$ .

This completes the proof of Proposition 1.

## B Proposition 2

**Item (i).**

- $dF_l^m/d\tau = -\frac{w}{(v+\tau-w)^2} \left[ \frac{K_s}{1-K_l-K_s} + \frac{K_l-K_s}{1-K_s} \right] < 0$  and  $dF_s^m/d\tau = \frac{-wK_l}{(1-K_l-K_s)(v+\tau-w)^2} < 0$ .

- Assume that  $\tau \geq \hat{\tau}$ .  $dF_s^l/d\tau = \frac{(1-K_s)((1-K_l-K_s)v-(1-K_l)w)}{(v+\tau-w)^2(1-K_l-K_s)(1-K_l)}$ . Since  $w \leq \bar{w}^l = \frac{(1-K_l-K_s)v}{1-K_l}$ ,  $dF_s^l/d\tau \geq 0$ .  $F_l^l = wK_s/(1-K_l-K_s)(v-w)$  is independent of  $\tau$ .
- Assume that  $\tau < \hat{\tau}$ .  $dF_l^l/d\tau = \frac{-(1-K_l)}{(1-K_s)(v-w)} < 0$  and  $dF_s^l/d\tau = \frac{-wK_l}{(1-K_l-K_s)(v+\tau-w)^2} < 0$ .
- $dF_l^s/d\tau = \frac{(1-K_l)((1-K_l-K_s)v-(1-K_s)w)}{(v+\tau-w)^2(1-K_l-K_s)(1-K_s)}$ . Since  $w \leq \bar{w}^s = \frac{(1-K_l-K_s)v}{1-K_s}$ ,  $dF_l^s/d\tau \geq 0$ .  $F_s^s = wK_l/(1-K_l-K_s)(v-w)$  is independent of  $\tau$ .

**Item (ii).** Assume that  $c \in \{m, s\}$  or that  $c = l$  and  $\tau < \hat{\tau}$ .  $dF_l^c/d\sigma = \frac{1-K_l-K_s}{u_s^c-w} \left[ \frac{u_l^c(2-K_l-K_s)}{(1-K_s)^2} - \frac{w}{1-K_l-K_s} \right]$ .  $dF_l^c/d\sigma > 0$  if  $w < \frac{u_l^c(1-K_l-K_s)(2-K_l-K_s)}{(1-K_s)^2} = w_1$ . Since  $w \leq \bar{w}^c < w_1$ ,  $dF_l^c/d\sigma$  is positive.  $dF_s^c/d\sigma = \frac{w(K_l+K_s)}{(1-K_l-K_s)(u_l^c-w)} > 0$ .

Assume that  $c = l$  and  $\tau \geq \hat{\tau}$ .  $dF_s^c/d\sigma = \frac{K_l+K_s}{u_l^c-w} \left[ \frac{w}{1-K_l-K_s} - \frac{u_s^c(2-K_l-K_s)}{(1-K_l)^2} \right]$ .  $dF_s^c/d\sigma < 0$  if  $w < \frac{u_s^c(1-K_l-K_s)(2-K_l-K_s)}{(1-K_l)^2} = w_2$ . Since  $w \leq \bar{w}^c < w_2$ ,  $dF_s^c/d\sigma$  is negative.  $dF_l^c/d\sigma = -\frac{w(K_l+K_s)}{(1-K_l-K_s)(u_s^c-w)} < 0$ .

This completes the proof of Proposition 2.

## C Competition for price-sensitive customers under exclusivity

Price-sensitive customers buy from the distributor offering the higher net utility and so obtain a net utility  $w_h^c = \max\{w_l^c, w_s^c\}$ . Let  $J^c(w)$  be the cumulative distribution of  $w_h^c$  given that the distribution of content is  $c \in \{m, l, s\}$ :  $J^c(w) = F_l^c(w) \times F_s^c(w)$ . A higher  $J$  means that price-sensitive customers receive a high net utility with a higher probability. Let  $M(w) = J^s(w) - J^l(w)$ . In order to prove that price-sensitive customers enjoy higher net utility if the content provider affiliates exclusively with the larger rather than the smaller distributor, we show that  $M(w) \geq 0$  for any  $w$ . Since  $\bar{w}^s \leq \bar{w}^l$ , it is straightforward that  $M(w) = 0$  if  $w > \bar{w}^l$ . If  $w \in (\bar{w}^s, \bar{w}^l]$ ,  $J^l(w) \leq 1$  and  $J^s(w) = 1$  and thus  $M(w) \geq 0$ . Finally,

$$M(w) = \begin{cases} \frac{\sigma\tau w\alpha(2-\alpha)}{(1-\alpha)(v-w)(\tau+v-w)(1-\alpha+\sigma\alpha)} & \text{if } \tau < \hat{\tau} \\ \frac{\alpha(2\sigma-1)w(\tau(1-\alpha+\sigma(1-\sigma)\alpha^2)+v((1-\alpha)\alpha+2\sigma(1-\sigma)\alpha^2))}{(1-\alpha)(v-w)(\tau+v-w)(1-\sigma\alpha)(1-\alpha+\sigma\alpha)} & \text{if } \tau \geq \hat{\tau} \end{cases}, \quad (5)$$

if  $w \leq \bar{w}^s$ . Since  $\bar{w}^s \leq v$ , each term in (5) is positive and  $M(w) \geq 0$  if  $w \leq \bar{w}^s$ . Therefore,  $M(w) \geq 0$  for any  $w$ .

## D Relative difference in competition intensity under exclusivity

Assume that  $\tau \geq \hat{\tau}$  and let  $F_{i-j}^{s-l}(w) = F_i^s(w) - F_j^l(w)$ , with  $i \neq j \in \{l, s\}$ . Since  $\bar{w}^s \leq \bar{w}^l$ , integration by parts implies that

$$\mathbb{E}(w_j^l) - \mathbb{E}(w_i^s) = \int_0^{\bar{w}^s} F_{i-j}^{s-l}(w) dw + \int_{\bar{w}^s}^{\bar{w}^l} 1 - F_j^l(w) dw. \quad (6)$$

Since  $F_j^l(w) \leq 1$ ,  $F_{i-j}^{s-l}(w) \geq 0$  is a sufficient condition to guarantee that  $0 \leq \mathbb{E}(w_j^l) - \mathbb{E}(w_i^s)$  for  $i \neq j \in \{l, s\}$ . We first prove that  $F_{i-j}^{s-l}(w) \geq 0$  for  $i \neq j \in \{l, s\}$ .

(i)  $F_{s-l}^{s-l}(w) = \frac{(K_l - K_s)w}{(1 - K_l - K_s)(v - w)}$ , and thus  $F_{s-l}^{s-l}$  is positive.

(ii)  $F_{l-s}^{s-l}(w) = \frac{B_v \times v + B_w \times w}{(1 - K_l)(1 - K_s)(1 - K_l - K_s)(v + \tau - w)}$ , with  $B_v = (K_l - K_s)(2 - K_l - K_s)(1 - K_l - K_s) \geq 0$  and  $B_w = -(1 - K_l)(K_l - K_s)(1 - K_s) \leq 0$ .  $B_v \times v + B_w \times w$  decreases with  $w$  and  $B_v \times v + B_w \times \bar{w}^s = (K_l - K_s)(1 - K_s)(1 - K_l - K_s)v \geq 0$ . Thus,  $F_{l-s}^{s-l}(w)$  is positive.

$F_{i-j}^{s-l}(w) \geq 0$  and thus  $\mathbb{E}(w_i^s) \leq \mathbb{E}(w_j^l)$  for  $i \neq j \in \{l, s\}$ . Since  $p_i^i = v + \tau - w_i^i$  and  $p_i^j = v - w_i^j$ ,  $\mathbb{E}(p_i^s) / \mathbb{E}(p_j^l) \geq 1$  with  $i \neq j \in \{l, s\}$ . Let  $E_{i-j}^{s-l} = \mathbb{E}(p_i^s) / \mathbb{E}(p_j^l)$ . We now show that  $E_{i-j}^{s-l}$  decreases with  $\tau$  for  $i \neq j \in \{l, s\}$ .

(iii)  $E_{s-l}^{s-l} = \frac{v + \tau - \mathbb{E}(w_s^s)}{v + \tau - \mathbb{E}(w_l^l)}$ .  $\mathbb{E}(w_s^s)$  and  $\mathbb{E}(w_l^l)$  are independent of  $\tau$  and  $\mathbb{E}(w_l^l) \geq \mathbb{E}(w_s^s)$ . It follows that  $E_{s-l}^{s-l}$  decreases with  $\tau$ .

(iv)  $dE_{l-s}^{s-l} / d\tau = d(\mathbb{E}(p_l^s) / \mathbb{E}(p_s^l)) / d\tau = \left( \mathbb{E}(p_s^l) \frac{d\mathbb{E}(p_l^s)}{d\tau} - \mathbb{E}(p_l^s) \frac{d\mathbb{E}(p_s^l)}{d\tau} \right) / \mathbb{E}(p_s^l)^2$  and thus

$$\frac{dE_{l-s}^{s-l}}{d\tau} = \frac{\mathbb{E}(p_l^s) \left( \frac{d\mathbb{E}(w_s^s)}{d\tau} - \frac{d\mathbb{E}(w_l^l)}{d\tau} \right) + \frac{d\mathbb{E}(w_l^l)}{d\tau} (\mathbb{E}(p_l^s) - \mathbb{E}(p_s^l))}{\mathbb{E}(p_s^l)^2}.$$

Since  $0 < \mathbb{E}(p_s^l) \leq \mathbb{E}(p_l^s)$  and  $d\mathbb{E}(w_l^l) / d\tau \leq 0$ ,  $\frac{d\mathbb{E}(w_l^l)}{d\tau} (\mathbb{E}(p_l^s) - \mathbb{E}(p_s^l)) \leq 0$ . It follows

that  $d(\mathbb{E}(w_s^l) - \mathbb{E}(w_l^s))/d\tau \leq 0$  will imply that  $\mathbb{E}_{l-s}^{s-l}$  decreases with  $\tau$ . We now show that  $d(\mathbb{E}(w_s^l) - \mathbb{E}(w_l^s))/d\tau \leq 0$ .

Using equation (6) and given that  $\bar{w}^s$  and  $\bar{w}^l$  are independent of  $\tau$ ,  $d(\mathbb{E}(w_s^l) - \mathbb{E}(w_l^s))/d\tau = \int_0^{\bar{w}^s} \frac{dF_{l-s}^{s-l}(w)}{d\tau} dw - \int_{\bar{w}^s}^{\bar{w}^l} \frac{dF_s^l(w)}{d\tau} dw$ , with  $dF_{l-s}^{s-l}(w)/d\tau = \frac{A_v \times v + A_w \times w}{(1-K_l-K_s)(v+\tau-w)^2}$ ,  $A_w = (K_l - K_s) \geq 0$  and  $A_v = (1 - K_l - K_s) \left( \frac{1-K_l}{1-K_s} - \frac{1-K_s}{1-K_l} \right) \leq 0$ . Since  $A_v \times v + A_w \times w$  increases with  $w$  and  $A_v \times v + A_w \times \bar{w}^s = v \times \frac{K_s(1-K_s) - K_l(1-K_l)}{1-K_l} \leq 0$ ,  $dF_{l-s}^{s-l}(w)/d\tau \leq 0$ . In addition,  $F_s^l$  increases with  $\tau$ . It follows that  $d(\mathbb{E}(w_s^l) - \mathbb{E}(w_l^s))/d\tau \leq 0$  and thus  $\mathbb{E}_{l-s}^{s-l}$  decreases with  $\tau$ .

Items (iii) and (iv) imply that  $\mathbb{E}(p_s^s)/\mathbb{E}(p_l^l)$  and  $\mathbb{E}(p_l^s)/\mathbb{E}(p_s^l)$  decrease with  $\tau$ .

## E Lemma 3

First, we analyze the conditions under which expected industry profits are higher when the content provider (a) affiliates exclusively with the larger rather than the smaller distributor and (b) multi-homes rather than providing exclusive access to one distributor. Then, we determine which content-distribution strategy maximizes expected industry profits.

**(a) Exclusivity for the larger or smaller distributor.** Let  $\Lambda^{c_1, c_2} = \pi_l^{c_1} + \pi_s^{c_1} - (\pi_l^{c_2} + \pi_s^{c_2})$  with  $c_1 \neq c_2 \in \{l, s\}$ ,  $\tau_1^d = \frac{(2-3\alpha+\alpha^2)v}{1-\alpha+\alpha^2\sigma-\alpha^2\sigma^2}$  and  $\alpha^x = \frac{1+\sigma-\sqrt{5\sigma^2-4\sigma+1}}{\sigma(3-2\sigma)}$ . Expected industry profits are higher when the content provider affiliates exclusively with the larger rather than the smaller distributor only if  $\Lambda^{l,s} \geq 0$ .  $\Lambda^{l,s}$  is continuous in  $\tau$ ,  $\Lambda_{\tau=0}^{l,s} = 0$  and

$$\frac{d\Lambda^{l,s}}{d\tau} = \begin{cases} \frac{\sigma(2\sigma-3)\alpha^2+2(\sigma+1)\alpha-2}{1+\alpha\sigma-\alpha} \equiv \Upsilon_{\Lambda^{l,s}}^{inf} & \text{if } \tau < \hat{\tau} \\ (2\sigma-1)\alpha \equiv \Upsilon_{\Lambda^{l,s}}^{sup} & \text{if } \tau > \hat{\tau} \end{cases},$$

with  $\Upsilon_{\Lambda^{l,s}}^{sup} \geq 0$ . If  $\alpha \leq \alpha^x$ :  $\Upsilon_{\Lambda^{l,s}}^{inf} < 0$ ,  $\Lambda^{l,s} \geq 0$  if  $\tau \geq \tau_1^d$  and  $\Lambda^{l,s} < 0$  otherwise. If  $\alpha > \alpha^x$ :  $\Upsilon_{\Lambda^{l,s}}^{inf} \geq 0$  and thus  $\Lambda^{l,s} \geq 0$ .

**(b) Exclusive distribution vs. Non-exclusive distribution.** Let  $\Lambda^{c_1, c_2} = \pi_l^{c_1} + \pi_s^{c_1} - (\pi_l^{c_2} + \pi_s^{c_2})$  with  $c_1 \neq c_2 \in \{m, l, s\}$ ,  $\underline{\alpha} = \frac{2\sigma+1-\sqrt{8\sigma^2-4\sigma+1}}{2\sigma(2-\sigma)}$  and  $\bar{\alpha} = \frac{1-\sqrt{\sigma(1-\sigma)}}{1+\sigma^2-\sigma}$  with  $0 < \underline{\alpha} \leq \bar{\alpha} < 1$

and  $\underline{\alpha} < \alpha^x$ . Expected industry profits are higher when the content provider multi-homes only if  $\Lambda^{l,m}$  and  $\Lambda^{s,m}$  are both negative.  $\Lambda^{s,m} > 0$  if  $\alpha < \underline{\alpha}$  and  $\Lambda^{s,m} \leq 0$  otherwise. Therefore, multi-homing never maximizes expected industry profits if  $\alpha < \underline{\alpha}$ .

Assume that  $\alpha \geq \underline{\alpha}$  and so  $\Lambda^{s,m} \leq 0$ : multi-homing maximizes expected industry profits if  $\Lambda^{l,m}$  is also negative. To analyze the sign of  $\Lambda^{l,m}$ , we need to do the distinction between smaller and larger values of  $\tau$ .

- Assume that  $\tau < \hat{\tau}$ .  $\Lambda^{l,m} \leq 0$ .
- Assume that  $\tau \geq \hat{\tau}$ .  $\Lambda^{l,m} = c_\tau \times \tau + c_v \times v$  with  $c_v = \frac{\alpha(1-\sigma)(2-\alpha)}{1-\alpha\sigma} - \frac{(2-\alpha)\alpha\sigma}{1-\alpha+\alpha\sigma} < 0$  and  $c_\tau = \frac{\alpha^2(1-\sigma+\sigma^2)-2\alpha+1}{1-\alpha+\alpha\sigma}$ . When  $\alpha \geq \bar{\alpha}$ ,  $c_\tau \leq 0$  and so  $\Lambda^{l,m} \leq 0$ . When  $\alpha \in [\underline{\alpha}, \bar{\alpha})$ ,  $c_\tau > 0$ ,  $\Lambda^{l,m}$  increases in  $\tau$  and is negative if  $\tau = \hat{\tau}$ . It follows that  $\Lambda^{l,m} \leq 0$  if  $\tau \in [\hat{\tau}, \tau_2^d]$  and  $\Lambda^{l,m} > 0$  if  $\tau \geq \tau_2^d$  with  $\tau_2^d = \frac{-c_v \times v}{c_\tau} = \frac{\alpha(2-\alpha)(\sigma(1-\alpha\sigma)-(1-\sigma)(1-\alpha+\alpha\sigma))v}{(1-\alpha\sigma)((1-\sigma+\sigma^2)\alpha^2-2\alpha+1)}$ .

**The content-distribution strategy that maximizes expected industry profits.** Multi-homing never maximizes expected industry profits if  $\alpha < \underline{\alpha}$  and always maximizes expected industry profits if  $\alpha \geq \bar{\alpha}$ . When  $\alpha \in [\underline{\alpha}, \bar{\alpha})$ , either multi-homing or exclusive affiliation with the larger distributor maximizes expected industry profits. The content quality threshold that determines which content-distribution strategy maximizes expected industry profits is  $\tau_1^d$  if  $\alpha < \underline{\alpha}$  and  $\tau_2^d$  if  $\alpha \in [\underline{\alpha}, \bar{\alpha})$ . It follows that multi-homing maximizes expected industry profits when  $\alpha \in [\underline{\alpha}, \bar{\alpha})$  and  $\tau \leq \tau_2^d$  or when  $\alpha \geq \bar{\alpha}$ . Exclusive affiliation with the larger distributor maximizes expected industry profits when  $\alpha \in (0, \underline{\alpha})$  and  $\tau > \tau_1^d$  or when  $\alpha \in [\underline{\alpha}, \bar{\alpha})$  and  $\tau > \tau_2^d$ . Finally, exclusive affiliation with the smaller distributor maximizes expected industry profits when  $\alpha \in (0, \underline{\alpha})$  and  $\tau \leq \tau_1^d$ . This completes the proof of Lemma 3.