Does Direct Connect Benefit Travelers?

Jorge Padilla and Salvatore Piccolo

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Abstract
Direct connect refers to a business practice that has become fashionable again in the travel industry after a period of irrelevance. Airlines provide direct access to their sales systems to travel retailers, who can thus avoid dealing with traditional indirect distribution intermediaries, such as GDS aggregators. Although this practice is often advertised as pro-competitive, we show that it may actually harm consumers, especially in very competitive environments.

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* Compass Lexecon.
** Università di Bergamo, Compass Lexecon, and CSEF. Email: salvatore.piccolo@unibg.it
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References
1 Introduction

Direct connect refers to a business practice through which airlines used to distribute their content to travel agents in the past, prior to the emergence of the GDS\textsuperscript{1} aggregators such as Amadeus, Sabre, Travelport and Travelsky. After the advent of GDSs it then became largely irrelevant, but it is now growing again, as prominent airlines are seeking for sources of leverage against the GDSs. Notably, airlines are progressively providing direct access to their sales systems, which enables third party travel retailers (e.g., travel management companies) to search for availability, make and manage bookings on a one-to-one basis.

This practice is often advertised as a pro-competitive tool (especially by American Airlines and Lufthansa)\textsuperscript{2}, limiting the market power of traditional distribution channels and promoting consumer welfare. The idea is that, thanks to this technology, passengers and retailers can avoid paying high booking fees and retail prices, often associated with the presence of platforms’ (profit) margins.

Yet, to the best of our knowledge, there is no formal economic model supporting this claim. Is the positive view of direct connect grounded on solid economic principles? If not, why? And, when should it be a concern for competition policy?

We consider an agency model (see, e.g., Johnson, 2017) where a supplier (airline) distributes its product (content) both directly through its own distribution channel and indirectly through two retailers (travel agents). Absent direct connect, the intermediaries rely on the IT infrastructure provided by specialized platforms (GDSs) to buy the seller’s content on behalf of final consumers. By contrast, with direct connect, the supplier grants direct access to its content to one retailer, while the other continues to access the market through its exclusive platform. In both regimes, platforms charge the supplier a commission for each sale they process, and the supplier profits by charging retailers access prices — i.e., the prices (net of commissions, surcharges and discounts) that the supplier requests to authorize a transaction in the indirect channel, whether it is carried out on a platform or through the direct connect technology. We characterize the equilibrium of the game with and without direct connect, and compare consumer surplus across the two regimes.

We show that the effect of direct connect on consumer surplus is ambiguous and depends on the degree of competition between retailers within the indirect channel and across distribution channels — i.e., between the supplier in the direct channel and the retailers in the indirect channel. Specifically, when the supplier grants direct access to its sales system to a retailer, it has an incentive to reduce demand for the content distributed by the other retailer in order to minimize the commissions paid to the platform dealing with that retailer.

\textsuperscript{1}Global Distribution System.

The retailer using the GDS platform is thus charged an access price larger than the retailer operating under direct connect. Hence, since access prices are passed on to travellers, the demand for the content distributed directly by the supplier and indirectly by the retailer operating under direct connect increases. This consolidates the supplier’s market power, who has an incentive to increase the price paid by travellers in the direct channel without being afraid of losing business to the indirect channel (in particular to the retailer using the GDS platform). Yet, when competition across different distribution channels is strong — i.e., when many passengers regard different distribution channels as close substitutes — this leads retailers to increase their prices too, whereby harming consumers. By contrast, when competition is sufficiently weak, direct connect benefits consumers. In this case, the effect described above is negligible because demand functions in the direct and indirect channels are nearly independent. Hence, the main effect of direct connect is that of reducing double marginalization — i.e., the supplier saves the commissions that it would have paid to the platform dealing with the retailer operating under direct connect. Obviously, when competition is neither too strong nor too weak, the two effects balance out.

The structure of the paper is as follows. Section 2 introduces the model. Section 3 presents the results. Section 4 concludes.

2 The model

A monopolistic travel supplier (airline) denoted by $S$ distributes its product (content) both through a direct sales system, and indirectly through an intermediated channel where two platforms (denoted by $P_i$, with $i = A, B$) are accessed by exclusive retailers (denoted by $R_i$, with $i = A, B$) competing to attract final consumers (see, e.g., Bisceglia et al., 2019, Boik and Corts, 2016, Gaudin, 2019, and Johansen and Vergé, 2016, among others). In contrast to the existing models, however, consider the possibility that, in addition to the direct distribution channel, the supplier may also grant direct access to its content to one of the retailers operating in the indirect channel: ‘direct connect’. Suppose, without loss of generality, that $R_B$ always deals with $P_B$ in order to access $S$’s content, while $R_A$ can either access the market by dealing directly with $S$ or, alternatively, it operates through its own exclusive platform $P_A$ when $S$ gives up direct connect (and allows that platform to market its content).

Figure 1 below provides a graphical illustration of the different industry structures we

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3The assumption of exclusivity seems realistic in the travel industry because travel retailers usually access only one platform, and learning by doing economies together with switching costs may actually make competition for retailers harder. In Bisceglia et al. (2019) we discuss how competition between platforms affects the equilibrium of the game.
$S$ sets a price $p_d$ on its direct sales system, and contracts with platforms and retailers. Following the literature and business practice contracts are linear and secret. The business structure of the industry is the agency model proposed by Johnson (2017). Specifically, a contract between $S$ and $P_i$ specifies a commission (fee) $f_i$ paid by $S$ to $P_i$ for each unit distributed by $R_i$. In addition, $S$ sets the access price $\tau_i$ that it charges $R_i$ for every unit sold through $P_i$ or via direct connect. The timing of the game is as follows:

$t = 0$  $S$ decides whether to $R_A$ operates via direct connect or via $P_A$;

$t = 1$  Platforms (only one or both depending on $S$’s decision in $t = 0$) offer commissions to the supplier;

$t = 2$  The supplier accepts or refuses the offers, and sets access prices;

$t = 3$  The retailers and the supplier simultaneously post final prices and demand allocates across the two channels.

Production costs are linear and marginal costs are normalized to zero without loss of generality. Hence, $S$’s aggregate profit is

$$\pi^S(\cdot) \triangleq (\tau_A - f_A)q_A + (\tau_B - f_B)q_B + p_dq_d,$$

with $q_i$ and $q_d$ denoting the quantities sold through platform $i = A, B$ and the direct distribution system, respectively. The indicator function $\mathbb{I}$ takes value 0 if $R_A$ deals directly with $S$ and 1 otherwise. $P_i$’s profit is $\pi^P_i(\cdot) \triangleq f_iq_i$, while $R_i$’s profit is $\pi^R_i(\cdot) \triangleq \tau_iq_i$.

Since contracts are secret, following Johansen and Vergé (2016) and Rey and Vergé (2017), the solution concept is *Contract Equilibrium* (Crémer and Riordan, 1987, and Horn
and Wolinsky, 1988). This equilibrium concept has some of the features of a perfect Bayesian Nash equilibrium with passive beliefs: even if it receives an out-of-equilibrium contract, each retailer chooses its price assuming that the rival remains under the equilibrium contract. This is in line with the market-by-market bargaining restriction of Hart and Tirole (1990) and with the passive beliefs or pairwise-proofness assumption of McAfee and Schwartz (1994).

In line with the evidence (see, e.g., Cazaubiel et al., 2018) we assume that consumers perceive the contents distributed through the direct and the indirect channel as imperfect substitutes. Hence, following Johansen and Vergé (2016), we consider the following demand functions

\[ q_i \triangleq D^A(p_i, p_{-i}, p_d) = \frac{1 - b - (1 + b) p_i + b (p_{-i} + p_d)}{(1-b)(1+2b)} \quad \forall i = A, B, \]  

(1)

and

\[ q_d \triangleq D^d(p_d, p_A, p_B) = \frac{1 - b - (1 + b) p_d + b (p_A + p_B)}{(1-b)(1+2b)}, \]  

(2)

where \( b \) reflects the degree of substitutability between products within and across distribution channels. We assume that \( b \in [0, \bar{b}] \), with \( \bar{b} \approx 0.9 \) to guarantee that second-order conditions hold (see Appendix 2 in Bisceglia et al. 2019).

Before solving the game, it is useful to observe that a multiproduct supplier, who fully internalizes the effects of intra- and inter-channel competition, charges the same price for all products \( p^M = \frac{1}{2} \) and, because demand functions feature preference for variety, it sells the same quantity of each product.

### 2.1 Equilibrium analysis

We first develop the analysis for the case of direct connect, then we briefly review the logic of the model in the regime without direct connect. In Section 2.2 we then compare the retail models.
prices and consumer surplus across the two regimes.

**Equilibrium with direct connect.** Suppose that $S$ forecloses $P_A$ and deals directly with $R_A$. Consider an equilibrium in which: (i) $R_i$ charges $p_{i}^{dc}$ and $S$ charges $p_{d}^{dc}$ in the indirect and direct channel, respectively; (ii) $S$ charges $\tau_{i}^{dc}$ to $R_i$; (iii) $S$ is charged $f_{B}^{dc}$ by $P_B$. We solve the game with a backward induction logic.

$R_i$ solves

$$\max_{p_{i} \geq 0} D(p_{i}, p_{i}^{dc}, p_{d}^{dc}) (p_{i} - \tau_{i}) ,$$

whose first-order condition yields

$$p_{i}^{dc}(\tau_{i}) \triangleq \frac{\tau_{i}}{2} + \frac{1 - b + b \left( p_{i}^{dc} + p_{d}^{dc} \right)}{2(1 + b)} \quad \forall i = A, B , \tag{3}$$

representing $R_i$’s best response to $\tau_{i}$. Clearly, $p_{i}^{dc}(\tau_{i})$ is increasing in $\tau_{i}$ and in the rivals’ prices $p_{i}^{dc}$ and $p_{d}^{dc}$.

$S$ solves

$$\max_{p_{d}} (\tau_B - f_B) D(p_{B}^{dc}, p_{A}^{dc}, p_{d}) + \tau_A D(p_{A}^{dc}, p_{B}^{dc}, p_{d}) + p_{d} D(p_{d}, p_{A}^{dc}, p_{B}^{dc}) ,$$

whose first-order condition is

$$\frac{1 - b - (1 + b) p_{d}}{(1 - b)(1 + 2b)} - \frac{1 + b}{p_{d} (1 - b)(1 + 2b)} + \frac{b}{(1 - b)(1 + 2b)} (\tau_B - f_B + \tau_A) = 0 . \tag{4}$$

Clearly, a higher $p_d$ increases $S$’s profit margin but lowers demand in the direct channel; moreover, it also increases $S$’s profit from the indirect channel because (other things being equal) consumers switch from the direct to the indirect channel, so that $S$ collects higher fees from $R_B$. The solution of (4) yields $S$’s best response to the access prices and the fee charged by $P_B$ — i.e.,

$$p_{d}^{dc}(\tau_A, \tau_B, f_B) \triangleq \frac{1 - b}{2(1 + b)} + \frac{b}{2(1 + b)} (p_{A}^{dc} + p_{B}^{dc}) + \frac{b}{2(1 + b)} (\tau_A + \tau_B - f_B) , \tag{5}$$

which is increasing in the rivals’ retail prices and in the access prices, and decreasing in the fee charged by $P_B$ (the higher this fee, the lower the incentive to increase $p_d$ since volumes diverted to $R_B$ are less profitable).
Moving back to stage 2, \( S \) solves

\[
\max_{\tau_A \geq 0, \tau_B \geq 0} \left( \tau_B - f_B \right) D(p_B^{dc}(\cdot), p_A^{dc}(\cdot), p_d^{dc}(\cdot)) + \tau_A D(p_A^{dc}(\cdot), p_B^{dc}(\cdot), p_d^{dc}(\cdot)) + p_d^{dc}(\cdot) D_d(p_d^{dc}(\cdot), p_A^{dc}(\cdot), p_B^{dc}(\cdot)) + \tau_B D(p_B^{dc}(\cdot), p_A^{dc}(\cdot), p_d^{dc}(\cdot)).
\]

Let \( \mathbb{I}_i \) be an indicator function taking value 1 for \( i = B \) and 0 for \( i = A \). The first-order condition with respect to \( \tau_i \) is

\[
\frac{1 - b - (1 + b) p_i^{dc}(\cdot)}{(1 - b)(1 + 2b)} \left( \frac{1 + b}{(1 - b)(1 + 2b)} \left( \tau_i - \mathbb{I}_i f_i \right) \frac{\partial p_i^{dc}(\cdot)}{\partial \tau_i} \right) + \frac{b}{(1 - b)(1 + 2b)} \left[ \tau_{-i} - \mathbb{I}_{-i} f_{-i} + p_d^{dc}(\cdot) \right] \frac{\partial p_i^{dc}(\cdot)}{\partial \tau_i} = 0 \quad \forall i = A, B.
\]

(6)

\( S \)'s profit increases with \( \tau_i \) because (for given demand) \( S \) collects higher revenues from \( R_i \). However, since contracts are secret, a higher \( \tau_i \) only increases the retail price charged by \( R_i \). Hence, other things being equal, \( R_i \)'s demand drops, whereas \( R_{-i} \)'s demand on the indirect channel and \( S \)'s demand on the direct channel increase.

Solving (6), we obtain access prices in terms of \( f_B \) — i.e.,

\[
\tau_B^{dc}(f_B) = \frac{(2 + 3b)^2}{2(1 + 2b)(4 + 3b)} + \frac{16 + 48b + 10b^2 - 59b^3 - 33b^4}{2(1 + 2b)(1 - b)(4 + 3b)(4 + 5b)} f_B,
\]

(7)

and

\[
\tau_A^{dc}(f_B) = \frac{(2 + 3b)^2}{2(1 + 2b)(4 + 3b)} - \frac{b(1 + b)(4 + 8b - 3b^2)}{2(1 + 2b)(1 - b)(4 + 3b)(4 + 5b)} f_B.
\]

(8)

While \( \tau_B^{dc}(f_B) \) is increasing in \( f_B \) because a higher fee will be passed on by \( S \) to \( R_B \), \( \tau_A^{dc}(f_B) \) is decreasing in \( f_B \) because as \( R_B \) becomes less efficient due to a higher ‘marginal cost’ \( S \) has an incentive to divert business towards \( R_A \).

We can finally move to stage 1. Let

\[
p_d^{dc}(\tau_A^{dc}(f_B), \tau_B^{dc}(f_B), f_B) \triangleq p_d^{dc}(f_B),
\]

and

\[
p_R^{dc} (\tau_R^{dc}(f_B)) \triangleq p_R^{dc}(f_B).
\]

\( P_B \) solves

\[
\max_{f_B \geq 0} f_B D(p_B^{dc}(f_B), p_A^{dc}(f_B), p_d^{dc}(f_B)),
\]

and

\[
P_B \text{ solves } f_B D(p_B^{dc}(f_B), p_A^{dc}(f_B), p_d^{dc}(f_B)),
\]

\[
\text{max}_{f_B \geq 0} f_B D(p_B^{dc}(f_B), p_A^{dc}(f_B), p_d^{dc}(f_B)),
\]

7
whose first-order condition is

\[
\frac{1 - b - (1 + b) p_B^{dc}(\cdot) + b (p_A^{dc}(\cdot) + p_d^{dc}(\cdot))}{(1 - b)(1 + 2b)} - f_B \frac{1 + b}{(1 - b)(1 + 2b)} \frac{\partial P_B^{dc}(f_B)}{\partial f_B} + \\
\frac{b}{(1 - b)(1 + 2b)} \left[ \frac{\partial P_A^{dc}(f_B)}{\partial f_B} + \frac{\partial p_B^{dc}(f_B)}{\partial f_B} \right] = 0. \tag{9}
\]

Three effects shape \( P_B \)'s optimal fee. First, for given demand, by increasing the commission charged to \( S \), \( P_B \) earns a higher profit. Second, since \( S \) reacts to such a higher fee by increasing the access price charged to \( R_B \), demand on platform \( P_B \) drops. Third, since \( f_B \) affects the access prices and \( S \)'s profit margin on \( R_B \)'s sale volume, there is also a strategic effect: \( p_A^{dc}(\cdot) \) drops as \( f_B \) increases because \( R_A \)'s access price decreases as explained before; \( p_d^{dc}(\cdot) \) also drops because \( R_A \) charges a lower price as just explained and \( S \)'s profit margin on \( R_B \) is lower, which means that \( S \) has a weaker incentive to increase the price in the direct channel in order to profit on the indirect one.\(^7\) Solving (9) we have

\[
f_B^{dc} = \frac{(4 + 5b) 4 (1 - b)^3 (1 + b) (1 + 2b)}{32 + 96b + 10b^2 - 179b^3 - 122b^4 + 85b^5 + 87b^6}. \tag{>0} \]

Substituting \( f_B^{dc} \) into (7) and (8) we obtain the equilibrium access prices \( \tau_A^{dc} \) and \( \tau_B^{dc} \), then using (4) and (5) we obtain the equilibrium retail prices \( p_A^{dc} \), \( p_B^{dc} \) and \( p_d^{dc} \) (see the Appendix).

**Proposition 1** With direct connect, access prices are such that \( \tau_B^{dc} > \tau_A^{dc} > 0 \) and \( \tau_B^{dc} > f_B^{dc} \). Retail prices are such that with \( p_B^{dc} > \max \{ p_A^{dc}, p_d^{dc} \} \) and \( p_A^{dc} > p_d^{dc} \) if and only if \( b \leq 0.75 \). The supplier and both retailers sell positive quantities in the direct and indirect channel, respectively — i.e., \( q_A^{dc} > q_B^{dc} > 0 \) and \( q_d^{dc} > 0 \).

In order to make positive profits \( P_B \) charges a positive commission to \( S \), who will then pass on this commissions to \( R_B \) by increasing \( \tau_A \). In turn, \( R_B \) marks up consumers by setting a price larger than \( p^M \). Because contracts are linear and prices are strategic complements, \( S \) will also charge a positive access price to \( R_A \), which creates a mark-up also for consumers

\[\begin{align*}
\frac{\partial p_A^{dc}(f_B)}{\partial f_B} &= \frac{b}{2(1+b)} \left( \frac{\partial \tau_A^{dc}(f_B)}{\partial f_B} + \frac{\partial \tau_B^{dc}(f_B)}{\partial f_B} - 1 \right) \\
&= - \frac{b (2(1+b) - 3b^2)}{2(1-b)(1+2b)(4+3b)} < 0.
\end{align*}\]
buying through direct connect. Obviously, in equilibrium, $\tau^{dc}_A < \tau^{dc}_B$ because $S$ diverts demand from $R_B$ to $R_A$ in order to minimize the commissions paid to $P_B$. Finally, due to strategic complementarity, $S$ will also charge a positive mark-up on the direct channel.\footnote{Because consumers feature taste for variety, $S$ never shuts down $P_B$.}

**Equilibrium without direct connect.** The analysis of the regime without direct connect has been already developed in Bisceglia at al. (2019). Hence, for brevity, we will only state the result (details are in the Appendix).

**Proposition 2** (Bisceglia et al. 2019) Without direct connect there exists a unique symmetric equilibrium such that platforms charge a fee $f^n > 0$ to $S$, who then sets $\tau^n > f^n$ to each retailer and charges $p^n_d$ in the direct channel, retailers set the same price $p^n > \tau^n$ in the indirect channel.

The equilibrium features multiple marginalization: platforms charge $S$ positive commissions, which will be passed on to the retailers via higher access prices, which in turn induce a final price higher than $p^M$. Due to strategic complementarity, $S$ charges a very high price in the direct channel too.

**2.2 Consumer welfare analysis**

We now examine the effects of direct connect on consumers. We start by comparing retail prices.

**Proposition 3** Direct connect always increases the price charged by $S$ in the direct channel — i.e., $p^{dc}_d \geq p^n_d$ with equality only at $b = 0$. As for the indirect channel, there exist two thresholds $b_0$ and $b_1$, with $0 < b_0 < b_1 < \bar{b}$, such that:

- $p^{dc}_A \leq p^n$ if and only if $b \in [0, b_1]$, with equality at $b = b_1$;
- $p^{dc}_B \leq p^n$ if and only if $b \in [0, b_0]$, with equality at $b = b_0$ and $b = 0$.

With direct connect, $S$ charges $\tau^{dc}_B > \tau^{dc}_A$ in order to divert business from $R_B$ towards $R_A$. This induces $R_B$ to pass on the higher access price to consumers. Hence, demand in the direct channel increases and, in turn, $S$ charges a higher price in that market segment. However, a higher price in the direct channel also induces retailers to charge higher prices in the indirect channel when $b$ is sufficiently large because of a relatively stronger effect of $p_d$ on $R_A$ and $R_B$’s demand functions.

Figure 2 shows the equilibrium prices as a function of $b$. 
In panel a, the solid curve is $p^n_d$ while the dashed one is $p^{dc}_d$; in panel b, the black curve is $p^n$, the red $p^{cd}_A$ and the green $p^{cd}_B$. In line with the intuition provided above, the region of parameters in which direct connect increase prices in the indirect channel corresponds to the region of parameters in which the difference $p^{dc}_d - p^n_d$ is larger.

We can now study consumer surplus.

**Proposition 4** There exits a threshold $b^* \in (0, b_1)$ such that direct connect harms consumer surplus if and only if $b \geq b^*$.

The intuition is straightforward. Because $p^{dc}_d > p^{dc}_d$, direct connect unambiguously harms consumers that buy directly from the supplier. However, in the indirect channel the effect is ambiguous. Clearly, for $b$ sufficiently large (e.g., $b > b_1$) direct connect increases prices in the intermediated channel too, and hence it harms consumers in both channels. On the contrary, for $b \to 0$ it can be seen that $p^{dc}_A < p^n$, $p^{dc}_d \to p^n_d$ and $p^{dc}_B \to p^n$. Hence, for $b$ sufficiently small direct connect overall benefits consumers: it has a first-order beneficial effect in the indirect channel and a second-order negative effect in the direct channel. When $b$ takes intermediate values the two effects balance out. Figure 3 provides a graphical illustration of the result.
The solid (dashed) curve represents consumer surplus with (without) direct connect.

Finally, it should be noticed that while direct connect harms consumers for $b$ large enough, it unambiguously benefits the supplier who (absent efficiencies on the platforms’ side) has always an incentive to grant direct access to its sales system at least to one retailer. By revealed preferences, in fact, the supplier saves on the commission it would have paid to the platform dealing with $R_A$, while being able to control the retail prices through an appropriate choice of $\tau_A$ and $\tau_B$.

3 Conclusion

The view that direct connect unambiguously benefits consumers in the travel industry is flawed. By providing some retailers direct access to their sales systems, travel suppliers can actually consolidate their market power vis-à-vis traditional distribution channels, especially in competitive environments.

Last, but not least, our model has important implications on the current debate on platform parity provisions — i.e., contractual agreements according to which airlines commit not to charge different prices for the same product distributed through different platforms. In Bisceglia et al. (2019) we have shown that, in a model without direct connect, platform parity benefits consumers as long as competition between and across distribution channels is sufficiently intense. Hence, the likelihood that direct connect harms consumers when the fall back option is an indirect channel with two platforms and price parity is very high. Therefore, in this case (under the assumption that regulation cannot impose airlines to drop direct connect) imposing a price parity agreement according to which airlines cannot charge different (access) prices to the retailer operating under direct connect and those operating through platforms certainly increases consumer welfare. The reason is that direct connect would still allow airlines to save on the commissions paid to the active platforms (whereby reducing multiple marginalization), but it would also prevent them from consolidating their market power by increasing the access price charged to the retailers accessing the market through platforms.
Appendix

Proof of Proposition 1. Substituting for (3), (5), (8) and (7) into (9) and solving for $f_B$ yields $f_B^{dc}$. Substituting $f_B^{dc}$ into (8) and (7), yields $\tau^A_{dc}$ and $\tau^B_{dc}$. Showing that $\tau^A_{dc} < \tau^B_{dc}$ and $\tau^A_{dc} > f_B^{dc}$ is immediate. Substituting $f_B^{dc}$, $\tau^A_{dc}$ and $\tau^B_{dc}$ into the system (3)-(5), solving for $p_A$, $p_B$ and $p_d$

\[
p^{dc}_d = p^M + \frac{b (1 + b) (24 + 7b + 24b^2 - 141b^3 - 128b^4 + 65b^5 + 87b^6)}{3b + 4 (1 + 2b) (32 + 96b + 10b^2 - 179b^3 - 122b^4 + 85b^5 + 87b^6)},
\]

\[
p^{dc}_A = p^M + \frac{64 + 296b + 284b^2 - 492b^3 - 879b^4 + 95b^5 + 703b^6 + 124b^7 - 159b^8}{3 (4 + 3b) (1 + 2b) (32 + 96b + 10b^2 - 179b^3 - 122b^4 + 85b^5 + 87b^6)},
\]

\[
p^{dc}_B = p^M + \frac{96 + 416b + 292b^2 - 860b^3 - 1087b^4 + 471b^5 + 967b^6 - 4b^7 - 255b^8}{2 (4 + 3b) (1 + 2b) (32 + 96b + 10b^2 - 179b^3 - 122b^4 + 85b^5 + 87b^6)},
\]

with $p^{dc}_B > \max \{p^{dc}_A, p^{dc}_d\}$ and $p^{dc}_A > p^{dc}_d$ if and only if $b \leq 0.75$. Checing that $q^{dc}_A > q^{dc}_B > 0$ and $q^{dc}_d > 0$ is immediate. □

Proof of Proposition 2. From Bisceglia et al. (2019) it follows that $S$ sets

\[
p^{n}_d = p^M + \frac{b (1 + b) (8 - 9b^2)}{64 + 152b - 28b^2 - 171b^3 - 54b^4},
\]

while retailers charge the same price

\[
p^n = p^M + \frac{48 + 56b - 130b^2 - 59b^3 + 81b^4}{2(64 + 152b - 28b^2 - 171b^3 - 54b^4)}. □
\]

Proof of Proposition 3. The proof follows by comparing $p^{dc}_A$ and $p^{dc}_B$ with $p^n$, and $p^{dc}_d$ with $p^n_d$ (Figure 2). □

Proof of Proposition 4. Consumer surplus under direct connect obtains by substituting the equilibrium prices into the utility function that generates the demand system (1)-(2) — i.e.,

\[
CS^{dc} = \sum_{j=A,B,d} q^{dc}_j - \frac{1}{2} \sum_{j=A,B,d} (q^{dc}_j)^2 - b \sum_{i,j=A,B,d, j \neq i} q^{dc, dc}_{ij} q^{dc}_{ij} - \sum_{j=A,B,d} p^{dc}_j q^{dc}_j + m,
\]

where

\[
q^{dc}_d = \frac{1 - b - (1 + b) p^{dc}_d + b (p^{dc}_A + p^{dc}_B)}{(1 - b)(1 + 2b)}, \quad q^{dc}_i = \frac{1 - b - (1 + b) p^{dc}_i + b (p^{dc}_{i-1} + p^{dc}_d)}{(1 - b)(1 + 2b)},
\]

for every $i = A, B$. Similarly,

\[
CS^n = 2q^n + q^n_d - (1 + b) (q^n)^2 - \frac{1}{2} (q^n_d)^2 - 2bq^n q^n_d - 2p^n q^n - p^n_d q^n_d + n,
\]
where,

\[ q^n = \frac{1 - b - p^n + b p^n d}{(1 - b)(1 + 2b)} , \quad q^n d = \frac{1 - b - (1 + b) p^n d + 2 b p^n}{(1 - b)(1 + 2b)} . \]

Comparing \( CS^{dc} \) and \( CS^n \) it follows that \( b^* \approx 0.5 \) (Figure 3). ■

References


