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Does Direct Connect Benefit Travelers?

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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.

JEL classification: L42, L50, L81

Keywords: Agency Model, Direct Connect, Distribution Channels, Travel Industry.

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Table of contents

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[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 progressivily 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 pracitce is often advertised as a pro-competitive tool (especially by American Airlines and Lufthansa)[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 ans 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.

[1]Global Distribution System.

[2]See, e.g., https://lufthansa-city-center.com/leisure/en/distribution-platform

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 loosing 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).[3] 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

[3] The 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.

consider.

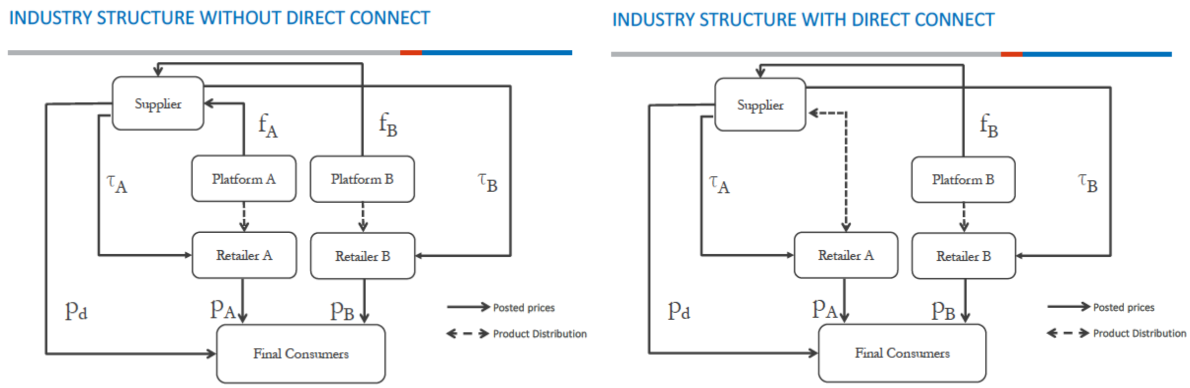


Figure 1

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 τ_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

$$\pi^S(\cdot) \triangleq (\tau_A - \mathbb{I} f_A)\, q_A + (\tau_B - f_B)\, q_B + p_d q_d,$$

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 $\pi_i^P(\cdot) \triangleq f_i q_i$, while R_i's profit is $\pi_i^R(\cdot) \triangleq \tau_i q_i$.

Since contracts are secrect, 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.[4] Hence, following Johansen and Vergé (2016), we consider the following demand functions

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

and

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

where b reflects the degree of substitutability between products within and across distribution channels.[5] We assume that $b \in \left[0, \overline{b}\right]$, with $\overline{b} \approx 0.9$ 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.[6]

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

[4] Some consumers may in fact prefer to purchase through the indirect channel because intermediaries offer (un-modelled) additional services that M is unable or unwilling to supply in the direct channel.

[5] To simplify exposition, we assumed that the degree of intra- and inter-channel competition is the same (b). Nevertheless, our results hold qualitatively when consumers perceive the contents distributed by the two retailers as less differentiated than the content distributed directly by the supplier. In this case, it can be shown that direct connect harms consumers as long as inter- and intra-channel competition is sufficiently intense. Proofs and numerical simulations are available upon request.

[6] Indeed, the above demand system reflects the preferences of a representative consumer, whose utility function is

$$U(\cdot) \triangleq \sum_{j=A,B,d} q_j - \frac{1}{2}\sum_{j=A,B,d} q_j^2 - b \sum_{i,j=A,B,d;,j\neq i} q_j q_i - \sum_{j=A,B,d} p_j q_j + m,$$

which is strictly concave and thus exhibits preference for variety. For example, in the airline ticket industry, consumers may want to have the ability to book in different ways because they may not always be able to reach directly the airline website.

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 τ_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

$$\max_{p_i \geq 0} D\left(p_i, p_{-i}^{dc}, p_d^{dc}\right)\left(p_i - \tau_i\right),$$

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 τ_i. Clearly, $p_i^{dc}(\tau_i)$ is increasing in τ_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

$$\underbrace{\frac{1 - b - (1+b)\,p_d + b\left(p_A^{dc} + p_B^{dc}\right)}{(1-b)(1+2b)} - p_d \frac{1+b}{(1-b)(1+2b)}}_{\text{Monopoly rule}} +$$

$$+ \underbrace{\frac{b}{(1-b)(1+2b)}(\tau_B - f_B + \tau_A)}_{\text{Channel externality}} = 0. \tag{4}$$

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.,

$$p_d^{dc}\left(\tau_A, \tau_B, f_B\right) \triangleq \frac{1-b}{2\left(1+b\right)} + \frac{b}{2\left(1+b\right)}\left(p_A^{dc} + p_B^{dc}\right) + \frac{b}{2\left(1+b\right)}\left(\tau_A + \tau_B - f_B\right), \tag{5}$$

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

$$\max_{\tau_A \geq 0, \tau_B \geq 0} (\tau_B - f_B) D(p_B^{dc}(\cdot), p_A^{dc}(\cdot), p_d^{dc}(\cdot)) + \tau_A D(p_A^{dc}(\cdot), p_B^{dc}(\cdot), p_d^{dc}(\cdot)) + p_d^{dc}(\cdot) D^d(p_d^{dc}(\cdot), p_A^{dc}(\cdot), p_B^{dc}(\cdot)).$$

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 τ_i is

$$\underbrace{\frac{1 - b - (1+b)\, p_i^{dc}(\cdot) + b\left(p_{-i}^{dc}(\cdot) + p_d^{dc}(\cdot)\right)}{(1-b)(1+2b)} - \frac{1+b}{(1-b)(1+2b)} (\tau_i - \mathbb{I}_i f_i) \frac{\partial p_i^{dc}(\cdot)}{\partial \tau_i}}_{\text{Monopoly rule}} +$$

$$+ \underbrace{\frac{b}{(1-b)(1+2b)} \left[\tau_{-i} - \mathbb{I}_{-i} f_{-i} + p_d^{dc}(\cdot)\right] \frac{\partial p_i^{dc}(\cdot)}{\partial \tau_i}}_{\text{Channel externality}} = 0 \quad \forall i = A, B. \tag{6}$$

S's profit increases with τ_i because (for given demand) S collects higher revenues from R_i. However, since contracts are secret, a higher τ_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.,

$$\tau_B^{dc}(f_B) = \frac{(2+3b)^2}{2(1+2b)(4+3b)} + \underbrace{\frac{16 + 48b + 10b^2 - 59b^3 - 33b^4}{2(1+2b)(1-b)(4+3b)(4+5b)}}_{>0} f_B, \tag{7}$$

and

$$\tau_A^{dc}(f_B) = \frac{(2+3b)^2}{2(1+2b)(4+3b)} - \underbrace{\frac{b(1+b)(4+8b-3b^2)}{2(1+2b)(1-b)(4+3b)(4+5b)}}_{>0} f_B. \tag{8}$$

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

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

whose first-order condition is

$$\underbrace{\frac{1-b-(1+b)\,p_B^{dc}(\cdot)+b\left(p_A^{dc}(\cdot)+p_d^{dc}(\cdot)\right)}{(1-b)(1+2b)}-f_B\frac{1+b}{(1-b)(1+2b)}\frac{\partial p_B^{dc}(f_B)}{\partial f_B}}_{\text{Monopoly rule}}+$$

$$\underbrace{+f_B\frac{b}{(1-b)(1+2b)}\left[\frac{\partial p_A^{dc}(f_B)}{\partial f_B}+\frac{\partial p_d^{dc}(f_B)}{\partial f_B}\right]}_{\text{Strategic effect }<0}=0. \tag{9}$$

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

$$f_B^{dc}=\underbrace{\frac{(4+5b)\,4\,(1-b)^3\,(1+b)\,(1+2b)}{32+96b+10b^2-179b^3-122b^4+85b^5+87b^6}}_{(>0)\ P_B\text{'s mark up}}.$$

Substituting f_B^{dc} into (7) and (8) we obtain the equilibrium access prices τ_A^{dc} and τ_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* $p_B^{dc}>\max\left\{p_A^{dc},p_d^{dc}\right\}$ *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 τ_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

[7] Formally, by (5) we have

$$\begin{aligned}\frac{\partial p_d^{dc}(f_B)}{\partial f_B} &= \frac{b}{2\,(1+b)}\left(\frac{\partial \tau_A^{dc}\,(f_B)}{\partial f_B}+\frac{\partial \tau_B^{dc}\,(f_B)}{\partial f_B}-1\right)\\ &= -\frac{b\left(2\,(1+b)-3b^2\right)}{2\,(1-b)\,(1+2b)\,(4+3b)}<0.\end{aligned}$$

buying through direct connect. Obviously, in equilibrium, $\tau_A^{dc} < \tau_B^{dc}$ 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.[8]

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_d^n 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.

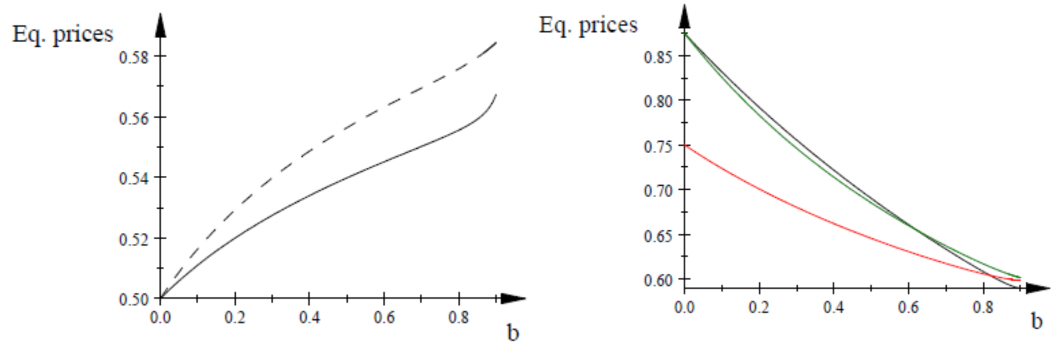
Proposition 3 *Direct connect always increases the price charged by S in the direct channel — i.e., $p_d^{dc} \geq p_d^n$ with equality only at $b = 0$. As for the indirect channel, there exist two thresholds b_0 and b_1, with $0 < b_0 < b_1 < \overline{b}$, such that:*

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

With direct connect, S charges $\tau_B^{dc} > \tau_A^{dc}$ 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.

[8] Because consumers feature taste for variety, S never shuts down P_B.



Panel a: direct channel Panel b: indirect channel

Figure 2: Equilibrium prices

In panel a, the solid curve is p_d^n while the dashed one is p_d^{dc}; in panel b, the black curve is p^n, the red p_A^{cd} and the green p_B^{cd}. 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 $p_d^{dc} - p_d^n$ 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 $p_d^{dc} > p_d^{dc}$, 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 $p_A^{dc} < p^n$, $p_d^{dc} \to p_d^n$ and $p_B^{dc} \to p^n$. 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

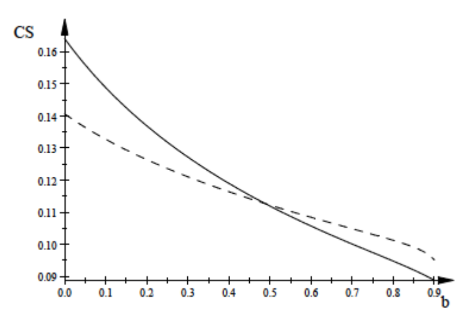


Figure 3: Consumer surplus

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 τ_A and τ_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 τ_A^{dc} and τ_B^{dc}. Showing that $\tau_A^{dc} < \tau_B^{dc}$ and $\tau_B^{dc} > f_B^{dc}$ is immediate. Substituting f_B^{dc}, τ_A^{dc} and τ_B^{dc} into the system (3)-(5), solving for p_A, p_B and p_d

$$p_d^{dc} = p^M + \frac{b\,(1+b)\,(24+78b+24b^2-141b^3-128b^4+65b^5+87b^6)}{(3b+4)\,(1+2b)\,(32+96b+10b^2-179b^3-122b^4+85b^5+87b^6)},$$

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

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

with $p_B^{dc} > \max\left\{p_A^{dc}, p_d^{dc}\right\}$ and $p_A^{dc} > p_d^{dc}$ if and only if $b \leq 0.75$. Checing that $q_A^{dc} > q_B^{dc} > 0$ and $q_d^{dc} > 0$ is immediate. ■

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

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

while retailers charge the same price

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

Proof of Proposition 3. The proof follows by comparing p_A^{dc} and p_B^{dc} with p^n, and p_d^{dc} with p_d^n (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.,

$$CS^{dc} = \sum_{j=A,B,d} q_j^{dc} - \frac{1}{2}\sum_{j=A,B,d} (q_j^{dc})^2 - b \sum_{i,j=A,B,d;,j\neq i} q_j^{dc} q_i^{dc} - \sum_{j=A,B,d} p_j^{dc} q_j^{dc} + m,$$

where

$$q_d^{dc} = \frac{1-b-(1+b)\,p_d^{dc} + b\left(p_A^{dc}+p_B^{dc}\right)}{(1-b)(1+2b)}, \quad q_i^{dc} = \frac{1-b-(1+b)\,p_i^{dc} + b\left(p_{-i}^{dc}+p_d^{dc}\right)}{(1-b)(1+2b)},$$

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

$$CS^n = 2q^n + q_d^n - (1+b)\,(q^n)^2 - \frac{1}{2}(q_d^n)^2 - 2bq^n q_d^n - 2p^n q^n - p_d^n q_b^n + n,$$

where,

$$q^n = \frac{1 - b - p^n + bp_d^n}{(1-b)(1+2b)}, \quad q_d^n = \frac{1 - b - (1+b)\, p_d^n + 2bp^n}{(1-b)(1+2b)}.$$

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

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