# Exclusive dealing with distortionary pricing

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Online Appendix 4

## 1. Exclusive dealing out-of-equilibrium

In this Appendix, we analyze the case of duopoly when each firm offers two tariffs, one exclusive and one non-exclusive, and the retailer chooses which one to sign. Since the retailer will sign at most one contract with each firm, some contracts are destined not to be accepted. These barrage contracts may however act as a coordination device.

To begin with, note that the exclusive representation equilibrium of Proposition 4 continues to exist also under our new assumption, and remains the only exclusive representation equilibrium. Now, however, this equilibrium may not be unique: there might exist other equilibria in which common representation prevails.

Such common representation equilibria may exist because they can now be supported by exclusive contracts suitably designed in order to counter the unilateral incentives to deviate to exclusive representation discussed in the main text. Therefore, in these equilibria each firm must offer both a non-exclusive and an exclusive contract. The non-exclusive contracts are the ones destined to be accepted, the exclusive contracts serve to prevent deviations from the equilibrium. In particular, the exclusive contract offered by firm $i$ must make it unprofitable for firm $j$ to switch to exclusive representation, and vice versa.

Reaching an equilibrium of this sort clearly requires a delicate coordination among the firms. Scope for coordination exists because the single sourcing outcome destroys the value of product variety. Firms might therefore gain by providing variety and then extracting the value that it has for the retailer.

If this strategy does work, exclusive contracts will not be signed by the retailer in equilibrium. This opens the way for another form of coordination: firms could also, to some extent, raise their exclusive tariffs in a coordinated fashion. This move cannot be profitable directly, as exclusive contracts are not signed, but can benefit the firms indirectly, allowing them to increase their non-exclusive prices as well.

However, in a non-cooperative equilibrium there are limits to the possibility of coordinating price strategies in this way. Firstly, the coordination mechanism is delicate in that the non-exclusive tariffs must perform two distinct functions: they must induce the retailer to opt for common representation, and split the extra surplus between the firms in such a way that both are better off than under exclusive dealing. It is not obvious that both goals can be achieved

simultaneously. Secondly, raising the exclusive tariffs increases the temptation to deviate to exclusive representation. This puts an upper bound on the degree of price coordination that can be sustained.

We are interested in characterizing the equilibria in which coordination is as strong as it can be in a non-cooperative equilibrium. Before proceeding to the formal analysis, however, a few preliminaries are in order. Firstly, recall that direct side payments between the firms, which would make the coordination problem trivial, are ruled out in our model. With two-part tariffs, however, side payments can be implemented indirectly, *via* the fixed fees: one firm may lower its fixed fee, thereby allowing the rival to increase its own by the same amount. We limit the possibility of transferring profits between the firms in this fashion by assuming that fixed fees cannot be negative: $F_i \geq 0$.

Secondly, to abstract from irrelevant details, we define as *outcome equivalent* any two equilibria in which the contracts accepted by the retailer are the same. All outcome equivalent equilibria are practically identical; as such, they will be regarded as one and the same.

## 2. Characterization

We now provide a characterization of the common representation equilibria. As we have argued above, any common representation equilibrium must consist of two tariffs for each firm, a non-exclusive and an exclusive one. The exclusive contracts are not accepted, but serve to prevent deviations to exclusive representation.

To begin with, we show that one can restrict attention to exclusive contracts that are efficient, in the sense that they maximize the firm's profit for any given payoff left to the retailer. Formally, given a retailer's payoff of $\kappa$, the efficient exclusive contract for firm $i$ corresponds to the solution to the following program:

$$\max \Pi_i^E(q_i) = \frac{1}{1+\mu}\left[v^E(q_i) - c_i q_i - \kappa\right] + \frac{\mu}{1+\mu} q_i v_{q_i}^E(q_i).$$

We denote the solution to this problem by $q_i^E(\kappa)$, the corresponding tariff by $(p_i^E(\kappa), F_i^E(\kappa))$, and the profit by $\hat{\Pi}_i^E(\kappa)$. We have:[1]

**Lemma 1** *For any common representation equilibrium in which the retailer obtains a payoff of $\kappa$, there is an outcome-equivalent equilibrium with the same non-exclusive tariffs, in which the exclusive tariffs are given by $(p_i^E(\kappa), F_i^E(\kappa))$.*

*Proof.* It is immediate to verify that any profitable deviation from the proposed candidate equilibrium would also be a profitable deviation from the original equilibrium. By definition, however, no such deviation exist, implying that the candidate equilibrium is, indeed, an equilibrium. ■

[1] Remember the tie-breaking rule, i.e., that a retailer who is indifferent between common and exclusive representation opts for common representation.

In view of the lemma, a common representation equilibrium is fully pinned down by the non exclusive tariffs $(p_i, F_i)$. Given these, one can calculate the retailer's payoff

$$\kappa = \max_{q_1,q_2} \left[u(q_1, q_2) - p_1 q_1 - p_2 q_2 - (1+\mu)\left(F_1 + F_2\right)\right], \tag{A4.1}$$

and the corresponding exclusive tariffs $(p_i^E(\kappa), F_i^E(\kappa))$.

Next, let us denote by $\mathcal{E} \subset R_+^4$ the set of four-tuples $(p_1, F_1, p_2, F_2)$ that satisfy the following conditions:

$$\begin{array}{ll} (p_i - c_i)\, q_i^{CR}(p_i, p_j) + F_i \geq \hat{\Pi}_i^E(\kappa) & (E_i) \\ BR_i(p_j) \geq p_i & (NE_i) \\ \left[BR_i(p_j) - p_i\right] F_i = 0, & (CS_i) \end{array}$$

where $BR_i(p_j)$ is the best response function implcitly defined by condition (11) in the main text.

We then have:

**Proposition 2** *Any element of $\mathcal{E}$ is a common representation equilibrium; conversely, any common representation equilibrium is outcome equivalent to an element of $\mathcal{E}$.*

*Proof.* See below. ■

Proposition 1 clarifies the scope and limits to coordination informally discussed above. Inequalities $(E)$ say that each firm must prefer its equilibrium non-exclusive contract to the most profitable exclusive one that would be accepted by the retailer. Crucially, since both firms offer an exclusive contract which is worth $\kappa$ to the retailer, a firm that considers deviating to exclusivity must guarantee to the retailer a payoff of at least $\kappa$. If exclusive contracts were not offered, in contrast, a firm could deviate simply by guaranteeing to the retailer what he could obtain by trading only with the rival *at the non-exclusive terms*. This makes deviations to exclusivity less attractive and explains why common representation equilibria may be sustained.

However, preventing deviations to exclusivity is not the only condition for the sustainability of common representation equilibria: deviations to a different common representation outcome must be prevented as well. This is the role of inequalities $(NE)$ and the corresponding "complementary slackness" conditions $(CS)$. These conditions say that each firm's marginal price must lie on the corresponding best-response curve if the firm's fixed fee is positive, or below the best-response curve if the fixed fee vanishes. These conditions imply that if firms try to redistribute the profit by means of the fixed fees, they must stick to the equilibrium marginal prices $p_i^*$; if instead they try to change (reduce) the marginal prices, they must set the fixed fees at zero.

# 3. Types of equilibria

Proposition 1 allows us to provide a complete description of the possible equilibria that are payoff dominant for the upstream firms. Three cases can arise.

### 3.1. Quasi-neutrality

First of all, there might exist common representation equilibria in which the marginal prices are the same as in the forced common representation equilibrium, and only the fixed fees are different. In this case, we say that exclusive contracts are *quasi-neutral*. This case is obtained whenever $v(p_1^*, p_2^*) \geq \kappa$, which implies that both fixed fees can be positive. By the complementary slackness conditions, the marginal prices must then lie on the best response curves and thus must be $p_1^*$ and $p_2^*$. Thus, in this case exclusive contracts do not affect the marginal prices but decrease the fixed fees

Of course, for this to be an equilibrium the no-deviation conditions $(E_i)$ must hold. Figure 1 illustrates a case in which these conditions are indeed met. For clarity, the figure focuses only on the no-deviation condition for the dominant firm, $(E_1)$, which is generally tighter than the corresponding condition for its rival, $(E_2)$. The condition may be checked by drawing the iso-profit curve $p_1 q_1^{CR}(p_1, p_2) + F_1 = \hat{\Pi}_1^E(\kappa)$. It should be noted that the retailer's participation constraint (A4.1) pins down only the aggregate level of the fixed fees. The curve is drawn for the limiting case $F_1 = 0$, which further contributes to relax constraint $(E_2)$. As drawn, condition $(E_1)$ is met even if $F_1 = 0$. In other cases, such quasi-neutral equilibria may require a division of the fixed fees between the firms more favorable to the dominant firm.

### 3.2. Non neutrality

A second possibility is that common representation equilibria exist, but the marginal prices are strictly smaller than $p_1^*$ and $p_2^*$. (By conditions $(NE_i)$, they can never be greater.) This requires that $v(p_1^*, p_2^*) < \kappa$. This possibility is illustrated in Figure 2. As before, the figure focuses on the no-deviation condition for the dominant firm, $(E_1)$, taking it for granted that the weaker condition $(E_2)$ is also satisfied. In the case depicted, for the given $\kappa$ there is a range of possible marginal prices. All of them lie strictly below firm 2's best response, implying that $F_2 = 0$. The value of $F_1$ is then pinned down by condition (A4.1) at $\bar{F}_1$.

In this case, exclusive contracts lower the marginal prices. Therefore, they increase the retailer's payoff, gross of the fixed fees, and hence presumably also the welfare of the final consumers. On the other hand, upstream firms' profits are lower than in the common representation equilibrium. Since the division of profits is, to some extent, indeterminate, one cannot rule out the possibility that one firm (but not both) might be better off than under common representation. But overall the effect of exclusive contracts is clearly pro-competitive.

### 3.3. Non existence

The third and last possibility is that the set $\mathcal{C}$ is empty. This case is illustrated in Figure 3. To make condition $(E_1)$ as weak as possible we set $\kappa = v(0, c)$ and $F_2 = 0$. This notwithstanding, firm 1's iso-profit curve $p_1 q_1^{CR}(p_1, p_2) + F_1 = \hat{\Pi}_1^E(\kappa)$ does not intersect the locus $v(p_1, p_2) = \kappa$ in the region between the two

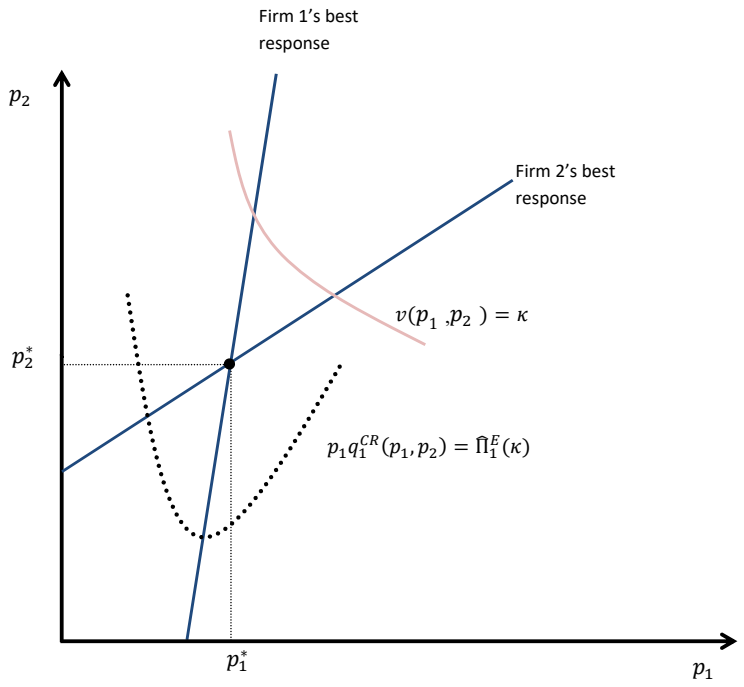


Figure 1: Coordination on the forced common representation marginal prices

best responses, meaning that it is not possible to meet simultaneously conditions (A4.1), $(E_i)$, and $(NE_i)$. In this case, the only equilibrium is the exclusive representation equilibrium of Proposition 4 in the main text.

To understand why coordination may fail altogether, it is useful to note that coordination is easiest when $F_i = 0$. The reason for this is twofold. Firstly, setting $F_i > 0$ forces $p_i$ to lay exactly on the best response $BR_i(p_j)$, eliminating one degree of freedom. Secondly, raising $F_i$ by $\Delta F_i$ increases the left-hand side of $(E_i)$ by the same amount. However, $\kappa$ decreases by $(1+\mu)\Delta F_i$, and hence the right-hand side increases by at least $\Delta F_i$. This means that when $F_i$ increases conditions $(E_i)$ cannot become looser and may in fact become tighter.

When $F_i = 0$, however, firms cannot redistribute the profits by manipulating the fixed fees. Therefore, marginal prices must play a double role: they must create an efficiency gain with respect to the single sourcing outcome, and at the same time they must redistribute the surplus between the firms in an incentive-compatible way. When the dominant firm's competitive advantage is small, the two goals then do not conflict with each other as firms are almost symmetric, and thus they both can be attained. But when the competitive advantage is

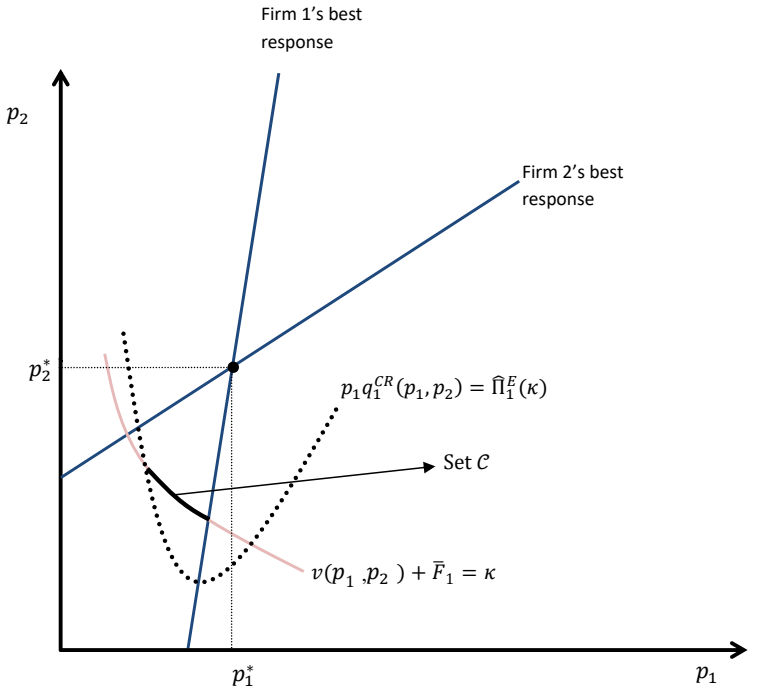


Figure 2: Common representation equilibria exist but marginal prices are lower than in the forced common representation equilibrium

larger, the goals become conflicting and cannot be both achieved simultaneously.

It is important to note that this case can arise even if exclusive representation is unprofitable for the dominant firm. Even in that case, coordination may simply not be possible, implying that firms are inevitably trapped in a prisoner's dilemma.

Proposition 9 in the main text illustrates when each of the three cases arise in the case of the quadratic payoff function (10).

**Proof of Proposition 1.** *Necessity.* We must show that for any common representation equilibrium the non-exclusive tariffs $(p_1, p_2, F_1, F_2)$ satisfy conditions $(E_i)$, $(NE_i)$ and $(CS_i)$. The exclusive tariffs may be different from $\left(p_i^E(\kappa), F_i^E(\kappa)\right)$, but since these contracts are not signed in equilibrium, this does not affect the outcome.

If condition $(E_1)$ does not hold, the dominant firm can profitably deviate from the original equilibrium by changing its non-exclusive tariff so as to make it

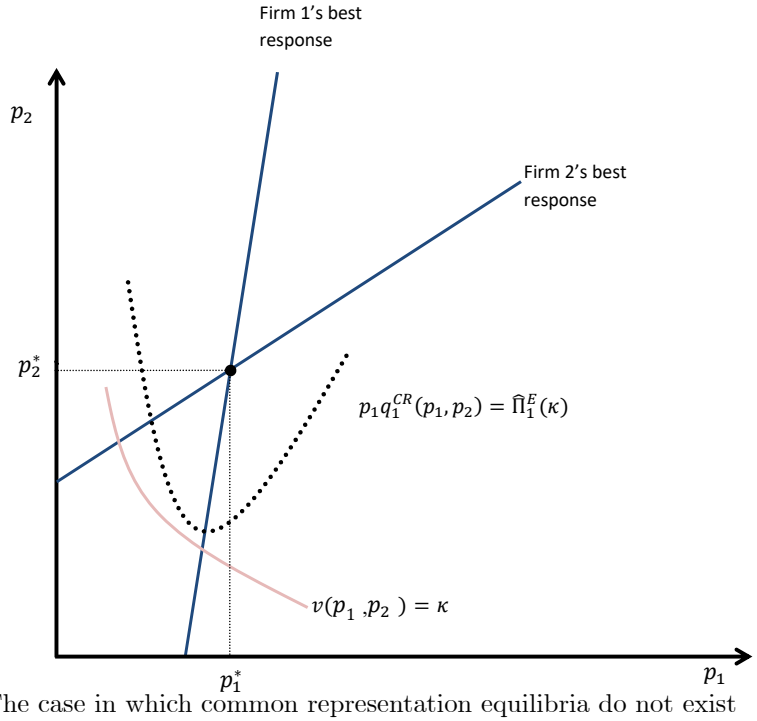

Figure 3: The case in which common representation equilibria do not exist

less attractive for the retailer and offering the exclusive contract $\left(p_1^E(\kappa), F_1^E(\kappa)\right)$. The retailer would then sign the exclusive contract $\left(p_1^E(\kappa), F_1^E(\kappa)\right)$ since the rival's exclusive contract entail an expected utility not greater than $\kappa$ (otherwise, the retailer would not have signed the non-exclusive contracts in the original equilibrium). But the exclusive contract $\left(p_1^E(\kappa), F_1^E(\kappa)\right)$ is more profitable than the equilibrium non-exclusive contract if condition $(E_1)$ fails. The argument for $(E_2)$ is similar, except that firm 2's deviation may have to slightly undercut the exclusive contract $\left(p_2^E(\kappa), F_2^E(\kappa)\right)$ to break a possible indifference.

If condition $(NE_i)$ does not hold, a firm could profitably deviate by decreasing its marginal price. Finally, if condition $(CS_i)$ does not hold, a firm could profitably deviate by increasing its marginal price. This completes the proof of necessity.

*Sufficiency.* We must show that any vector $(p_1, p_2, F_1, F_2)$ that satisfies conditions $(E_i)$, $(NE_i)$ and $(CS_i)$ is a common representation equilibrium. This requires that the retailer signs the non-exclusive contracts, and that no firm has any profitable deviation.

That the retailer signs the non-exclusive contracts is guaranteed by condition (A4.1) and our tie-breaking rule.

There are three types of possible deviations: a firm could change its exclusive contract, its non-exclusive contract, or both. Consider first a deviation to a different exclusive contract. Since the rival's exclusive contract guarantees to the retailer an expected utility of $\kappa$, no exclusive contract could be signed if it does not entail at least the same expected utility. However, condition $(E_i)$ says that the most profitable among the exclusive contracts that could be signed by the retailer is less profitable than the equilibrium non-exclusive contract. Thus, there is no profitable deviation to a different exclusive contract.

Second, a firm could deviate to a different non-exclusive contract. In particular, it could either increase or decrease its marginal price. However, if the deviating firm increases its marginal price, it must reduce the fixed fee; otherwise, the retailer would sign an exclusive contract. Therefore, an increase in the marginal price is feasible only if the original fixed fee is positive. But in this case condition $(CS_i)$ says that the marginal price lies on the firm's best response curve. On the other hand, condition $(NE_i)$ says that a decrease in the marginal price is unprofitable. Therefore, no firm can profitably deviate to a different non-exclusive contracts.

Finally, consider a deviation in which a firm changes simultaneously both the exclusive and the non-exclusive tariff. If the retailer still signs the non-exclusive contracts, the deviation is equivalent to a deviation in which only the non-exclusive contract is changed. The reason for this is that the retailer can still choose the rival's exclusive contract, and thus his reservation utility is at least $\kappa$. If instead the retailer chooses the new exclusive contract, this contract must give the retailer at least the same expected utility as the rival's exclusive contract, which has not changed. But then by condition $(E_i)$ the new exclusive contract cannot be more profitable than the equilibrium non-exclusive contract. ■