Exclusion through speculation[1]

(Work in progress)

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Abstract

Many products are traded on both a spot market and a derivative market. We show that an incumbent producer and a large buyer may have a joint interest in using financial instruments so as to extract rent from a potential entrant. The incumbent can indeed use those instruments to "commit" himself to compete aggressively in the spot market and drive the price down for the entrant. It can do so by selling more option contracts than his expected production level, i.e. by taking a speculative position. This comes at the cost of inefficiently deterring entry.

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1 Introduction

Many products are traded on both a spot market and a derivate market. On this latter market, financial instruments are used to take positions on the spot market price. There is evidence that many firms are active on this market.[2] In this paper, we explore the possibility for incumbent firms with market power to use financial instruments so as to deter the entry of a more efficient rival.

In this paper, we show that an incumbent producer and a large buyer may have a joint interest in speculating on the changes in the spot market price so as to extract rent from a potential entrant. This comes at the cost of inefficiently deterring entry.

The intuition is as follows. In the seminal paper by Aghion and Bolton (1987), an incumbent convinces the buyer to sign an exclusivity contract that forces an entrant to charge a low price upon entry. Indeed, because of contractual penalties, breaching the exclusivity contract is costly to the buyer. Hence, in order to remain competitive, the entrant must compensate him for the penalty by posting a lower price. This price reduction discourages entry but, through the transfers specified in the contract, accrues to the incumbent in cases where entry does occur.

Our model extends the logic of Aghion and Bolton (1987) to the case where the incumbent offers the buyer a purely financial contract (call option or forward contract) instead of an exclusivity contract. The incumbent can use this contract to "commit" himself to compete aggressively in the spot market and drive the price down for the entrant. It can do so by selling more option contracts than his expected production level, i.e. by taking a speculative position.

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[2] For empirical evidence on the use of commodity derivatives by firms, see, *inter alia*, Nance et al. (1993), Mian (1996), Berkman and Bradbury (1996), Haushalter (2000), Hentschel and Kothari (2001), Graham and Rogers (2002), Guay and Kothari (2003), Adam and Fernando (2006). For a recent overview of the various reasons for, and techniques used in, corporate risk management, see Chew (2007).

Currently, competition authorities do not routinely monitor the financial positions taken by dominant firms. We argue that on certain markets, this may be needed to counter the incentives for incumbents to commit to (overly) aggressive pricing.

This paper relates to several strands of economic literature. First, there is a small industrial organization literature which looks at the interaction between derivatives markets and product markets. The main message in this literature is that firms may use financial derivatives as a way to affect the equilibrium in the spot market and increase their overall profit. The precise strategy depends on the nature of competition. If oligopolists compete à la Cournot, then they will sell forward contracts (or integrate vertically) to compete more aggressively in the market, which increases their market share at the expense of the other participants (Allaz and Vila, 1993). Willems (2005) shows that those results also hold for option contracts. On the other hand, if oligopolists compete à la Bertrand, then they have an incentive to buy forward contracts, and commit to being less aggressive (Mahenc and Salanié, 2004). We show that even under price competition, financial instruments can be used by an incumbent to increase the intensity of competition but with deleterious effects on entry incentives.

Second, in finance, there is now a voluminous literature on corporate risk management.[3] It is typically interested in explaining how product market interaction affects (should affect) the pattern of financial positions taken by firms. For instance, Adam et al. (2007) analyze the simultaneous hedging decisions of oligopolistic firms subject to cost shocks and show that in equilibrium some firms hedge while others don't, even if they are ex ante identical. In our research, we focus on the other direction of the relationship, i.e. how financial positions can affect strategic interaction in the product market.

Third, in this respect, predation constitutes a prominent link between financial markets and product markets. Bolton and Scharfstein (1990) were the first to provide theoretical underpinnings to the "long purse" predation theory, according to which

[3] See the references mentioned in footnote 1.

cash-rich firms can drive out rivals with limited access to internal funds in the presence of agency problems. Scott Morton (1997) indeed finds that "financially weaker" entrants tended to be fought more often by nineteenth-century shipping cartels. Chevalier (1995) and Campello (2003, 2006) report some evidence that rivals of highly-leveraged firms increase investments so as to gain more market share and drive the financially-constrained firms out of business. Froot, Scharfstein and Stein (1993) argue that the use of corporate derivatives can protect firms from this predatory risk. Haushalter et al (2007) indeed present some evidence that the extent of the interdependence of firm's investment opportunities with rivals is positively associated with its use of derivatives. All modern theories of predation involve asymmetric information and some manipulation of (the entrant's or its creditors') beliefs.[4] Our model shows that below-cost pricing can also arise in a perfect information model when an incumbent has an interest in taking a financial bet on low prices. It also suggests that the availability of derivatives, although useful to the prey, can also be useful to the predator.

Fourth, our paper relates more generally to the large industrial organization literature on exclusion, most recently surveyed by Rey and Tirole (2007). We show that the range of exclusionary contractual practices is not limited to instruments with obvious entry restrictions, such as exclusivity contracts, but that apparently innocuous contracts such as standard financial instruments can also be misused.

Fifth, there is small literature on price-increasing entry, a feature of our model. Hollander (1987) and Perloff et al. (2006) show that on a market for differentiated products, composition effects on the demand-side may cause prices to increase when an additional variant is introduced. Schulz and Stahl (1996) stress the role of endogenous search costs. Chen and Riordan (2008) use a discrete choice model of product differentiation to analyze how more consumer choice can change the price elasticity of demand. We show that on a market for a *homogenous* good, the exclusionary strategy of an incumbent can give rise to this phenomenon.

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[4] As examplified by the presentations in Bolton, Brodley and Riordan (2000) or Motta (2004).

The paper is structured as follows. The model is presented in Section 2. In Section 3, we conduct the main analysis. In Section 4, we extend the model to deal with two complications: the case where the buyer is free to choose the number of option contracts he takes on, and the case where the identity of the parties to a financial contract is not observable. Section 5 concludes.

2 Model

We study the subgame-perfect equilibria of a game between three players: the buyer, the incumbent and the entrant.

The *buyer* buys zero or one unit of the good. His reservation price for the good is equal to 1. The buyer is risk-averse and his preferences are represented by a von Neumann-Morgenstern utility function U. The expected utility of the buyer when consuming 1 unit of the good is equal to

$$E[U(1-p)] \tag{1}$$

where expectations are taken over the different states of the world, and $\max\{c_I, c_E\}$ is the price faced by the buyer in a specific state. The utility function of the buyer is upward-sloping and concave ($U'>0$ and $U''\leq 0$), and (without loss of generality) is such that $U(0)=0$.

The *incumbent* producer is risk-neutral and has a production cost $c_I<1$. He seeks to maximize expected profit.

The *entrant* producer is also risk-neutral and has a production cost c_E which, for simplicity, is drawn from the uniform distribution over $[0,1]$. The cumulative distribution function of her production costs is thus $F(c_E)=c_E$. Uncertainty about c_E is the only source of uncertainty in our model.[5] The entrant strives to maximize expected profit.

[5] We solve for pure-strategy equilibria. Hence, there is no additional, 'strategic' source of risk in the model.

The game consists of four stages. In stage 1 the incumbent makes a-take-it-or-leave-it offer to sell to the buyer x *call options* with strike price s and fee f. According to this contract (x, f, s), the buyer pays x times the fixed fee f upfront in order to acquire the right to be paid x times the difference between the spot market price p and the strike price s (which he will exercise as long as this difference is positive). Hence, the buyer's financial gains from the contract are given by

$$x(-f + \max\{p - s, 0\}) \tag{2}$$

In stage 2 of the game, the buyer decides whether he accepts the contract offered by the incumbent or not.

In stage 3 the entrant and all other players in the game observe the financial position of the incumbent and the buyer and learn about c_E. The entrant decides whether she enters the market.

In stage 4, Bertrand competition takes place in the spot market. Firms who are active in the market post bids. They are committed to serve all demand addressed to them at their posted price. The payoff of the entrant directly depends on the spot market price and sales. The utilities of the buyer and the incumbent producer depend not only on the spot market sales but also on the financial contract that they may have previously signed.

3 Analysis

3.1 Taking a financial position so as to hedge

Before looking for the equilibrium of this game, we will first look at the case where players use financial contracts for the sole purpose of hedging their activities.

We therefore restrict the incumbent to offer a forward contract for one unit of production. This contract perfectly insures the buyer against any price change in the sport market and, as demand is inelastic, leads to perfect hedging. The forward contract specifies that in exchange for paying f the buyer has the right to be paid the amount p by the incumbent, where p is the spot market price. In the general model, a forward contract is equivalent to a contract with $x = 1$ and $s = 0$.

Suppose that this contract has been accepted by the buyer and that the entrant has decided to enter the market. Upon observing the prices posted by firms in stage 4, the buyer is indifferent between buying from the incumbent or the entrant.

If he makes the sale, the incumbent is perfectly hedged against the variations in the spot market price. However, he is willing to cut his price if that is needed to prevent the entrant from making the sale and leaving him with financial liabilities only. This is the case as long as $p_E > c_I$. Note that the incumbent never wants to sell below his own cost. The entrant always wants to undercut any price $p_I > c_E$ posted by the incumbent, as in standard Bertrand competition.

In Bertrand games, multiplicity of equilibria is endemic. As is common, we assume that players do not play weakly dominated strategies. So, in equilibrium, both sellers post the same price $p_I = p_E = \max\{c_I, c_E\}$ and the buyer buys from the firm with the lowest marginal cost.

By backward induction, the entrant will enter only if her marginal cost is small enough to allow her to make profitable sales. The condition is given by,

$$\pi_E = (c_I - c_E) > 0.$$

That is, the entrant enters only when she is the most efficient firm. Given our assumption that c_E is uniformly distributed, the probability of entry under hedging (superscript H) is:

$$\phi^H = c_I. \tag{3}$$

In case the entrant stays out, then the incumbent (and the buyer) will subsequently be indifferent between all prices. For determinacy (and without any impact on the results, which depend only on the entry pattern), we assume that the incumbent will post a price p_I equal to the monopoly price, 1 (as would be the case if any additional buyer, however marginal, were present on the demand side).

In stage 1, the incumbent will thus offer the buyer a contract solving

$$\max_f \; f-\phi^H c_I-(1-\phi^H)c_I$$
$$s.t.$$
$$(i) \quad \phi^H = c_I \tag{4}$$
$$(ii) \quad U\left[1-f\right] \geq \phi^H U(1-c_I)$$

The objective function reflects the fact that the incumbent is perfectly hedged: in any case, he collects the fixed fee f for selling the forward contract. Upon entry, which occurs with probability ϕ^H, the entrant makes the sale and the incumbent has to pay the market price (c_I) to the buyer. When the entrant chooses to stay out, the incumbent makes the sale and earns the spot market price $p=1$ but because of the forward contract he pays it back to the entrant, while he incurs production cost c_I.

Constraint (i) reflects the anticipation of entry. Constraint (ii) is the participation constraint of the buyer: in order to accept the contract, he must be left with at least as much utility as when he refuses it.

Observe that with the forward contract there is nothing that the incumbent can do to affect entry. The program thus boils down to providing insurance to the buyer and extracting as big a fraction of risk-sharing gains as possible from the buyer through forward price f. Having all bargaining power, the incumbent will thus hold the buyer to his reservation utility level by setting f so as to make (ii) bind.

Note that entry will be efficient. The entrant will enter whenever her cost of production is smaller than the incumbent's. Thus, the presence of the financial contract is efficient as production is assured by the lowest-cost firm and the risk-averse buyer is fully insured.

3.2 Taking a financial position so as to exclude

Assume now that the incumbent can offer x call options with strike price s and fee f to the buyer. The buyer will exercise his options whenever $p \geq s$. If the strike price is high $(s \geq c_I)$, then the option will have no effect on the product market outcome. It is easy to show that the incumbent will never want to enter into such financial arrangements. Therefore, in what follows we will assume that the strike price is smaller than the cost of the incumbent: $s < c_I$.

In Stage 4, following entry, the profit of the incumbent is the following

$$\Pi_I = x f - x \max\{0, p - s\} + (p_I - c_I) q_I \tag{5}$$

where p is the spot price, p_I denotes the price posted by the incumbent, and q_I the sales made by him. Those sales equal 1 when the buyer buys from the incumbent and 0 when he buys from the entrant. The incumbent sells the options at fee f (first term), insures the buyer when the spot price is high (second term), and makes an operational profit on his activity as producer (third term).

The buyer maximizes his utility by choosing whether he accepts the offer of the incumbent or the entrant:

$$\max_{p_B \in \{p_I, p_E\}} U\left(1 - p_B + x \max\{0, p - s\}\right) \tag{6}$$

where p_B stands for the price at which the buyer transacts, and $p = \min\{p_I, p_E\}$ is the spot market price. We assume that the buyer cannot affect the spot market price p by switching to a more expensive supplier and pay a price $p_B > p$. (Again, this would be the case in the presence of any additional buyer, however marginal.) As a consequence, the buyer will always buy from the firm that offers the lowest price.

That is to say, in our model the financial contracts are defined with reference to the spot market price, and not the price at which the buyer transacts. This is a plausible assumption. Parties to a contract would be wary of moral hazard when indexing a transfer on a price which could be manipulated by one of them. Besides, options, as traded on financial markets, are typically defined with respect to the spot price, as quoted on the exchange, and not to the price observed in over-the-counter transactions.

The profit of the entrant is given by

$$\Pi_E = (p_E - c_E) q_E \tag{7}$$

where $q_E \in \{0,1\}$ stands for her sales in the spot market.

3.2.1 Pricing subgame

We now study the pricing behavior of the incumbent and the entrant. The behavior of the entrant is straightforward. As in a standard Bertrand game, she will undercut any price posted by the incumbent as long as this price is above her production cost c_E.

The behavior of the incumbent depends on his financial commitments. He will undercut as long as the financial gains from decreasing the price outweigh the operational losses from selling below cost. By not undercutting, the incumbent does not make the sale ($q_I = 0$), and receives from (5) a profit equal to

$$x\,f - x\max\{p_E - s, 0\}. \tag{8}$$

Upon undercutting ($q_I = 1$), he makes

$$x\,f - x\max\{p_I - s, 0\} + (p_I - c_I) \tag{9}$$

If the entrant bids below the strike price ($p_E < s$), then the option is not exercised and the incumbent will not undercut the entrant as it would only obtain a negative operational profit (since we assumed that $s < c_I$). If the entrant bids above the strike price ($p_E \geq s$) and the contract is such that $x > 1$, then, upon undercutting, the incumbent drop its price to the strike price $p_I = s$ to get rid of his financial liability.[6] In this case his profit is:

$$x\,f + s - c_I \tag{10}$$

Comparing (8) and (10), dropping the bid to the level of the strike price is profitable as long as $p_E > p^*$, where the threshold is given by $p^* \equiv s + \frac{c_I - s}{x}$. Note that $s \leq p^* \leq c_I$, and that the incumbent will undercut the entrant even when the price of the entrant is below his own marginal cost.

[6] If $x \leq 1$, the operational profit is always bigger than financial losses, so that the subgame reduces to standard Bertrand competition.

We proceed with deriving the equilibrium price, p, as a function of the cost of the entrant, c_E. Several cases must be distinguished.

(1) If $c_E \geq p^*$, then any profitable bid by the entrant is matched by a bid at $p_I = s$ by the incumbent. Thus, the equilibrium prescribes $p_I = s$ and $p_E \geq p^*$ and the buyer buys from the incumbent ($q_I = 1, q_E = 0$). That is, as the entrant's cost is relatively high, she cannot post a price that overcomes the incentive for the incumbent to price so low as to avoid financial losses. We call this a type A equilibrium.

(2) If $s < c_E < p^*$, there are several equilibria. The type A equilibrium still constitutes a Nash equilibrium ($p_E > p^*, p_I = s,$). Yet, there is another class of equilibria in which the incumbent and the entrant bid the same price, $c_E \leq p_E = p_I \leq p^*$ and the buyer buys from the entrant. As in the standard Bertrand game, we only take an interest in the highest price in this class of equilibria, as the other ones involve the play of weakly dominated strategies. Hence in this type B equilibrium $p_E = p_I = p^*$.[7] This multiplicity raises an equilibrium selection problem. In the type A equilibrium with price s, the profits of the incumbent and the entrant are as follows:

$$\Pi_I = s - c_I + xf, \qquad \Pi_E = 0 \tag{11}$$

In the type B equilibrium, the profits of the incumbent and the entrant are:

$$\Pi_I = s - p^* + xf \qquad \Pi_E = p^* - c_E \tag{12}$$

Thus, the type B equilibrium brings strictly more profit to both firms given that $p^* < c_I$. We therefore assume that it is the one played by firms.

[7] In a standard Bertrand game with asymmetric marginal costs, a similar set of multiple equilibria arises. The price can be lower than the second lowest marginal cost because one player, although he doesn't make any sale, constrains the price of the lowest cost firm by pricing low. Such equilibria do not survive standard refinements such as perfection.

(3) If $c_E < s$, only type B equilibria exist.

To summarize, if the marginal cost of the entrant is high ($c_E > p^*$), then the equilibrium price is equal to the strike price, ($p = p_I = s, p_E > p^*$), and the sale is made by the incumbent. If the marginal cost of the entrant is low ($c_E < p^*$), then the equilibrium is given by $p = p_E = p_I = p^*$, and the sale is made by the entrant. If there is no entry in the market, then the incumbent, who is making the sale for sure, wants to minimize his financial losses by charging the strike price. Interestingly, the spot price is higher when the entrant has a low cost. This is of course due to the profit wedge created by financial bets.

3.2.2 Entry decision

Anticipating this pattern, the entrant will thus enter only if $c_E < p^*$. The probability of entry under speculation (superscript S) is then equal to $\phi^S = p^*$. So, in the absence of entry, the spot price is s, while it is $p^* > s$ following entry. Therefore, the presence of a large volume of option contracts between the incumbent and the buyer gives rise to the phenomenon of price-increasing entry.

3.2.3 Program of the incumbent

The incumbent maximizes its profit by offering x option contracts with strike price s and fee f to the buyer. Under the proviso that $x > 1$, his program is

$$\begin{aligned}
&\max_{f,x,s} \; xf - \phi x(p^* - s) + (1-\phi)(s - c_I) \\
&s.t. \\
&(i) \quad \phi = p^* (= s + \tfrac{c_I - s}{x}) \\
&(ii) \quad \phi U\left[1 - p^* + x\left(p^* - s - f\right)\right] + (1-\phi)U\left[1 - s - xf\right] \geq c_I U(1 - c_I)
\end{aligned}$$

This optimization problem can be simplified to:

$$\begin{aligned}
&\max_{F,\phi} \; F - c_I \\
&s.t. \\
&\phi U\left[1 - F + c_I - \phi\right] + (1-\phi)U\left[1 - F\right] \geq c_I U(1 - c_I)
\end{aligned} \tag{13}$$

where $\phi = s + \frac{c_I - s}{x}$ is the probability of entry, and $F \equiv xf + s$, the *generalized price* of the contract. Along with the constraint, which will bind as F is a transfer, the optimal contract is characterized by the following condition:

$$U\left[1-F+c_I-\phi\right]-U\left[1-F\right]=\phi U'\left[1-F+c_I-\phi\right] \quad (14)$$

The left-hand side of equation (14) is the marginal benefit of allowing additional entry (the good is obtained from the entrant at cost ϕ instead of being produced by the incumbent at cost c_I), while the right-hand side is the marginal effect on the buyer's expected utility of the increase in the post-entry price that comes with additional entry. It is easily seen that in case of risk neutrality $\left(U(x)=x\right)$ this expression simplifies to $\phi = c_I/2$. Together with the participation constraint of the buyer, equation (14) then determines the optimal entry rate and the optimal fee structure. Observe that there are infinitely many choices of f, s and x that allow the incumbent to implement the optimal rate of exclusion so as to maximize his rents.

If the buyer is risk averse ($U'' < 0$), then the optimal level of entry will be larger than under risk neutrality ($\phi > c_I/2$). This follows directly from the concavity of the utility function. The average utility increase of receiving an extra $c_I - \phi$ is larger than the marginal effect of this increase evaluated at the terminal value[8]

$$\frac{U[1-F+(c_I-\phi)]-U\left[1-F\right]}{(c_I-\phi)} > U'\left[1-F+c_I-\phi\right] \quad (15)$$

Combining this expression with (14) gives $\phi > c_I/2$ That is, risk aversion obliges the incumbent to allow for more entry than joint-surplus maximization would dictate. The intuition for this result is clear. At $\phi = c_I/2$, any change in ϕ has second-order effects on the surplus extracted from the entrant. At the same time, allowing for entry improves the terms of the lottery faced by the buyer, which is a first-order effect

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[8] For a strictly concave utility function, it must hold that $U(x+y)-U(x) > U'(x+y)y$, for all x and y.

under risk aversion. Hence, the incumbent has an incentive to depart from joint-surplus maximization.

Interestingly, among the infinitely many combinations of s, x, and f that allow the incumbent to achieve optimal exclusion (from his point of view), there is an optimal contract with $s = 0$, i.e. a forward contract. Hence, exclusion does not require the use of (somewhat) complicated option contracts. Simple forward contracts can be used.

3.3 Equilibrium

We are now in the position to assert our main result: for any level of risk aversion, the incumbent will offer, and the buyer will accept, a speculative contract that leads to an inefficiently low level of entry.

To this purpose, it is sufficient to compare the profit of the incumbent under the optimal hedging (section 3.1) and optimal speculative (section 3.2) contracts, respectively. Observe that when faced with program (13) (when restricted to $x > 1$), the incumbent can reproduce the solution to program (4) (when restricted to $x \leq 1$) by choosing $s = c_I$, in which case the objective function takes the same value in both programs. Hence, the incumbent can always do at least as much as by hedging perfectly. As matter of fact, it is easy to show that it can do strictly better. From equation (14), when $\phi = c_I$, the net marginal benefit of increasing entry is strictly negative, indicating that the incumbent can strictly win by choosing $\phi < c_I$.

Proposition 1. *In subgame-perfect equilibrium, the incumbent offers, and the buyer accepts, a contract* (x, f, s) *characterized by*

$$\begin{cases} U\left[1-F+c_I-\phi\right]-U\left[1-F\right]=\phi U'\left[1-F+c_I-\phi\right] \\ \phi U\left[1-F+c_I-\phi\right]+(1-\phi)U\left[1-F\right]=c_I U(1-c_I) \end{cases} \tag{16}$$

where $\phi = s + \frac{c_I - s}{x}$ *and* $F = xf + s$. *There are infinitely many such contracts but they are all such that* $x > 1$ *and* $\phi < \phi^H$.

4 Complications

4.1 Buyer's contracting freedom

[to be written]

4.2 Unobservable contract offerers

Until now we have assumed that the contract signed by the incumbent and the buyer was perfectly observable by the entrant. In particular, it was known to her that the incumbent had committed to certain financial transfers. The buyer also observed who was offering the contracts. This may not be realistic. Bilateral, over-the-counter contracts are typically not made public and trades in a centralized market remain anonymous; only some terms are made public, e.g. the price of the clearing, or the latest, transaction. The question then arises as to whether the exclusion mechanism we identified above can survive non-observability of the parties to financial contracts.

Indeed, in principle, on an anonymous derivatives market, arbitrageurs may want to take advantage of the presence of the incumbent or the buyer by becoming their counterparties, thus preventing the incumbent-buyer pair from jointly extracting surplus from the entrant. (Indeed, if, say, the buyer buys an option contract from an arbitrageur, then this will not affect the spot price following entry, since the incumbent does not have an interest in charging low prices. If the fixed fee is high enough, the arbitrageur can still make a profit.)

This environment can be modeled as a (non-standard) signaling game where different option sellers (the incumbent and some arbitrageurs) submit bids into the derivatives market. The specifications of the bids are observed by the entrant and the buyer, but the identity of the bidders is not. The entrant and the buyer must thus form some beliefs about the type of bidders based on the bids they submit. We will look for a "separating equilibrium", in which the identity of the bidders is revealed by the bids they make.

Our aim is simply to illustrate how such an equilibrium can arise, in which all market participants expect that only the incumbent can profitably offer speculative contracts. That is all that is required in order to sustain the belief that exclusion will indeed subsequently occur. (As is well-known, asymmetric information games typically admit many non outcome-equivalent equilibria.)

The model in Section 2 is accordingly modified as follows. n risk-neutral financial investors are now part of the set of players. Along with the incumbent, in stage 1 they simultaneously post the terms (x, f, s) of the option contract they are willing to sell. With probability $1/(n+1)$, one of the bids is presented to the buyer.[9] The identity of the contract offerer is not revealed. In stage 2, the buyer decides whether he accepts the contract on offer. The game then proceeds as in the original model.

The incumbent's actions are now constrained by the presence of other sellers of financial instruments. In a "separating equilibrium", the incumbent must make an offer that cannot be profitably mimicked by financial investors. This will prove possible because the contract will have an effect on spot market competition *only if* it is signed by the incumbent.

We thus try to construct an equilibrium in which the incumbent offers one contract, the financial investors another one, the buyer accepts any offer put to him but correctly anticipates that only the incumbent is able to take a speculative position and decrease spot prices.

On the equilibrium path, a financial investor offers a contract that identifies him as such. So, with probability one, the buyer and the entrant believe that spot market prices will not be affected by acceptance. A financial investor maximizes his payoff by insuring the buyer against the price risk under efficient entry and, because it has all bargaining power, to extract all gains from risk-sharing. That is, it will offer a forward contract such that $s=0$, $x=1$ and f is such that:

$$U\left(1-f\right)=cU(1-c_I) \tag{17}$$

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[9] The probability with which various contracts are presented to the buyer does not affect the structure of the equilibrium, as long as it is non-zero.

In order to prevent financial investors from masquerading as an incumbent and offering "his" financial contract, it must be the case that this contract brings them less utility than their equilibrium contract.

Suppose that the arbitrageur deviates from the candidate equilibrium by offering the same contract as the incumbent's. If this contract happens to be presented to the incumbent, then the latter will choose to agree to it, under the belief that the offerer is the incumbent with probability one. The entrant, upon observing the financial position of the buyer, will entertain the same belief. Hence, she will choose to enter only when $c_E < p^*$. A sufficient condition for this deviation not to be profitable to the arbitrageur is that the financial gains from the contract are non-positive. That is,

$$\begin{aligned} & xf - \phi^S x(c_I - s) - (1-\phi^S)x(1-s) \le 0 \\ & s + f \le \phi^S c_I + (1-\phi^S) \end{aligned} \tag{18}$$

On the equilibrium path, one can thus define the program of the incumbent as follows:

$$\begin{aligned} \max_{\phi,F} \quad & F - c_I \\ s.t. \quad (i) \quad & (1-\phi)U(1-F) + \phi U(1-F+c_I-\phi) \ge \phi^H U(1-c_I) \\ (ii) \quad & s + f \le \phi^S c_I + (1-\phi^S) \end{aligned}$$

This is a well-behaved convex program. Ignoring the second constraint, one gets a unique solution ϕ^*, F^*, as in Proposition 1. We claim that it is always possible to choose a contract that solves this relaxed program and in addition satisfies constraint (ii). Indeed, choose s very close to ϕ^*. For instance, set $s = \phi^* - \varepsilon$ for a very small ε. Then, set x so that $\phi^* = s + \frac{c_I - s}{x}$. That is, $x = \frac{c_I - \phi^* + \varepsilon}{\varepsilon}$. Given s and x, finally choose f such that $F^* = s + xf$. That is, $f = \frac{F^* - \phi^* + \varepsilon}{c_I - \phi^* + \varepsilon}\varepsilon$. Notice that when ε approaches zero, x becomes very large while f becomes very small. Meanwhile, $s < c_I$ and the right-hand side of (ii) is strictly greater than c_I so that constraint (ii) is satisfied.

Hence, inequation (ii) does not constrain the solution to the programme! This result is intuitive. The profitability of the contract to arbitrageurs does not depend on x but only on the fixed fee that compensates for the payments to be made in case of entry. By contrast, the incumbent can always increase the volume of contracts to compensate for a decrease in the fee. Note that the incumbent's scheme cannot be implementing with a forward contract without violating the incentive constraint. The availability of option contracts is what allows him to set a low f and a high x and still keep control of the probability of entry through the choice of s.

Thus, an equilibrium can be specified as follows. Financial investors both offer a contract characterized by $x=1$, $s=0$ and f such that $U(1-f)=\phi^H U(1-c_I)$, which consists in guaranteeing the buyer the certainty equivalent of the lottery he faces under efficient entry ϕ^H.

The incumbent offers a contract implementing F^* and ϕ^* with a very low f.

The buyer accepts any offer presented to him (out of indifference).

The entrant observes the contract that has been offered. When he believes the offerer is an arbitrageur, he enters whenever $c_E < c_I$ and prices at c_I. When he believes the offerer is the incumbent, he enters whenever $c_E < p^*$ and price at p^*.

In equilibrium, from Stage 2 on, the buyer and the entrant believe that the first type of contract is offered by a financial investor with probability one and that the second contract is offered by the incumbent with probability one. Upon observing any other contract, the buyer and the entrant believe it comes from a financial investor with probability one.

The incumbent has no incentive to deviate: he offers the buyer the best contract compatible with his equilibrium outside option.[10] Mimicking financial investors would lead to a decrease in his profit.

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[10] If the buyer were presented with more than one contract, then his outside option would become endogenous and the participation constraint could become tighter as a result.

Financial investors do not want to deviate either. They have no incentive to offer better insurance terms to the buyer, since that does not affect the likelihood of making the deal. Suppose they mimicked the incumbent and offered "his" contract as well. If their contract were accepted by the buyer, they would then make a loss, as constraint (ii) is not binding.

Thus, even if no market participant can be certain that it is the incumbent that is taking a speculative position, in equilibrium, everybody infers that he is the only one with an interest in doing so. More precisely, he is the only player with an interest in betting *a lot* on low prices.

Note that if some arbitrageurs were also allowed to *buy* the contract offered by the incumbent in Stage 2, they could be interested in doing so. However, they would in any case have a valuation below the one of the buyer and the argument above makes clear that the incumbent can always use a contract that makes zero expected gains under efficient entry.

5 Conclusion

We have shown in a very simple model that an incumbent is able extract rent from an efficient entrant by taking a speculative position in the financial market, inefficiently deterring entry. To do so, he will sell more option contracts than the underlying volume of transactions. This speculative position will give him an incentive to behave more aggressively in the spot market, both in situations where entry occurs, and in situations where it does not.

The incumbent is able to recoup the low prices it charges to the buyer by adjusting the fee for which it sells the option and the number of contracts. Interestingly, the exclusionary outcome can also be attained under perfect information by using a simple forward contract.

When the buyer is risk-neutral, the contracting pair solves a problem that is akin to a standard monopsony problem, trading-off the likelihood of entry against the level of the post-entry price. When the buyer is risk-neutral, the pair is led to allow for more entry, as a way to improve the terms of the risky lottery that the buyer faces as a result of uncertain entry.

The optimal contract is such that the incumbent prices below costs in all circumstances. In a sense, through the use of financial instruments, the incumbent commits to predatory pricing, although this expression may be misleading. Indeed, there is no profit sacrifice in the short-term: given his financial commitments, the incumbent does what is optimal to him in a static fashion. For this reason, the competition abuse we identify in this paper might not be caught by current case law about predation, which requires short-term losses recouped by future gains.

When the buyer is free to decide about the number of contracts he takes on, the incumbent can still implement his preferred exclusion scheme by using option contracts with very low fees.

Similarly, when the identities of the parties to a financial contract are not public, the incumbent and the buyer are still in the position of inefficiently deterring entry. The reason is that nobody but the incumbent has an incentive to bet on very low prices since those low prices will not materialize unless the incumbent is financially committed to them! Thus, in equilibrium, everybody rightly infer from the availability of such contracts that reduced entry will ensue.

This paper thus adds to the literature that warns that the availability of financial instruments is not always good news for the functioning of product markets. As far as we can judge, there is very little recognition of this concern and, indeed, competition authorities do not typically monitor the financial positions of dominant firms. We argue that on certain markets, such as the electricity, gas, or gold markets, in which big producers and big buyers are both active on the spot market and the derivatives market, there might be reasons to start doing so.

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