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RSCAS 2011/63

ROBERT SCHUMAN CENTRE FOR ADVANCED STUDIES
Loyola de Palacio Programme on Energy Policy

EXCLUSION THROUGH SPECULATION

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ISSN 1028-3625

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Printed in Italy, December 2011

European University Institute

Badia Fiesolana

I – 50014 San Domenico di Fiesole (FI)

Italy

www.eui.eu/RSCAS/Publications/

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Abstract*

Many commodities are traded on both a spot market and a derivative market. We show that an incumbent producer may use purely financial derivatives to extract rent from a potential entrant. It can do so by selling derivatives to a large buyer for more than his expected production level. This exclusionary scheme comes at the cost of inefficiently deterring entry and creating too much risk for the buyer. We further show that it can still be used when contracts are offered anonymously through a broker, as the incumbent can signal its identity by adjusting the contracting terms.

Keywords

Exclusion, monopolization, contracts, financial contracts, derivatives, risk aversion, speculation

JEL codes: D43, D86, K21, L12, L42

* An earlier version of this paper was published as TILEC discussion paper 2010-027, <http://ssrn.com/abstract=1651112>. Bert Willems' work was funded under a Marie Curie Intra European Fellowship (PIEF-GA-2008-221085). The authors thank Georges de M n il, Jens Pr ufer and Gijsbert Zwart for useful comments as well as seminar participants at TILEC/Tilburg University, University of Luxemburg, ACLE/University of Amsterdam and Facult s universitaires Notre-Dame de la Paix, Namur. The authors are responsible for any mistake.

1 Introduction

Competition authorities routinely monitor and curb the use of exclusivity contracts, as they can be used to deter the entry of more efficient rivals.² In the US, exclusivity contracts were contested in such early cases as *United Shoe Machinery*³ or *Lorain Journal*⁴. In Europe, competition authorities recently dealt with a series of cases involving energy companies.⁵ Firms are well aware of the fact that exclusivity clauses are scrutinized by regulators, and can therefore try to rely on other contracting schemes to deter entry. In this paper we investigate whether dominant firms can use standard financial contracts instead of exclusivity contracts to discourage entry by new competitors.

In the seminal paper by Aghion and Bolton (1987; henceforth, AB), an incumbent convinces a large buyer to sign a sales contract that specifies penalties for contract breach, forcing an entrant to charge a low price upon entry. Indeed, in order to remain competitive and make the sale, the entrant must compensate the buyer for those penalties 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. Rey and Tirole (2007; footnote 91) note that the contract in AB is in effect equivalent to a physical option: the buyer pays a fixed fee at the contracting stage in order to acquire the right to acquire the good from the incumbent at a pre-specified low price in the future. Thus, physical options — that is,

² Bernheim and Whinston (1999) provide an excellent overview.

³ *United Shoe Machinery Corp. v. United States*, 258 U.S. 451 (1922).

⁴ *Lorain Journal Co. v. United States*, 342 U.S. 143 (1951).

⁵ The cases involved *Distrigaz*, *Synergen*, *Repsol*, *EDF* and *E.ON/Ruhrgas*. (European Commission decisions COMP/B-1/37966 – *Distrigaz*, COMP/E-3/37732 – *Synergen*, COMP/B-1/38348 – *Repsol*, COMP/39386 – *EDF*, German competition authority (Bundeskartellamt) decision B8-113/03-1 – *E.ON Ruhrgas*.)

options that are settled by physical delivery of the underlying asset — can be used for exclusionary purposes.

In practice, however, most derivatives are financial in nature, that is, they are settled in cash rather than *in natura*. For instance on EUREX only 2% of all transactions are physically settled (Deutsche Börse, 2008; p. 15).⁶ In this paper, we show that a purely financial option is not equivalent to the AB contract, which prevents incumbents from using Rey's and Tirole's (2007) scheme. It is therefore not obvious that financial instruments can be used to deter entry.

We proceed to demonstrate that an incumbent firm can instead sell a very large volume of purely financial derivatives to a large buyer, in order to achieve entry deterrence. Although this scheme still deters entry, it is costlier for the incumbent. Hence, the financial settlement of derivatives makes it harder for an incumbent firm to exclude, but not impossible.⁷

The intuition for those results is simple. In the model, the incumbent sells call options for more than his expected production level, i.e. takes a speculative position. This exposes the incumbent to high spot prices, and induces him to compete more aggressively in the spot market. The incumbent can therefore use financial contracts to “commit” to be a tough competitor and drive the price down for the entrant. Accepting those contracts, however, is risky for the buyer who must be compensated for signing up to the deal if he is risk-averse.

⁶ Only a small number of derivatives, mainly the ones concerning agricultural products or metals, provide for physical delivery. Even then, very few contracts are finally executed, for it is customary for traders to close their position ahead of maturity by entering into an opposite contract.

⁷ Although the mechanism is different, our outcome resonates with Joskow and Tirole (2000). They show in the context of transmission congestion pricing that financial transmission rights are less harmful to social welfare than physical transmission rights in the presence of market power.

This additional inefficiency causes extra costs for the incumbent, in comparison with the use of exclusivity contracts.

The use of commodity derivatives has exploded. In June 2008 the notional value of outstanding over-the-counter commodity derivatives worldwide was estimated at 13,229 billions of US dollars (BIS, 2010; p. A121), about 30 times the 1998 value.⁸ A significant fraction of those instruments are held by large non-financial firms.⁹ In some specific industries such as gold mining (Tufano, 1996, 1998) and energy (Haushalter, 2000), their usage is widespread.¹⁰

Many of those commodity markets cover concentrated, capital-intensive sectors where market power can be considerable. Electricity, gas, oil, or steel markets are highly concentrated, and some firms have dominant market positions. That those firms might try to use financial instruments to affect spot market competition is not far-fetched. We do not know of an existing antitrust case where financial contracts have been used for entry deterrence, but for another type of anticompetitive practice, collusion, a first case has already been brought to court.¹¹

⁸ Notional values are not available for exchange-traded derivatives but in June 2010 about 37.6 millions commodity futures and 20.6 millions options were outstanding (BIS, 2010; p. A127).

⁹ 70% of European OTC commodity derivatives were held by non-financial firms in 2006 according to Deutsche Börse (2008; p. 9), citing a survey by McKinsey.

¹⁰ For additional empirical evidence on the use of commodity derivatives by firms, see, *inter alia*, Nance et al. (1993), Mian (1996), Berkman and Bradbury (1996), Hentschel and Kothari (2001), Graham and Rogers (2002), Guay and Kothari (2003), Adam and Fernando (2006).

¹¹ The *US v. KeySpan Corporation* case recently settled by the US Department of Justice involved the use of financial derivatives by an incumbent electricity producer allegedly to collude on high prices with a new entrant in the New York City market, in violation of Section 1 of the Sherman Act. We thank Patrick Bolton for pointing our attention to this case.

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

The paper is structured as follows. We review the relevant literature in the next section. We present our model in Section 3. In Section 4, we conduct the main analysis. Section 5 extends the model by assuming that the identity of the parties to the financial contract is not observable. Section 6 concludes.

2 Related literature

This paper relates to several strands of economic literature. First, there is now a voluminous literature on corporate risk management.¹² It is typically interested in explaining the hedging behavior of firms, in spite of the possibility for claimholders (such as shareholders) to diversify their portfolio. Leading explanations resort to conflicting objectives between managers and shareholders (Stulz, 1984, 1991), agency problems between firms and investors leading to credit rationing, thus providing firms with an incentive to smooth out their cash flow (Campbell and Kracaw, 1990; Froot, Scharfstein and Stein, 1993), or tax distortions (Smith and Schultz, 1985; MacMinn, 1987). At the same time, it is known that some factors lead firms not to hedge their income flow. Market power is one of them. Forward sales reduce monopoly power and, in the absence of reinvestment needs, a monopolist would find it optimal never to hedge income.¹³ We push the logic one step

¹² It is impossible to do justice to all contributors. For a state-of-the-art survey of corporate finance theory, see Tirole (2006).

¹³ See Tirole (2006; section 5.4)

further by showing that a monopolist can actually favor taking a *risky* position for the sake of deterring entry.

Second, a growing literature looks at the interaction between derivatives markets and product markets in oligopoly settings. The main message in this literature is that firms may use financial derivatives strategically 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, in an attempt at increasing their market share at the expense of the other participants (Allaz and Vila, 1993).¹⁴ 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).¹⁵ 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.

Third, 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 cash-rich firms can drive out rivals

¹⁴ Hughes and Kao (1997) extend the analysis to the case where forward contracts are not observable and show that they can still be used for strategic purposes.

¹⁵ See Adam, Dasgupta and Titman (2007) for a model in which only a subset of symmetric firms choose to hedge. Starting with Brander and Lewis (1986) and Showalter (1995) a parallel literature developed on the interaction between corporate financing choices and product market competition.

with limited access to internal funds in the presence of agency problems.¹⁶ 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 commodity derivatives can protect firms from this predatory risk. Haushalter, Klasa and Maxwell (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. Most modern theories of predation involve asymmetric information and some manipulation of (the entrant's or its creditors') beliefs.¹⁷ Our model shows that below-cost pricing can also arise in a complete 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 literature on exclusion.¹⁸ Several authors explore the effect of a firm's capital structure on product market exclusionary strategies. McAndrews and Nakamura (1992) investigate entry deterrence in a Cournot model and show that when demand is uncertain, an incumbent can use debt to discourage

¹⁶ See also Benoît (1983) (exogenous financial constraints) and Fudenberg and Tirole (1986) ("long-purse" interpretation of their "signal-jamming" predation model).

¹⁷ As exemplified by the presentations in Bolton, Brodley and Riordan (2000) or Motta (2004).

¹⁸ The literature on entry deterrence is enormous. See Ordober and Saloner (1989) and Wilson (1992) for surveys of early pieces. Exclusion by means of (exclusivity) contracts was most recently surveyed by Whinston (2006) and Rey and Tirole (2007).

entry without deviating from the all-equity monopoly output. Showalter (1999) shows that in an industry with uncertain costs and Bertrand competition, an incumbent can occasionally deter entry by using debt to commit to a sufficiently low price. Cestone and White (2003) show that, if credit markets are imperfectly competitive, commitment problems on the part of the investor lead to the choice of equity as the way to fund an incumbent so as to prevent rivals from accessing credit. In this paper, we look at *derivatives* markets, rather than debt or equity markets.

Fifth, there is a small literature about price-increasing entry, a feature of our model. Rosenthal (1980), Hollander (1987) and Perloff, Suslow and Seguin (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. Similarly, 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. Satterthwaite (1979), Schulz and Stahl (1996) and Janssen and Moraga-González (2004) stress the role of endogenous search costs. We show that on a market for a *homogenous* good, the exclusionary strategy of an incumbent can give rise to the phenomenon.

3 Model

We study the subgame-perfect equilibria of a game between three players: the buyer, the incumbent and the entrant. With the exception of the contracts used and risk preferences, the model closely follows AB.

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

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

where expectations are taken over the different states of the world, and p_B is the price faced by the buyer in a specific state. The utility function of the buyer is increasing and concave ($U' > 0$ and $U'' \leq 0$), and so normalized that $U(0) = 0$.¹⁹

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.²⁰ The entrant strives to maximize expected profit.

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 purely financial *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

¹⁹ Risk aversion provides a justification for the very existence of a derivatives market. However, our exclusion result can also be derived with a risk-neutral buyer.

²⁰ We solve for pure-strategy equilibria. Hence, there is no additional, 'strategic' source of risk in the model.

(which he will exercise as long as this difference is positive). Hence, the buyer's financial gains from the contract are given by

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

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 .²¹ The entrant decides whether she enters the market.

In *stage 4*, the spot market operates. Active firms post bids (p_I and p_E for the incumbent and the entrant, respectively) and the buyer decides whether to transact at spot market price $p = \min\{p_E, p_I\}$.²² 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.²³

²¹ Although this is an extreme assumption, accounting rules often provide for some form of disclosure of the financial positions taken by public firms. See, for instance, International Financial Reporting Standard (IFRS) 7, *Financial Instruments: Disclosures*, issued by the International Accounting Standards Board (IASB). We relax this assumption in Section 5.

²² We have an open limit-order book system in mind, in which the bids of the entrant and the incumbent are collected, and the lowest bid supplied is executed first and thus sets the price in the spot market. The outcome is the same as the one of Bertrand competition.

²³ We assume that derivatives contracts have to be executed. Renegotiation-proofness is an issue in models of inefficient exclusion by means of contracts, as shown by Spier and Whinston (1995) in the case of the original Aghion and Bolton (1987) model. The general issue is the one of the commitment value of contracts towards third parties. Asymmetric information may restore commitment power; see, e.g., Dewatripont (1987), Katz (1991) or Caillaud, Jullien and Picard (1995). We note that financial

4 Analysis

4.1 Physical option contracts

We will first study the case where the incumbent can use a *physical* option contract to implement the original AB scheme. Recall that a contract in AB is a pair (P, P_0) where P stands for the purchase price and P_0 for the contractual penalty to be paid by the buyer in case he does not procure from the incumbent. As suggested by Rey and Tirole (2007), this contract can be interpreted as a call option bought at fee P_0 to buy one unit of the good at pre-specified price $P - P_0$.

Proposition 1 (Rey & Tirole, 2007) *If the incumbent sells a physical call option for one unit $x = 1$ with strike price $s = P - P_0 < c_I$, and option price $f = P_0$ then entry will be partially deterred, as in AB. The contracting framework (x, f, s) is therefore equivalent to (P, P_0) .*

Proof. Suppose that a contract (x, f, s) has been accepted by the buyer and that the entrant has decided to enter the market. In stage 4 the buyer can either exercise his option and procure the good at price $s = P - P_0$ or buy at spot market price $p = \min(p_E, p_I)$. He prefers buying from the market whenever $p \leq s = P - P_0$. Hence, the entrant has to post price $p_E \leq s$ if she wants to make the sale. By backward induction, she will anticipate that she will make the sale at price s and will enter only when $c_E \leq s$. Entry is thus deterred in

contracts typically involve intermediaries and that agents have to execute the promised trade in order to remain in good standing with the exchange or the broker.

all circumstances where the entrant's cost is above the strike price and below the incumbent's cost ($s < c_E < c_I$).■

Hence, a physical call option is equivalent to a contract with a penalty for breach.

4.2 Financial option contracts: hedging

We now study the case where the option contract is *purely financial*, i.e. settled in cash, and where the incumbent offers a hedging contract with $x \leq 1$. If contracts are financial, then the buyer makes two independent decisions: whether to exercise the option and whether to buy from the market. In the previous case of a physical option, only one decision was to be made as exercising the option automatically meant buying from the incumbent.

4.2.1 Pricing subgame

We first look at the pricing subgame. Suppose the buyer accepted the financial contract, and the entrant is active in the market. Then, in Stage 4, the financial gains to the buyer are given by $x \max\{p - s, 0\}$. The buyer will exercise his option whenever $p \geq s$. In that case, he will be (partially) hedged against the spot market price.

If the incumbent makes the sale at a price above s , he will also be (partially) hedged against the variations in the spot market price. However, if he does not make the sale, then he will be left with only financial liabilities. Thus, the incumbent will be willing to cut his price to prevent the entrant from making the sale as long as $p_E > c_I$. Note that the incumbent never wants to sell below his own cost: that would only add to his financial losses. The entrant always wants to undercut any price $p_I > c_E$ posted by the incumbent, as in standard Bertrand competition. So, in equilibrium, both sellers post the same price

$p_I = p_E = \max c_I, c_E$ and market-clearing dictates that the buyer buys from the firm with the lowest marginal cost.²⁴ By backward induction, the entrant will enter only if her marginal cost is small enough to allow her to make profitable sales:

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

That is, the entrant enters only when $c_E \leq c_I$, and the probability of entry is the same as in the absence of contracts. Thus, a purely financial option does not allow the incumbent to affect the pattern of entry. The scheme suggested by Rey and Tirole (2007) requires the use of a physical option.

4.2.2 Optimal contract

So what contract should the incumbent propose in stage 1 if only financial options are available, and he is not allowed to speculate ($x \leq 1$)?

Proposition 2 *When options are settled in cash and the incumbent cannot speculate ($x \leq 1$), then in equilibrium entry will be efficient and the incumbent will fully insure the buyer by offering a contract*

x_H, f_H, s_H characterized by

$$\begin{aligned} x_H &= 1 \\ s_H &\leq c_I \\ U(1 - f_H - s_H) &= \phi_H(1 - c_I). \end{aligned} \tag{3}$$

²⁴ Otherwise, the low-cost firm would undercut and we would not have an equilibrium. As is unavoidable under Bertrand competition with asymmetric costs, there are other equilibria where the price is lower than the second lowest marginal cost, because the high-cost firm, although he does not make any sale, constrains the price of the lowest cost firm by bidding low. Such equilibria do not survive standard refinements such as trembling-hand perfection or elimination of weakly dominated strategies, and are traditionally discarded.

Proof. The incumbent will offer the buyer a contract (f_H, x_H, s_H) solving the following optimization problem:

$$\begin{aligned}
 & \max_{f, s, x \leq 1} \quad xf - \phi_H \max \{0, x - c_I - s\} \\
 & \quad \quad \quad + (1 - \phi_H) [1 - c_I - x - s] \\
 & \text{subject to} \\
 & (i) \quad \phi_H = c_I \\
 & (ii) \quad \phi_H U [1 - c_I + x \max \{0, c_I - s - xf\}] \\
 & \quad \quad + (1 - \phi_H) U [x - s - xf] \\
 & \quad \quad \geq \phi_H U (1 - c_I)
 \end{aligned} \tag{4}$$

where ϕ_H is the probability of entry under a purely financial option (subscript H for hedging). The objective function reflects the fact that the incumbent is affected by the financial contract. He collects the fixed fees xf in any case. Upon entry, which occurs with probability ϕ_H , the entrant makes the sale and the incumbent is left with only financial liability when the option is exercised. In case the entrant stays out, which happens with probability $1 - \phi_H$, the incumbent makes the sale and earns spot market price $p = 1$ while he incurs production cost c_I . However, because of the option contract, he pays back (a fraction of) the increment over s to the buyer. Constraint (i) reflects the anticipation of entry, which is unaffected by the incumbent's actions. Given that c_E is uniformly distributed, the probability of entry is given by $\phi_H = c_I$. Inequality (ii) stands for 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 (in which case he makes a surplus only when entry occurs and the price drops from 1 to c_I). Under the option contract, the buyer pays s when entry does not take place and c_I when it does. As the incumbent cannot affect entry, the program boils down to finding a contract in which the risk-neutral incumbent fully

hedges the risk-averse buyer. This requires that $x = 1$, that is, the contract covers full demand, and that the strike price is sufficiently low ($s \leq c_I$), so that the option is always in the money. The transfer f is then set such that participation constraint (ii) is binding. ■

In the optimal contract, the incumbent provides insurance to the buyer and extracts all gains from risk-sharing. Note that entry is efficient: The entrant will enter whenever her cost of production is smaller than the incumbent's. Thus, the use of a financial contract for hedging purposes is efficient as production is performed by the lowest-cost firm and the risk-averse buyer is fully insured. Note also that the incumbent has a large amount of freedom in setting the strike price as long as it is sufficiently small.

4.3 Financial option contracts: exclusion

Assume now that the incumbent can offer $x > 1$ 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, in equilibrium, have no effect on the product market outcome. It follows that the incumbent cannot improve his payoff by selling such options. Therefore, in what follows we will assume that the strike price is smaller than the cost of the incumbent: $s < c_I$.

4.3.1 Pricing subgame

In Stage 4, following entry, the buyer maximizes his utility by choosing whether to buy and whether to exercise his options. His utility is given by

$$U = 1 - p - xf + x \max\{0, p - s\} \quad (5)$$

where, as before, $p = \min\{p_I, p_E\}$ stands for the spot market price.

Note that, since $x > 1$, the buyer would actually have an interest in facing a high spot price. However, in our model, he cannot affect that price which is determined by the lowest bid.

The profit of the incumbent is the following

$$\Pi_I = x f - x \max \{0, p - s\} + (p_I - c_I) q_I \quad (6)$$

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 a producer (third term).

The profit of the entrant is given by

$$\Pi_E = (p_E - c_E) q_E \quad (7)$$

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

We now show that, due to the presence of financial contracts, the outcome of price competition will depend on the cost of the entrant.

Proposition 3 *If the buyer has accepted a speculative contract ($x > 1$) from the incumbent with $s < c_I$ and the entrant is active in the market, then the equilibrium of the pricing subgame depends on whether the marginal cost of the entrant is below or above the critical price $p^* \equiv s + \frac{c_I - s}{x}$. For a high marginal cost ($c_E > p^*$), the equilibrium price is equal to the strike price, ($p = p_I = s, p_E \geq p^*$), and the sale is made by the incumbent. For a low marginal cost ($c_E \leq p^*$), the equilibrium is given by $p = p_E = p_I = p^*$, and the sale is made by the entrant.*

Proof. We first determine the reaction functions of the firms. As in a standard Bertrand game, the entrant 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 is more complex. Its objective function depends on his financial commitments. By not undercutting the price of the entrant, the incumbent does not make the sale ($q_I = 0$), and receives from (6) a profit equal to

$$x f - x \max(p_E - s, 0) . \quad (8)$$

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

$$x f - x \max(p_I - s, 0) + (p_I - c_I) \quad (9)$$

If the entrant bids below the strike price ($p_E < s$), then the option is not exercised and the incumbent will not undercut as it would only obtain a negative operational profit (since $s < c_I$). If the entrant bids above the strike price ($p_E \geq s$), then upon undercutting the incumbent will drop its price to the strike price ($p_I = s$) to get rid of his financial liability altogether. Indeed, since $x > 1$, the incumbent cares more about financial gains than about operational profit. In this case his profit is:

$$x f + s - c_I \quad (10)$$

Comparing (10) and (8), we see that undercutting is profitable as long as $p_E > p^*$. Note that $p^* \leq c_I$, and that the incumbent will undercut the entrant even when the price of the entrant is below his own marginal cost.

We proceed with deriving the equilibrium. Several cases must be distinguished, depending on the marginal cost of the entrant c_E .

- (1) If $c_E \geq p^*$, then any profitable bid by the entrant is matched by a bid $p_I = s$ by the incumbent. Thus, the equilibrium prescribes that $p_I = s$, $p_E \geq p^*$ and the incumbent makes the sale ($q_I = 1$). 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 those strategy profiles *type A equilibria*.
- (2) If $s \leq c_E < p^*$, there are still type A equilibria ($p_E \geq p^*$, $p_I = s$). Yet, there also exists a *type B equilibrium* in which $p_E = p_I = p^*$ and the entrant makes the sale.²⁵ This multiplicity raises an equilibrium selection problem. In the two types of equilibria, the profits of the incumbent and the entrant are as follows:

$$\begin{aligned} \text{Type A: } \Pi_I &= xf + s - c_I & \Pi_E &= 0 \\ \text{Type B: } \Pi_I &= xf + x(s - p^*) & \Pi_E &= p^* - c_E \end{aligned} \tag{11}$$

As the outcome in the type B equilibrium is Pareto-superior, we assume that it is the one played by firms.²⁶

- (3) If $c_E < s$, only the type B equilibrium exists. ■

²⁵ More accurately there is a whole set of type B equilibria where incumbent and the entrant bid the same price, $c_E \leq p_E = p_I \leq p^*$ and the buyer buys from the entrant. We only take an interest in the highest price equilibrium as in the standard Bertrand game. See also footnote 24.

²⁶ There is some experimental evidence that in coordination games with Pareto-ranked equilibria, players manage to achieve coordination in a number of environments. See Devetag and Ortmann (2007).

Anticipating this pricing pattern, the entrant will thus enter only if $c_E \leq p^*$. The probability of entry under speculation (subscript S) is then equal to $\phi_s = p^*$. 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 $p_I = s$. By contrast, the price is $p^* > s$ following entry. Therefore, interestingly, the presence of a large volume of option contracts between the incumbent and the buyer gives rise to the phenomenon of price-increasing entry. See Figure 1.

[Insert Figure 1 here]

4.3.2 Optimal contract

In stage 1, the incumbent maximizes his profit by offering x_s option contracts with strike price s_s and fee f_s to the buyer.

Proposition 4. *When options are settled in cash and the incumbent can only offer speculative contracts, ($x > 1$), then in equilibrium entry will be partially deterred, the buyer will take up some risk and the incumbent signs a contract x_s, f_s, s_s with the buyer characterized by*

$$U(1 - F^* + c_I - \phi^*) - U(1 - F^*) = \phi^* U'(1 - F^* + c_I - \phi^*) \quad (12)$$

$$\phi^* U(1 - F^* + c_I - \phi^*) + (1 - \phi^*) U(1 - F^*) = c_I U(1 - c_I) \quad (13)$$

with $\phi^* = s_s + \frac{c_I - s_s}{x_s}$, $F^* = x_s f_s + s_s$ and $s_s < c_I$.

Proof. The program of the incumbent is

$$\begin{aligned}
 & \max_{f,s,x>1} \quad xf - \phi x(p^* - s) + (1 - \phi)(s - c_I) \\
 & \text{subject to:} \\
 & (i) \quad \phi = p^* (= s + \frac{c_I - s}{x}) \\
 & (ii) \quad \phi U \left[1 - p^* + x p^* - s - f \right] + (1 - \phi)U \left[1 - s - xf \right] \geq c_I U(1 - c_I)
 \end{aligned}$$

By substitution of variables, this optimization problem can be simplified to:

$$\begin{aligned}
 & \max_{F,\phi} \quad F - c_I \\
 & \text{subject to} \quad \phi U \left[1 - F + c_I - \phi \right] + (1 - \phi)U \left[1 - F \right] \geq c_I U(1 - c_I)
 \end{aligned} \tag{14}$$

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 pure transfer, the optimal contract is characterized by the first-order condition given by (12).■

The left-hand side of equation (12) 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. Together with the participation constraint of the buyer, equation (12) determines the optimal entry rate and the optimal fee structure. Observe that there are infinitely many choices of f_s , s_s and x_s that allow the incumbent to implement the optimal rate of exclusion but they are all such that $x_s > 1$, $s_s < c_I$ and $\phi^* < \phi_H$. The last inequality follows from equation (12), for, when $\phi = \phi^H = c_I$, the net marginal benefit of increasing entry is strictly negative, indicating that the incumbent can strictly win by choosing $\phi^* < \phi^H$.

Interestingly, among the infinitely many combinations of s_s , x_s , and f_s that allow the incumbent to achieve optimal exclusion, there is a 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.

It is can easily be checked that in case of risk neutrality ($U(x) = x$) the incumbent will exclude the entrant as often as in the original AB model, that is, $\phi^* = \phi_{AB} = \frac{c_I}{2}$, where we use the subscript AB to indicate the Aghion-Bolton solution. Hence, under risk neutrality of the buyer the incumbent can achieve the same outcome as in AB, even with a purely financial contract. If the buyer is risk averse ($U'' < 0$), then the optimal level of entry will be larger than under risk neutrality ($\phi^* > \phi_{AB}$). The incumbent could achieve the same level of exclusion as in the AB model and extract all the rents from the entrant, but would have to refund the buyer for the risk. Increasing the level of entry ϕ from $\phi = \frac{c_I}{2}$ has second-order effects on the surplus extracted from the entrant. At the same time, it reduces the buyer's risk, which is a first-order effect under risk aversion. Mathematically, this result follows directly from the concavity of the utility function. The average increase in utility from receiving extra income $c_I - \phi$ is larger than the marginal utility evaluated at the end income level²⁷:

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

²⁷ For a strictly concave utility function, it must hold that $U(x + y) - U(x) > U'(x + y)y$, for any x and y .

Combining this expression with (12) gives $\phi^* > \phi^{AB} = c_I/2$. That is, risk aversion on the part of the buyer obliges the incumbent to allow for more entry than joint-surplus maximization would dictate.

4.4 Speculative or hedging financial contracts?

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

Proposition 5. *When options are settled in cash and the incumbent can offer speculative ($x > 1$) or hedging ($x \leq 1$) contracts, then in equilibrium the incumbent chooses a speculative contract x_s, f_s, s_s characterized by equations (12) and (13), irrespectively of the level of risk aversion of the buyer.*

Proof. It is sufficient to compare the profit of the incumbent under an optimal hedging contract (Proposition 2) and an optimal speculative contract (Proposition 4). Observe that when faced with program (14) (when restricted to $x > 1$), the incumbent can reproduce the solution to program (2) (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 perfectly hedging the buyer. Since such a strategy does not maximize program (11), the incumbent must do strictly better by choosing x_s, f_s, s_s .

■

5 Extension

Until now we have assumed that the buyer and the entrant knew that the contract was offered by the incumbent, who would price more aggressively upon entry. The buyer was willing to pay a premium for the contract, as he expected lower prices in the future. We now relax the assumption that the buyer and the entrant observe the identity of the contract's offerer and instead suppose that they only observe the contract characteristics. This may be more realistic. Bilateral, over-the-counter contracts are typically struck through a bank or a broker and the identity of the counterparty is not disclosed.²⁸

The question then arises as to whether the exclusion mechanism we identified above can survive non-observability of the contracting parties' identities. In particular, if the counterparties to the contract were not observed, would it be profitable for other agents (say, arbitrageurs) to mimic the contract that the incumbent is supposed to offer? Given that the buyer is willing to pay a premium for the contract when the counterparty is the incumbent, such mimicking behavior could be very profitable.

We model this environment as a signaling game where different option sellers (the incumbent and some arbitrageurs) submit bids to a broker who puts them to the buyer. 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 beliefs about the type of bidders based on the bids they submit. We show that a separating equilibrium can arise, in which

²⁸ Indeed, in the *KeySpan* case, an incumbent electricity producer turned to a broker (a major investment bank) which accepted to sell KeySpan an option, provided it could find a counterparty to take up the risk, which happened to be KeySpan's main competitor.

market participants believe that only the incumbent can profitably offer exclusionary, speculative contracts.²⁹

Our basic model is thus modified as follows. We add n risk-neutral arbitrageurs who in stage 1, along with the incumbent, simultaneously post the terms (x, f, s) of the option contract they are willing to sell.³⁰ The buyer will be randomly presented with one of the $n + 1$ contracts. The buyer can accept or reject the contract, and will not be presented with another contract. The identity of the contract offerer is not revealed. In stage 2, the buyer decides whether he accepts the contract on offer. The contracting position of the buyer is observed by the entrant and the game then proceeds as in the original model.

We construct a separating equilibrium in which the incumbent offers one contract (x_I, f_I, s_I) , the arbitrageurs another one (x_A, f_A, s_A) , the buyer accepts any offer put to him and correctly anticipates (as does the entrant) that only the incumbent is able profitably to offer the first contract.

In order to prevent arbitrageurs from masquerading as an incumbent, the incumbent must offer a contract that is costly for the arbitrageurs to mimic. Hence, the incumbent's actions are constrained by the presence of other sellers of financial instruments. However, we will show that the incumbent can still implement the same exclusion scheme as in Section 4, where identities were observed.

²⁹ As is typical in signaling games, other types of equilibria exist.

³⁰ 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. Hence, the number of arbitrageurs is immaterial.

Proposition 6. *There exists a perfect Bayesian separating equilibrium in which the incumbent offers a contract x_s, f_s, s_s which partially excludes entry, as in Proposition 4 ($F = F^*$ and $\phi = \phi^*$), and the arbitrageurs offer a contract that perfectly hedges the buyer ($x_A = 1$ and $s_A = 0$).*

Proof. We first propose an equilibrium set of strategies and a belief structure for the game.

Given F^* and ϕ^* as in Proposition 4, the incumbent chooses a sufficiently large number of option contracts $x_I > 1$ such that

$$x_I > \frac{F^* - c_I}{(1 - \phi^*)^2} \quad (16)$$

For this quantity x_I , it sets $s_I = \frac{c - x_I \phi^*}{x_I - 1}$, and $f_I = \frac{F^* + s_I}{x}$. The arbitrageurs offer a contract such that $x_A = 1$, $s_A = 0$ and f_A satisfies the participation constraint of the buyer, i.e. $U(1 - f_A) = \phi_H(1 - c_I)$. The entrant and the buyer observe the contract that has been offered. When the entrant and the buyer observe x_I, f_I, s_I , they believe that the contract was offered with probability one by the incumbent. The buyer accepts the contract, and the entrant enters whenever $c_E \leq p^*$ and prices at p^* . When they observe any other contract they believe that the contract was offered with probability one by an arbitrageur and the entrant enters whenever $c_E \leq c_I$ and prices at c_I . The buyer accepts the contract if it gives at least the certainty equivalent of the lottery under efficient entry, $\phi_H U(1 - c_I)$.

We now show that players have no incentive to deviate from the proposed strategy. The incumbent has no profitable deviation: he offers the buyer the best contract compatible with the latter's equilibrium outside option. He does not want to mimic arbitrageurs as this would decrease his profit. Arbitrageurs do not want to deviate either. They will not offer better insurance terms to the buyer, since that would only lower their profit. Offering

worse insurance terms would not be accepted by the buyer. Suppose they mimicked the incumbent and offered the contract (x_I, f_I, s_I) as well. If this contract happens to be presented to the buyer, then the latter will choose to accept it, under the (mistaken) belief that the offerer is the incumbent. The entrant, upon observing the financial position of the buyer, will hold the same (mistaken) belief. Hence, she will choose to enter only when $c_E < p^*$, and the probability of entry will be ϕ_s . In stage 4, she will follow her equilibrium strategy by bidding p^* . This deviation is not profitable to the arbitrageur because the financial gains from the contract are negative. That is,

$$\underbrace{x_I \cdot f_I}_{\text{fixed fees}} - \underbrace{\phi_s \cdot x_I \cdot p^* - s_I}_{\text{with entry } p = p^*} - (1 - \phi_s) \cdot \underbrace{x_I \cdot 1 - s_I}_{\text{without entry } p=1} < 0. \quad (17)$$

which, by our choice of f_I and s_I , is equivalent to equation (16). ■

This result is intuitive if one compares the incumbent's profit with the profit of the mimicking arbitrageurs. The profitability of selling the contract differs only when there is no entry, that is, in those cases where the incumbent makes the sale. If the contract of the mimicking arbitrageur has been accepted and the entrant stays out the market, then the incumbent will set a price $p = 1$ as there is no competitive pressure from the entrant. The arbitrageurs then will have to refund the buyer for high spot prices ($x_I(1 - s_I)$). By contrast, if the incumbent sells the contract himself and the entrant stays out, then he will want to get rid of financial liabilities by setting a price equal to the strike price $p = s$ and making an operational loss equal to $(c_I - s_I)$. Thus, by increasing the number contracts that is sold, the cost of mimicking can be increased to any arbitrary level without affecting the profit of the incumbent.

Note that the incumbent's scheme cannot be implemented with a standard forward contract, as the separation constraint would then be violated. The availability of option contracts allows the incumbent to set a low f and a high x while still keeping control of the probability of entry through the choice of s .

Thus, even if no market participant can be certain that it is the incumbent that is taking a large speculative position, in equilibrium everybody infers that he is the only one with an interest in doing so. As a result, each time the incumbent manages to sell to the buyer, entry is restricted below social optimum.

6 Conclusion

Exclusivity contracts are heavily monitored by competition authorities. We have shown in this paper that, whenever options are financially settled, an incumbent cannot use the scheme suggested by Rey and Tirole (2007) to reproduce the outcome in Aghion and Bolton (1987). However, the incumbent can resort to another, possibly costlier scheme to extract rent from an efficient entrant. That scheme consists in taking a speculative position in the derivatives market, inefficiently deterring entry. To do so, he will sell a large buyer more option contracts than their underlying volume of spot market transactions. This speculative position will give the incumbent 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 price for which it sells the option and the number of contracts. Interestingly, this exclusionary outcome can be attained under complete information by using a simple forward contract.

When the buyer is risk-neutral, the contracting pair solves a problem that is akin to the one in AB, trading-off the likelihood of entry against the level of the post-entry price. When the buyer is risk-averse, 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 way of presenting the case may be misleading. Indeed, there is no profit sacrifice in the short-term: given his financial commitments, the incumbent does what is optimal for 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 predatory pricing, which requires investment in short-term losses.

When the identities of the parties to a financial contract are not public but the contract characteristics are observable, the incumbent and the buyer are still able inefficiently to deter entry. The reason is that nobody but the incumbent has an incentive to bet a large amount of money on low prices. Thus, in equilibrium, everybody rightly infers from the availability of such contracts that reduced entry will ensue.

This paper thus raises the possibility that routine financial transactions may be used by incumbent firms to exclude efficient rivals. 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 would 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. Warning signs of an operative exclusion scheme can be found in the fact that a dominant

firm takes financial positions way in excess of its underlying production operations, that buyers are willing to pay a premium over the normal price of insurance and that spot prices increase upon entry.

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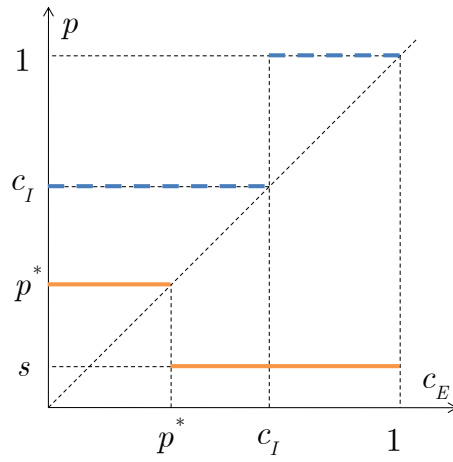


Figure 1: Market price as a function of entrant's cost for perfect hedging, $x = 1$ (dashed) and speculative contracts, $x > 1$ (continuous).

Figures

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