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Exclusionary Contracts

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When have market participants the incentive to strike contracts that exclude potential entrants? This article synthesizes the theory of exclusionary contracts and applies the theory to a recent antitrust case, *Nielsen*. We consider an incumbent facing potential entry and contracting with both upstream suppliers and downstream buyers. Focusing first on contracts with downstream buyers, we set out a "Chicago benchmark" set of assumptions that yields no incentive for exclusionary contracts. Departing from the benchmark in each of three directions yields a theory of exclusion. These include the two existing theories, developed by Aghion and Boulton and by Rasmusen, Ramseyer and Wiley. The structure also captures a third, vertical theory: long-term contracts at one stage of a supply chain can extract rents from a firm with market power at another stage. Turning to upstream contracts, we offer a theory of simultaneous contract offers that generalizes the "Colonel Blotto" game. Nielsen illustrates the full range of the predictions of the theories of exclusionary contracts. (*JEL* L14, K21, L23)

1. Introduction

The debate over whether contracts can have anticompetitive exclusionary effects has long been central to competition policy. In cases involving tied sales,[1] exclusive dealing,[2] and long-term contracts,[3] courts have struck

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1. E.g., *Northern Pacific Railway v. United States*; and the *U.S. v. Microsoft* cases.

2. E.g., *United States v. United Shoe Machinery Corporation* (1922); *Milkovich v. Lorain Journal Co.*, 497 U.S. 1 (1990).

3. *Canada (Director of Investigation and Research) v. Laidlaw Waste Systems Ltd. (1992), 40 C.P.R. (3d) 289 (Comp. Trib.)*; *Director of Investigation and Research v. D&B Companies*

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down contracts as anticompetitive because they exclude potential competitors from entering a market. Exclusivity contracts between an incumbent and buyers, for example, may be struck down by courts if these contracts deter entry by blocking access to a large share of buyers in a market. The contracts protect the incumbent's position as a monopolist or dominant firm. But contracts are entered into voluntarily. Why would buyers in a market ever agree to anticompetitive contracts?

A recent literature in economics addresses precisely this question. The central papers in this literature are Aghion and Bolton (1987) (AB), Rasmussen, Ramseyer, and Wiley (1991) and Segal and Whinston (2000a) (RRW-SW). The answer at a general level is that a contract, which must maximize the wealth of parties to the contract, may nonetheless be anticompetitive because of externalities imposed on parties outside the contract. In AB, an externality is imposed on the potential entrant because the incumbent's contract is designed so that if the entrant, if successful, must set a low price to attract buyers. In RRW-SW, externalities are imposed across buyers in that each buyer accepting an exclusive contract ignores the detrimental impact that acceptance of an exclusive contract has on other buyers.

This article makes three contributions. The first is to extend the theory of downstream contracts as barriers to entry to include contracts involving *vertical* externalities along the supply chain. Consider an incumbent facing the prospect of negotiating with a single upstream input supplier on the price of a vital input. The incumbent would gain from any strategy that lowers the input supplier's alternative in the negotiations since the strategy would lower the price that the incumbent pays for the input. Suppose that the input supplier's alternative to selling to the incumbent is selling to potential entrants into the market. By offering downstream buyers long-term contracts, the incumbent makes entry less profitable for the potential entrants, which in turn lowers the price that these entrants would be willing to pay for the supplier's input. This strengthens the incumbent's bargaining position in negotiating the price for the upstream input. The incumbent is thus able to extract a transfer from an *upstream* supplier with market power by offering contracts to buyers *downstream*.

We offer a simple framework that captures the three theories of downstream exclusionary contracts, the Aghion–Bolton theory, the horizontal buyer-externality theory and the vertical theory. A benchmark set of assumptions yields no incentive for exclusionary contracts because the terms of each contract exert no externalities on parties outside the contract. The three simplest departures from this benchmark capture three theories of exclusionary downstream contracts. Incumbency carries a first-mover advantage in this framework, as in the existing literature, in that contracts can be struck by the incumbent before entry decisions are made.

of Canada Ltd., CT-1994-01 (Canada), ("Nielsen"). The latter case is analyzed in Section 4 of this article.

Our second contribution is a theory of exclusionary contracts with upstream input suppliers. Contracts with upstream suppliers are less likely to carry a first-mover advantage for the incumbent, we suggest, because when an entrant decides to come into a market it is often immediately able to offer contracts to input suppliers. We develop a model in which two firms (the incumbent in a market and a potential entrant) bid for rights to upstream inputs prior to competing in a downstream market. Bidding for exclusive rights is an available strategy in this bidding game. We find that when total industry profits are maximized by an allocation of all inputs to one firm exclusively, then this allocation represents the only possible equilibrium of the non-cooperative bidding game. This reduces the problem of predicting exclusivity to asking when exclusivity is privately efficient. Equilibrium results in an exclusive allocation to one firm under a set of two conditions: a high degree of complementarity among upstream inputs, and high-inherent substitutability of the products downstream. Our model of bidding for rights to upstream inputs turns out to be a generalization of a model with a long history in game theory, the Colonel Blotto game (Borel 1921; Roberson 2006).

The third contribution of this article is an application of the theory of exclusionary contracts to *Nielsen,* a recent Canadian antitrust case.[4] *Nielsen* involved the Canadian market for scanner-based information including market shares, elasticity estimates, and response of demand to product promotions. Upstream suppliers (grocery chains) provided scanner data to *Nielsen*, which transformed the data into a usable form, combining it with software. *Nielsen* sold (and still sells) the resulting information product to downstream buyers, grocery manufacturers such as Kelloggs and Proctor and Gamble. In 1986, *Nielsen* faced the threat of entry into the Canadian market by a second firm, Information Resources Inc (IRI).

Nielsen illustrates all four theories of exclusionary contracts, the three sources of incentives for downstream exclusionary contracts and the theory of exclusion as the outcome of competition for rights to upstream inputs. With respect to *downstream* contracts, as soon as the threat of entry by IRI was evident, Nielsen changed its strategy. It offered long-term contracts to a critical subset of buyers. The facts of the case are consistent with all three theories of exclusionary downstream contracts. With respect to contracts with *upstream* suppliers of raw data, Nielsen and IRI competed intensively for the rights to upstream inputs in a short period of time in the summer of 1986, in a way represented by our bidding model for rights to upstream inputs. Upstream inputs were highly complementary, and downstream inputs close substitutes in this market,

4. *Director of Investigation and Research v. D&B Companies of Canada Ltd.*, CT-1994-01 (Canada). Winter was an expert witness for the government in this case. An earlier version of this paper, Jing and Winter (2013) includes as an appendix a case study of Nielsen for teaching purposes. This consists of a summary of the case and a set of questions.

explaining the outcome of the competition for upstream rights: the bidding for all inputs was won by Nielsen with contracts that contained exclusivity provisions.

An application of our vertical theory of exclusionary downstream contracts involves an interaction between the bidding game for upstream rights and the downstream contracting game in *Nielsen*. The equilibrium bid in any auction under certainty is the value of the item (here, the rights) to the agent with the second highest value. Any strategy that the incumbent can implement to reduce the value of the rights to the entrant leads to a lower equilibrium payment for the rights—and therefore a transfer of some of the upstream rents to the incumbent. The adoption of long-term contracts downstream was one such strategy. Hence our vertical theory of the long-term contract with downstream buyers: by inducing an asymmetry in values between Nielsen and IRI in the upstream bidding game, the *downstream* contracts implemented a transfer of rents from the *upstream* data suppliers to Nielsen.

Sections 2 and 3 of this article develop the theories of downstream contracts and upstream contracts, respectively. Section 4 applies the theories to *Nielsen*, and discusses the wide range of additional strategies adopted in the case.

2. Downstream Contracts

2.1 Background

The traditional theory of exclusionary contracts was that a dominant firm could *impose* exclusionary contracts to its own benefit and to the detriment of consumers. Exclusionary contracts were even taken evidence of monopoly power over consumers signing the contracts.[5] The early Chicago school responded with a simple proposition. Contracts are voluntary, not imposed, and must therefore maximize the combined benefits of the contracting parties. Some Chicago economists went further, arguing that if a contract maximizes the combined benefits of a buyer and seller signing the contract, it must be efficient.[6] As Aghion and Bolton (1987) showed, however, a contract need not be efficient where externalities are imposed on agents outside the contract. Even a simple long-term contract

5. In *Canada (Director of Investigation and Research) v. Laidlaw Waste Systems* (1992), 40 C.P.R. (3d) 289 (Comp. Trib.). ["*Laidlaw*"], the government economic expert adopted the traditional theory that "if one contracting party is a monopolist . . . it can preserve its market power by insisting that its customers (or suppliers) sign long-term contracts . . ."; and "buyers gain nothing from the . . . provisions in the contracts [at issue in the case]. Hence, the very fact that nearly all buyers sign such contracts is evidence that Laidlaw has and exercises market power". [Expert Report of Roger Noll, *Laidlaw*, pars. 21 and 42].

6. Judge Robert Bork is often cited for this view. He states "The truth appears to be that there has never been a case in which exclusive dealing or requirements contracts were shown to injure competition. A seller who wants exclusivity must give the buyer something for it. If he gives a lower price, the reason must be that the seller expected the arrangement to create efficiencies that justify the lower price." (Bork 1978: 309).

can be anticompetitive in acting as a barrier to entry. A "post-Chicago" literature has developed investigating the conditions under which contracts can profitably be used to exclude rivals.[7]

In this section of the article we develop a framework for synthesizing the theories under which contracts with downstream buyers can deter entry into a market. Under a "Chicago benchmark" set of assumptions, the incentive for exclusionary contracts does not arise. The Chicago benchmark is a setting under which the terms of each contract have no impact on individuals or firms outside the contract. Three departures from the benchmark yield the three theories of exclusionary downstream contracts.

2.2 The Setting

We adopt a canonical market setting. An incumbent firm I is supplied by upstream suppliers and sells to n downstream buyers. The incumbent firm faces potential entry by multiple rivals, who face a random, but common, unit cost of production, c. The unit cost, c, has a distribution $G(\cdot)$ and continuous density $g(\cdot)$ that is strictly positive on support $[0, \bar{c}]$ with $\bar{c} > v$. $G(c)$ is the probability that entrants would willingly supply all n buyers at a price c, and in this sense can be interpreted as the supply curve of the entrants. We denote the elasticity of this supply by $\eta \equiv d \log G / d \log c$. Upstream suppliers have zero cost of production and each unit of output requires one unit of the input.

The incumbent's cost is c_I, and the upstream input cost is 0. The incumbent has the opportunity to offer buyers an ex ante (or "long-term") contract prior to the realization of the entrants' cost, c. Ex post, the entrants and incumbent compete for any "free" buyers as Bertrand competitors. The entrants, ex post, also have the opportunity to attract buyers away from long-term contracts.

The ex ante contract can be described in two ways. A contract can be denoted by a price p that the buyer pays if she purchase from the incumbent and a stipulated damage d that the buyer pays when deciding, ex post, to opt out of the contract to purchase from an entrant instead. Equivalently, the buyer pays the amount d up front and then pays an additional amount p–d if she decides to buy the product. In other words, the contract can be described as a *call option* with option price d and exercise price $p - d$. We take the call option interpretation and adopt a simpler notation: p_o for the option price and x for the exercise price. The entire competitive impact of an ex ante call option contract lies in the optimal exercise price, x^*. The *socially efficient exercise price* is $x^* = c_I$ since this exercise price guarantees that the incumbent will supply if and only if it is the lowest cost producer in the market. Total surplus is maximized under the efficient exercise price. An *exclusionary contract* is characterized by $x^* < c_I$. If this inequality holds, then for realizations $c \in (x^*, c_I)$, the entrant(s) do not produce ex post, in spite of being the

7. For an excellent review of this literature, see chapter 4 of Whinston (2006).

lowest cost producers. The wrong firm produces. Our central task, explaining incentives for exclusionary contracts, reduces to the following question: *why would the equilibrium* x^* *be less than* c_I*?*

2.3 Chicago Benchmark

In this benchmark, the sets of upstream suppliers and entrants are each perfectly competitive. The competitive entrants share a common, random unit cost, c. In the ex post pricing game, the incumbent monopolist, having set a contract (p_o, x) sells if and only if $x \le c$. The sum of expected benefits to the incumbent-buyer pair from a contract (p_o, x) in this setting is the buyer's value minus the cost to the pair of acquiring or producing the product: $v - \int_0^x cdG(c) - [1 - G(x)]c_I$. Maximizing this sum yields the efficient exercise price, $x = c_I$. And it is readily verified that the efficient contract is equivalent, in terms of expected payoffs, to no contract at all. In summary,

Proposition 1. Under the assumptions of the Chicago Benchmark, the optimal exercise price is the efficient price, $x^* = c_I$. The efficient contract is equivalent, in terms of expected payoffs, to no contract at all.

Because sellers outside the contract earn zero rents, and each buyer is unaffected by contracts with other buyers (there are constant returns to scale and buyers do not compete), no externalities arise.

2.4 Entrant Market Power (Aghion–Bolton)

In the Aghion–Bolton model, upstream supply remains perfectly competitive, but there is only one potential entrant. With no contract, the Bertrand equilibrium of the ex post pricing game involves the entrant supplying at a price c_I if $c < c_I$ and the incumbent supplying at a price equal to $\min(c, v)$ otherwise. Ex ante, the incumbent can offer a contract (p_o, x). If the contract is accepted, then ex post the entrant supplies the market at a price equal to x whenever $c < x$. Otherwise, consumers exercise the option to purchase from the incumbent at x. The contract maximizes the incumbent's profit subject to the individual rationality constraint that the buyers achieve expected utility at least as great as in the subgame without a contract. The optimal x simply maximizes the total surplus generated by the contract for the contracting parties, which is equal to v minus the expected cost of acquiring the product from either the rival or "in-house" production:

$$\max v - xG(x) - c_I[1 - G(x)]. \tag{1}$$

The necessary first order condition leads directly to the following.

Proposition 2. With a single entrant, the optimal contract between the incumbent and each buyer satisfies

$$\frac{x^* - c_I}{x^*} = -\frac{1}{\eta}. \tag{2}$$

The unit *value* that the incumbent-buyer pair realizes by purchasing from the entrant is c_I, since by "outsourcing" to the entrant the pair avoids this cost of producing internally. Equation (2) is simply the Lerner equation for monopsony pricing: the optimal price is marked down from value according to the elasticity of supply.[8] The rents that the entrant earns in low-cost states are open to extraction via the call option contract between the incumbent and each buyer: lowering x reduces the price that the entrant must charge to attract the buyer, thus implementing a transfer from the entrant to the buyer.

Our call-option version of the Aghion–Bolton model is more than a simple change in notation from the original model. Two aspects of the formulation are worth highlighting. First, the characterization of the optimal, entry-deterring contract price in the equations (1) and (2) makes no reference to the individual rationality constraint and therefore no reference to the subgame following refusal of the contract. The individual rationality constraint affects only p_o, the price of the call option contract. Aghion–Bolton and subsequent surveys adopt a functional form for the model. But because of the separability in the characterization of the optimal contract—the optimal x is solved for independently of the individual rationality constraint—the economics are clearest in the general formulation. Second, the Aghion–Bolton theory has been dismissed by a number of scholars because the theory requires that the liquidation damage, d, exceed the seller's lost profit, $p - c_I$. A penalty for contract termination that exceeds anticipated profits is not enforceable under common law. Thus Richard Posner writes "The specific device considered by Aghion and Bolton, a penalty clause in the monopolist's contract with his customers, is not apt, because penalty clauses are legally unenforceable wholly apart from any antitrust objections" (Posner 2001: 232). In our formulation, no liquidation penalty is required. The optimal contract with an exercise price less than marginal cost is enforceable.

The interpretation of a contract as an option goes back to Oliver Wendall Holmes (1897). Holmes famously stated that "the duty to keep a contract at common law means a prediction that you must pay damages if you do not keep it and nothing else." This is the essence of the economic interpretation of "contract," as opposed to the interpretation by some legal centralists and philosophers that a contract entails a moral obligation not to breach. To an economist, *any* contract is an option.

2.5 Upstream Market Power (the Vertical Externality Theory)

We introduce market power upstream via the assumption of a single input supplier, while maintaining the competitive-entrants assumption of the benchmark. The product requires 1 unit of the upstream input for each

8. Aghion and Bolton described the characterization of optimal pricing as optimal "monopoly" pricing by the contract pair, but intended "monopsony" pricing.

unit produced. The assumption of market power upstream isolates a second theory, which we label the "vertical externality theory." The role of downstream contracts in this theory is to render entry less profitable, reducing the willingness-to-pay of entrants for the upstream input, thus enabling the incumbent firm to negotiate a lower price for the input. The game proceeds as follows. Ex ante, the incumbent can offer a contract (p_o, x) to a subset of buyers, who then each make a decision to accept or reject the contract. (Buyers are identical. We restrict attention to equilibria where all buyers' accept/reject decisions are identical.) The entrants' common cost, c, is then realized and is common knowledge. Ex post, prices are determined in two stages. In the first stage, the incumbent and entrants bid simultaneously for the input and the monopolist input supplier accepts at most one of the bids. In the second stage, if a contract was written ex ante the incumbent is bound by its obligation to supply the product to buyers at the price x, but can offer a lower price if it chooses.[9] An entrant, if it has won the auction, has the ability to supply and offers a price to consumers. Buyers then choose the lower of the incumbent's price and the price offered by the entrant. In the event that no contract was written ex ante, the winner of the auction for the input simply becomes a monopolist in the product market.

Payoffs without a long-term contract: With no long-term contracts in place, then ex post the multiple entrants each bid $\max(0, v - c)$ for the input since owning the input carries the right to be a monopolist in the downstream market at cost c. If $c \in [c_I, v]$, the incumbent wins the auction, paying $(v - c)$ for the input and then producing and selling the output at a price v, for a profit of $c - c_I$. If $c \geq v$ the incumbent wins the auction with a bid of 0. Hence the incumbent's expected profit with no long-term contract is

$$\begin{aligned}\pi^{nc} &= E[\max(0, v - c_I - \max(0, v - c))] \\ &= \int_{c_I}^{v} (c - c_I)dG(c) + [1 - G(v)](v - c_I).\end{aligned}$$

The buyers' surplus without a long-term contract is 0.

Payoffs with a long-term contract: Consider first the strategy on the part of the incumbent and a buyer of entering a contract with $x \in (c_I, v]$. Following the contract, the entrants' common bid for the upstream input is $\max(0, x - c)$, since any entrant bidding knows that its downstream price will be constrained by the right of buyers to purchase at

9. To fully define the game, we must specify the outcome in the event that an entrant has won the auction for the input but offers a price to buyers that exceeds x. We assume that the incumbent has a second, very high cost, source for the input. If the consumers exercise the option to buy after the incumbent has lost the bidding game for the input, the incumbent must resort to purchasing the high-cost input. (This does not happen in equilibrium.)

the exercise price, x. The incumbent's maximum bid is $x - c_I$, since its price to buyers is also constrained by x, through its commitment in the option contract. The incumbent wins the auction if $c_I \leq c$. Its expected profits, gross of the option price, are

$$\pi^c_{gross} = [1 - G(c_I)](x - c_I).$$

Since the buyer pays a price x whatever the realization of c, the expected total surplus to the incumbent and a buyer from the long-term contract with $x > c_I$ is $(v - x)$ plus π^c_{gross}:

$$S_c = (v - x) + [1 - G(c_I)](x - c_I). \tag{3}$$

From equation (3), $\partial S_c / \partial x = -G(c_I) < 0$, showing that the strategy $x > c_I$ is dominated by $x = c_I$. The optimal x thus satisfies $x \leq c_I$. It then follows that the incumbent loses $(c_I - x) \geq 0$ by winning the bid for the input ex post. The incumbent will therefore bid 0 for the input, whatever the value of $x \leq c_I$ in the contract. The entrants will submit positive (and identical) bids if $c < x$, and one of them will win the auction if $c < x$. Hence the expected total surplus to the buyer and incumbent from a long-term contract is, for $x \leq c_I$, still given by equation (3). This expression for total surplus is the same as equation (1), the objective function in the first (Aghion–Bolton) setting. The following is immediate.

Proposition 3. Suppose that there is a single upstream supplier and competitive entrants, with the input determined ex post via bidding by the incumbent and entrants prior to the opening of the downstream market. Then the optimal ex ante contract satisfies (2).

The buyer and seller again act as a monopsonist, in this case against the entrants' supply curve that is derived from the supply $G(c)$ and the upstream supplier's inelastic supply.[10]

2.6 Fixed Costs (Horizontal Buyer Externalities)

A third set of externalities can drive incentive for exclusionary contracts: externalities across buyers. To focus solely on this set of externalities, we retain the benchmark assumptions of many potential entrants and competitive upstream supply, but depart from the benchmark in assuming an entry cost. Potential entrants (at least two), each have a known fixed cost, f, as well as a random cost per unit, c. An entrant incurs the fixed cost only

10. This section considers a single set of contracts downstream, which have the effect of extracting rents from the upstream supplier. An analogous model would show that upstream exclusivity contracts can extract rents from a downstream buyer with market power. In an earlier version of this paper, Jing and WInter (2013), we develop as an extension a model of simultaneous strategies of upstream and downstream contracting (with a single upstream supplier and a single downstream buyer). The extension shows that such a simultaneous contracting strategy is the optimal strategy, with each vertical contract serving to relax the individual rationality constraint in the optimal design of the other contract.

after buyers have accepted its offer. This implies that potential entry imposes a contestability constraint on ex post prices: these prices cannot exceed the average cost that an entrant would incur selling to the buyers.

The game proceeds as follows. Ex ante, the incumbent decides on a contract offer (p_o, x). Ex post, the incumbent offers a price p_f^I to free buyers and, simultaneously, entrants offer prices (p_c^e, p_f^e) to contract and free buyers, respectively. The incumbent is free to offer a new, lower price to contract buyers, instead of relying on the contract x. Contract buyers then choose the least costly of three alternatives: paying p_c^e; exercising the option to buy at x; or accepting a new incumbent price if offered. Free buyers choose the lower of p_f^I and p_f^e.[11] Transactions take place. An entrant incurs cost $f + kc$ if k buyers have each accepted its price offer. The incumbent incurs cost c_I per unit.

We adopt the concept of coalition-proof Nash equilibrium (Bernheim et al. 1987) for this game. For a set of strategies to be an equilibrium, this concept requires not only that the set of strategies be immune to profitable deviations by a single player at each stage of the game (the Nash requirement) but also that the set of strategies be immune to deviations by a coalition that would make all members of the coalition better off. As in Segal and Whinston (2000a), this means that in the first stage of the game, the incumbent's equilibrium offer to a subset of m buyers will leave each of the m buyers with the expected utility that the buyer would achieve following no contract. Denote this expected utility by $\bar{u}$. The incumbent has no reason to offer buyers a higher expected utility than $\bar{u}$. And it cannot offer m buyers a lower expected utility because while "accept" by all m buyers might be a Nash equilibrium it would be ruled out by a deviation by all m buyers to "reject".

The effect of entrant fixed costs is that an option contract with a low exercise price, x, signed with $m < n$ buyers implements a transfer in expected surplus from non-contracted ("free") buyers to the incumbent. To see this, note that having signed the contracts with m buyers, if it supplies in the ex post market the incumbent is constrained in setting p_f by the following inequality:

$$mx + (n - m)p_f \leq nc + f. \tag{4}$$

If this inequality were violated by the incumbent's offer of p_f, an entrant could profit by capturing the entire market with prices undercutting x for contract buyers and undercutting p_f for free buyers.[12] In the range of cost realizations where the equation (4) is binding, reducing x allows the

11. At equal prices for the incumbent and an entrant, buyers purchase from the incumbent, as is standard in limit-pricing models.

12. We set aside for brevity the possibility that the incumbent sets x so high that a potential entrant would cover costs (for some realizations of c) by selling only to contract buyers. It is straightforward to extend the analysis to cover this possibility, showing that such a contract would be dominated.

incumbent to extract a transfer from free buyers because it allows the incumbent to set a higher price to free buyers without attracting entry.

The implication of the transfer from free buyers is that the optimal x is less than c_I, a property that we have identified as exclusionary. The intuition for this result follows from an expression for the incumbents' profit. The first best expected total surplus in the market can be written as $S^* = nv - n\Big[\int_0^{c_I - f/n} c{+}f/n dG(c){+}[1 - G(c_I - f/n)]c_I\Big]$, which is the total benefits of production minus the cost of producing the output by the most efficient firm, which of course depends on the realized c. Denote the expected deadweight loss (reduction in total expected surplus) as a result of a contract by $\Delta(x, m)$. The deadweight loss in this simple model is the additional expected cost incurred from production taking place by a firm when it is not the lowest cost firm in the market. Denote by s_c the expected surplus accruing to the m contract buyers accepting a contract (x, p_o) and denote by $s_f(x)$ the expected surplus accruing to free buyers following the contract. Since the total surplus in the market, $S^* - \Delta(x, m)$, accrues to the two groups of buyers and the incumbent, we have $S^* - \Delta(x, m) = \pi{+}s_c{+}s_f(x)$. This implies

$$\pi = S^* - \Delta(x, m) - s_c - s_f(x) = S^* - \Delta(x, m) - m\bar{u} - s_f(x). \tag{5}$$

Reducing x slightly below c_I has a positive impact on $\Delta(x, m)$, because it leads (via equation (4)) to production by the incumbent when an entrant's cost of production is lower. This, however, is only a second-order effect by the envelope theorem. On the other hand, the impact of x on s_f is a first-order impact: $\partial s_f(x)/\partial x < 0$ at $x = c_I$. This implies from equation (5) that the profit-maximizing contract involves $x < c_I$. The equilibrium of the model is set out and the proposition proved formally in the appendix:

Proposition 4. Under the assumptions of the buyer externality model, the incumbent's equilibrium strategy is to offer a contract (p_o, x) with $x < c_I$ to $m \in [1, n-1]$ buyers. The optimal contract yields expected surplus for contract buyers equal to that which would be earned in a market without long term contracts.

The idea that an incumbent can profit from exclusionary contracts by exploiting this buyer externality or collective action problem is familiar from RRW (1991) and Segal-Whinston (2000a).[13] We integrate the idea into our synthesis by adopting the minimal departure from the benchmark that yields the incentive. This is a set of assumptions that preserves zero profits on the part of the entrants, so that only contracting parties and buyers earn surplus in the market—a framework that yields no externalities other than the one at focus.

13. Aghion and Bolton (1987), Section 3, developed the idea earlier but in a setting in which the incumbent could offer contracts with a price conditional upon how many buyers accept. This type of contract might be difficult to enforce.

3. Simultaneous Bidding for Exclusivity: Upstream Contracts

The incentive for *upstream* exclusionary contracts is well-known. For example, if a downstream firm purchases exclusive rights from all upstream suppliers of an essential input it is guaranteed a monopoly. The gains to contracting, which are the prospective monopoly profits, are shared with the upstream firms via the purchase price of the exclusive rights.[14] The role of upstream contracts in foreclosing markets has been studied extensively (see Rey and Tirole (2007) for a review) as has the impact of contracts or integration that raise rivals' costs but fall short of full exclusion (Salop and Scheffman 1983).

Our contribution starts with the observation that in setting upstream contracts, an incumbent monopolist cannot be assured of a first-mover advantage. While a potential entrant must generally take time to become established in the market in order to enter downstream contracts (and this time provides the incumbent with the opportunity to offer the first contracts) this is not true for contracts with upstream suppliers. A potential entrant may be in the position of offering terms to input suppliers even before the incumbent is aware of its plans for entry. This asymmetry is again illustrated clearly by the *Nielsen* case discussed in the next section of this article.

We consider competition for upstream rights to inputs when the incumbent and potential entrant moves simultaneously in offering these rights. Consider two firms that are supplied by n upstream suppliers, and sell to downstream buyers. For simplicity (and to match the facts of the case), the n inputs supplied are *rights* such as patent rights or the rights to the use of particular information or other property. That is, the goods are non-rivalrous.[15] Each downstream firm acquires a subset of the rights from the upstream suppliers in a bidding game described below, and the two firms then compete in the downstream market, earning profits that depend on the allocation of rights to the two firms. If the downstream output were observable, it would in general be optimal to submit contracts such as non-linear royalty contracts for the upstream inputs.[16] Competition would take the form of contract offers, as in Bernheim and Whinston (1998). We assume that outputs are not observable, so that the only feasible bids for upstream inputs are dollar amounts. Whether or not the rival has access to an input is observable, so that bids can be conditioned upon that event. The question we ask is the following. When will the equilibrium in the bidding game for upstream rights will assign all rights to one firm?

14. A case that is sometimes associated with this theory is *Alcoa* (*United States v. Aluminum Co. of America*, 44 F. Supp. 97 (S.D.N.Y. 1941). Lopatka and Godek (1992), however, suggest a different view.

15. We relax this assumption in a footnote at the end of this section.

16. For example, if $n = 1$, then the single upstream input supplier by accepting the appropriate royalty contracts from downstream firms could elicit the prices downstream that maximize total industry profits.

When this is the equilibrium allocation, the outcome is an exclusionary *set* of contracts that ensures a monopoly for one downstream firm.

Consider the following game. First, the downstream firms $i = 1, 2$ simultaneously submit bids (b^i_j, e^i_j) to each of the n upstream suppliers. Here, b^i_j is a bid by i for the (shared) right to j's input; e^i_j is a bid for the exclusive right. Next, each upstream supplier j accepts bid(s), choosing the maximum from $\{b^1_j + b^2_j,\ e^1_j,\ e^2_j\}$. The result is an allocation $a \equiv \{a_1, \dots a_n\}$ with $a_j \in \{1, 2, B\}$ indicating whether that the jth input has been allocated to firm 1, firm 2, or both firms. The two downstream firms earn profits $\pi_1(a)$ and $\pi_2(a)$. These profit functions are an exogenous, reduced-form summary of the payoffs from downstream competition. We have in mind that the profit functions represent the payoffs from a differentiated Bertrand competition subgame, in which the value of either downstream product, 1 or 2, to buyers depends on the set of upstream inputs incorporated in the product. $\pi_i(B, \dots B) > 0$ because of, for example, *inherent* product differentiation in a Bertrand pricing game, as opposed to product differentiation induced by the assignment in a of different inputs to the two firms.[17] We assume that each profit function is monotonically increasing in the set of inputs allocated to the firm and decreasing in the set of inputs allocated to the rival firm.

Consider an artificial, "semi-cooperative" game in which the entire set of firms, upstream and downstream, choose an allocation subject to the constraint that given the allocation competition will take place. In this artificial game, lump sum transfers are possible. The allocation chosen is therefore $a^* = \arg\max_a \pi_1(a) + \pi_2(a)$, the privately efficient allocation.

The optimum a^* can in principle fall in any one of seven classes: all $a_i = 1$; all $a_i = 2$; all $a_i = B$; all $a_i \in \{1, 2\}$; all $a_i \in \{1, B\}$; all $a_i \in \{2, B\}$; and some $a_i =$ each of $1, 2$ and B. For example, suppose that inherent product differentiation is high enough that both firms produce positive amounts under a^*. Suppose further that at the optimum, a subset of inputs, M, is critical to the production of either product. And, finally, suppose that simultaneous purchase of any input outside of M would greatly reduce product differentiation, thereby making downstream price competition more intense. Under these three suppositions, a^* would allocate the inputs in M to both firms and the remaining inputs exclusively to one firm or the other.

The following proposition, proved in the appendix, draws a connection between the equilibria in the noncooperative bidding game and the hypothetical semi-cooperative game.

Proposition 5. If $\forall j \in \{1, \dots, n\}$, $a^*_j = 1$ or 2, then either a^* is the unique allocation implemented by the bidding game or an equilibrium does not exist.

17. Inputs could in principle be cost-reducing rather than value-adding in the downstream market.

Corollary If $a^* = (1, 1, ...1)$ or $(2, 2, \ldots, 2)$ then either a^* is the unique allocation implemented by the bidding game or an equilibrium does not exist.

The proposition states that whenever it is privately efficient to allocate each input exclusively to one firm or the other, then this is the only possible equilibrium of the bidding game. The corollary follows immediately. If it is privately efficiently to have only one firm supply the market, then this is the only possible equilibrium of the bidding game.

If there were only one upstream firm, and the only kind of bids allowed were exclusive bids, it would be trivial to show that the allocation maximized total industry profits. But the conditions here are more general: there are many inputs, simultaneous bidding, and bids for non-exclusive and exclusive rights. The equilibria in the semi-cooperative game and the bidding game do not always coincide. For example, if a^* includes $a^*_j = B$, exclusive allocation of each input to one firm is still an equilibrium outcome: the equilibrium bids in this case involve $b^1_j = b^2_j = 0$, with the two firms failing to coordinate on adequate non-exclusive bids. (Each firm's offer of $b^i_j = 0$ may be part of a Nash equilibrium in spite of profits being maximized at $a = B$, because it does not pay either firm individually to raise b^i_j.) If, however, a^* allocates each input exclusively, the coordination problem does not arise and a^* is then the only possible equilibrium outcome for the bidding game. The corollary shows that if maximum profits are achieved by allocating all rights to one firm exclusively, then this is the only possible outcome of the game. The other firm is excluded from the market.

An equilibrium may not exist, however. Suppose, for example, that $n = 10$, and a^* assigns all inputs to the firm 1 which then earns monopoly profits of 100 downstream. The most that firm 1 could pay for each input on average is 10. But firm 2 may respond by offering a total of 30.01 for 3 inputs: duopoly profits must be less than half monopoly profits, but they may well exceed 30% of monopoly profits. Then a^* would not be an equilibrium. But then any allocation other than a^* is also not an equilibrium by Proposition 5. A pure strategy equilibrium would not exist in this case.

Our bidding game is a generalization of the *Colonel Blotto game* (Borel 1921).[18] In the Colonel Blotto game, two army commanders each distribute a number of soldiers across n battlefields. Within each battle, the player (commander) allocating the higher number of soldiers wins. The payoff to either player is the number of battles won. The equilibria in the Colonel Blotto game are all mixed strategy equilibria, first characterized completely by Roberson (2006). Our game collapses to the Colonel

18. Borel's paper antedated the foundational game theory text of von Neumann and Morgenstern (1944) by 23 years. We are grateful to Sven Feldmann for pointing out the connection between our bidding game and the Colonel Blotto game.

Blotto game if bids are restricted to bids for exclusive rights and the game downstream involves the following demand structure: buyers are in n groups of equal size. Buyers in group i each value the product offered by either of the two at v if and only if the product contains the input i. Under this structure, a downstream firm wins the "battle" for buyers in group i if it outbids its rival for input i. In our more general game (i.e., with more general demand) pure strategy may exist.[19]

Structured Model: We must address our central question—when will the equilibrium set of contracts exclude one firm from the market?—with a more structured model. We impose the structure in two stages. In the first stage, we impose symmetry across upstream inputs on the impact on profit functions. In the second stage, we impose functional forms and simulate the model.

Symmetry: Define the condition of *symmetry* of profit functions as the following: $\pi_i(a)$ depends only on the *numbers* of inputs assigned to each firm.[20] (For example, the values of the two products to final buyers depend only on the numbers of inputs, not which inputs, are incorporated in each product.) Define the profit functions in this case as $\hat{\pi}_i(n_1, n_2),\ i = 1, 2,$ where (n_1, n_2) are the numbers of inputs allocated to the two firms. Under symmetry, the necessary and sufficient set conditions for an exclusionary equilibrium can be specified simply. We adopt the following two conditions:

Monotonicity: $\hat{\pi}_i(n_1, n_2)$ is strictly increasing in n_i and strictly decreasing in $n_k,\ k \neq i$.

Strong Complementarity:

$$\forall m_2, \forall k \in \{0, ...n-1\} \qquad \frac{1}{k}[\hat{\pi}_1(n, m_2) - \hat{\pi}_1(n-k, m_2)] > \frac{1}{n}\hat{\pi}_1(n, m_2).$$

Strong complementarity is the condition that the average contribution of the last k units to profits is greater than the average contribution across all units. In other words, the loss of a subset of inputs diminishes the average value of remaining inputs. Convexity of profits in n_1 is sufficient for strong complementarity. As we shall discuss, evidence in our case supports the assumption of strong complementarity.

19. The bidding game is also related to the Prat-Rustichini (2003) concept of a game played through agents (GPTA), which is a multi-principal, multi-agent game. In our model, the principals are the two firms downstream, and the agents are upstream suppliers. Our results are not special cases of the Prat-Rustichini theorems, however.

20. Formally, symmetry is the following condition. Given two allocations a and $\tilde{a}$ satisfying $\#\{j|a_j = 1\} = \#\{j|\tilde{a}_j = 1\}; \#\{j|a_j = 2\} = \#\{j|\tilde{a}_j = 2\};$ and $\#\{j|a_j = B\} = \#\{j|\tilde{a}_j = B\}$, then $\pi_i(a) = \pi_i(\tilde{a}), i = 1, 2.$

Proposition 6. Under symmetry, monotonicity and strong complementarity, the unique equilibrium allocation of the bidding game is the exclusionary allocation, $(1, \ldots, 1)$, if and only if the following conditions hold:

(a) $a^* = (1, \ldots 1)$;
(b) ("no hold-out") there is no $m < n$ such that $\hat{\pi}_1(n, 0)/n < \hat{\pi}_2(n-m, m)/m$.

Parameterization:

The central question is reduced by Proposition 6 to a necessary and sufficient set of two conditions: $a^* = (1, \ldots 1)$ and the no-holdout condition. When will these be satisfied? To answer this question, we must get underneath the exogenous profit functions and into the conditions in the downstream market. We do so with a parameterization of the symmetric case. Consumers are uniformly distributed along a unit line segment between two downstream firms and have a common transportation cost, t. (Higher t will represent lower inherent downstream substitutability of products.) The willingness of a consumer to pay for a particular downstream product, $i = 1$ or 2, depends on the number of inputs m_i embodied in good i, and is given by m_i^{θ}. The parameter θ measures the value and complementarity of the upstream inputs. Costs upstream are zero and the only costs downstream are the fixed costs of purchasing the rights to inputs.

The parameters of the model are t, θ, and n. Figure 1 below illustrates, for $n = 10$, the sets of parameters t and θ for which equation (1) the privately efficient allocation a^* assigns all inputs to the same firm; and equation (2) the parameters for which this allocation is implementable via the bidding game.[21] When upstream complementarity is sufficiently high, the only possible equilibrium values for a^* assign all rights to one firm or all rights to both firms, i.e. $a^* = (B, B, \ldots B)$, since the inputs must be used together. If we add the condition of sufficiently high inherent substitutability (low t), then the allocation $(B, B, \ldots B)$ is ruled out by the intensity of competition that would drive down profits were both firms to acquire the inputs. This leaves exclusivity as the privately efficient outcome with low t and high θ. For this exclusivity outcome to be implemented by the auction, however, the hold-out problem that leads to nonexistence must be overcome. This requires even stronger upstream complementarity and/or downstream inherent substitutability because when the profitability of exclusivity on the part of one downstream firm is small, it is relatively easy for the other downstream firm to out-bid its rival for a subset of the inputs.

21. Three scenarios are allowed for each point (t, θ) in generating Figure 1: (1) the "marginal consumer" is interior; (2) two local monopolists, which happens when t is high; (3) only one monopolist takes the whole market, which happens when the values from the two firms differ substantially, and t is small.

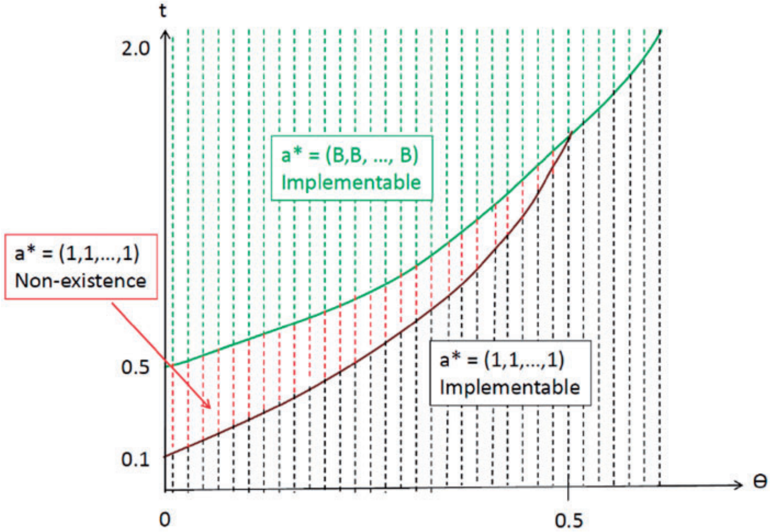

Figure 1. Parameters (θ, t) from structural model, for which the bidding game will implement a^*, exclusivity: $a^* = (1, 1, \ldots, 1)$; non-exclusivity: $a^* = (B, B, \ldots, B)$.

Its bid would reflect a sharing of the prospective profits among only this subset of input providers.

In short, the central prediction of the simultaneous bidding model is exclusivity, resulting from a single winner of all simultaneous bidding games, when three conditions are met: (1) sufficient complementarity upstream; (2) sufficient inherent substitutability downstream; and (3) informational conditions that restrict bids to dollar values rather than contracts.

This model is applied to *Nielsen* in the next section of the article. It is also potentially applicable to other cases involving nonrivalrous goods. Apple's four year exclusivity of IPhone with AT&T in the U.S. (now extended to include Verizon downstream) is one example. The exclusivity of News Corp's *The Daily* newspaper with Apple's IPad, Electronic Arts' exclusivity of a selection of games with Sony's PlayStation 3 are others.[22] Agreements between cable television networks and upstream program networks are yet another example.[23]

22. These examples are all discussed in an interesting paper by Chen and Fu (2013). Chen and Fu offer a model of bidding for exclusive rights that has some similarities to the model in this article. Nonexclusive contracts, however, are restricted to uniform pricing in the Chen-Fu model whereas exclusivity is assumed to open up the possibility for fixed transfers and hence lower and more efficient variable pricing. Exclusivity, by design, resolves the double mark-up problem in the Chen-Fu model and can increase consumer welfare as a result.

23. With some additional structure, the model can also be interpreted in terms of rivalrous goods. The exogenous payoff functions $\pi_1(a)$ and $\pi_2(a)$ can be interpreted as coming from the following downstream market game. Each input is produced at a constant unit cost and each

4. Application: *Nielsen*

We have outlined four channels through which an incumbent firm and its buyers or suppliers have the incentive to enter exclusionary contracts—contracts that deter a rival firm from entering the market. In this section we illustrate the set of incentives with a Canadian competition policy case, *Nielsen*.[24] Nielsen, wholly owned by D&B, had a monopoly in Canada over the provision of market-tracking services for grocery store product sales, when it was threatened in 1985 with the entry into the market by IRI. IRI is a US firm with which Nielsen shared the US market in approximately equal market shares at the time. The products supplied in the market were (and are) a combination of software and information that allowed tracking of market shares, estimation of demand elasticities and responsiveness of demand to product promotions, and so on. The downstream buyers of these information products are mainly manufacturers of grocery products. The key inputs required are raw scanner data provided by the major grocery chains, 11 chains in Canada in 1985. Conditional upon the same raw data inputs, the Nielsen and IRI products were very similar.[25] Some important product differentiation arises, however, due to the fact that Canadian subsidiaries of US firms prefer the product adopted by the United States parent because of complementarities in using the same software and informational products. In the upstream market, scanner data from grocery chains in the same regions were presumably functional substitutes, but evidence indicated a strong complementary in that a national data set, made up of data from all regions, was the product that Nielsen and IRI judged to be of the highest value. In short, the market was characterized by strong complementarity in *upstream* inputs and strong substitutability between the *downstream* information products. Finally, we refer to Nielsen as the incumbent because it was established in the broad market for market-tracking services, but the scanner-based information products were still in development in the mid-1980's.[26]

The case involved a challenge by the Canadian competition authority, the Director of Investigation and Research (now called the Commissioner

unit of an input can be purchased by only one firm. The bidding and allocation of rights to each input takes place in stage 1 of a game. Production involving the inputs takes place in stage 2. The contracts for rights (exclusive or not) signed in stage 1 are either "naked exclusion" contracts (RRW) or "naked rights" contracts. That is, the contracts contain no commitment at all to prices. The prices in stage 2 are set via take-it-or-leave-it offers on the part of any firm that has the rights. (The input prices will be set, via these offers, at unit cost.) Finally, the firms choose outputs as Cournot duopolists. The profits earned in the second stage can be written as functions $\pi_i(a)$ of the allocation determined in the first stage. Our model as it stands can be interpreted as including this example of rivalrous goods.

24. *Canada (Director of Investigation and Research) v. The D & B Companies of Canada Ltd. (1995), 64 C.P.R. (3d) 216 (Comp.Trib.)* ("Nielsen").

25. We label this feature as low *inherent* product differentiation in the discussion of our theoretical model.

26. Nielsen introduced the full scanner-based information product in 1988, after the main events of the case.

of Competition), of two sets of Nielsen contracts. With the threat of IRI's entry starting in 1985, Nielsen entered into 5-year exclusive contracts with all of the upstream grocery suppliers of scanner in 1986, contracts that contained liquidated damage clauses and prohibited the sale of scanner data to any other party. Nielsen had also entered into long-term (3 or more year) contracts with a set of downstream buyers (grocery product manufacturers). Until then, Nielsen's downstream contracts had been evergreen contracts that were terminable on 8 month's notice (in those contracts entered as evidence).[27] The Director's challenge of both sets of contracts before the Canadian Competition Tribunal was successful. The Tribunal nullified the terms of the downstream contracts and the exclusivity restrictions in the upstream contracts.[28]

4.1 Competition for Exclusive Contracts with Upstream Suppliers

As in our model in Section 4, the incumbent Nielsen did not have a first-mover advantage in establishing contracts with upstream suppliers of raw data. In fact, as Nielsen emphasized in its evidence, the potential entrant, IRI, was the first to offer exclusive contracts. The bidding was not literally simultaneous as in our theory, but was concentrated in a few months; our adoption of the assumption of simultaneous competition is a better fit than usual to the facts of the case. And consistent with the model, the principal elements in each contract were the price for upstream data and parameters of exclusivity rather than more complex royalty schemes.

The market for rights to the data inputs, in short, was one in which competition was intense—but the competition was for rights to the upstream inputs, not competition within the output market. Does this type of competition in some sense substitute for competition within the market—or provide any welfare benefits at all? Under the facts of this case, the *substitutability* or low inherent product differentiation downstream and the *complementarity* of inputs upstream, the equilibrium outcome of competition for the rights to inputs was a monopoly no matter how intense the competition, i.e. no matter how symmetric the positions of Nielsen and IRI were in their potential for exploiting the monopoly position.

The socially optimal allocation of inputs is clearly an allocation of each input to both firms. As a nonrivalrous good can be supplied to the second firm at zero cost. The benefits of the nonexclusive allocation are two-fold: greater product variety in the market (in allowing, for example, greater matching of software between Canadian subsidiaries and U.S. parents) and price competition downstream instead of monopoly pricing.

The conflict between the equilibrium outcome and the socially optimal allocation of inputs generalizes to the case where inherent product differentiation is strong enough that the equilibrium outcome is not a

27. *Nielsen,* p. 62.

28. Significantly, as we shall discuss, the Tribunal did not nullify the entire upstream contracts.

monopoly. Suppose that product differentiation is so strong that total industry profits would be maximized by the presence of both firms in the market. In general industry profits (upstream and downstream) will be maximized by allocating some raw inputs exclusively to Nielsen and some to IRI: the difference in the allocation of inputs translates into greater differentiation and therefore less intense price competition in the output market. If the two firms were cooperatively choosing the allocation of inputs, and then competing, in general some exclusivity but not complete exclusivity may well result. Partial exclusivity can increase profits when two firms compete because of the "competition-dampening effect" of exclusive dealing: increasing the sets of inputs to which firms have exclusive rights increases product differentiation in the final market, which dampens price competition and raises equilibrium prices and profits.

When firms choose how many input suppliers to sign up exclusively they trade off the private benefits of the competition-dampening effect with the costs of reduced product value. The social optimum involves no exclusivity because joint allocation of each input maximizes the value of each product to any purchaser (at zero social cost) and enhances downstream price competition, bringing prices closer to marginal cost.

Competition *for* the market in the form of competition for rights to upstream data inputs, in short, does not substitute for competition *within* the market, as the Tribunal noted.[29] It does, however, yield one simple efficiency benefit. Suppose that the two firms that are bidding for exclusive rights have positive costs, rather than zero costs, with constant marginal costs. Under a mild restriction on demand, the result of the bidding game is that at least the "right" monopolist is chosen. Whichever monopolist, Nielsen or IRI, would produce the greater social surplus is the one that would win the game.[30] Aspects of the strategic interaction between the firms reviewed below, however, distort even this modest efficiency outcome and leave us with the Aghion–Bolton type of prediction that the higher cost (or lower surplus) firm may survive as a monopolist in this market.

The key effect of intense competition for exclusive rights, when the downstream firms are symmetric in demand and costs and product differentiation is relatively low so that monopoly is the outcome, is a *shift in monopoly rents upstream* to the suppliers of the raw data as the price for the data is bid up to the present value of resulting monopoly profits. The scarce input was the raw data, not the ability to manage a monopoly

29. *Nielsen*, p. 79. See Mathewson and Winter (1987) for a model and case discussion in which the disciplining effects of competition *for* the market offset the loss of competition *within* the market in the adoption of exclusivity restrictions.

30. A sufficient restriction on demand is that the percentage difference in demand between Nielsen's product and IRI's product be independent of price. Under this assumption, the product generating the higher profit is also the product generating the higher total surplus.

downstream. The suppliers of raw data, the grocery store chains, were principle beneficiaries of the contract exclusivity. In light of the ultimate beneficiaries of the exclusivity contracts, it is interesting to note that the proposal to sign up retailer data suppliers exclusively was the outcome of negotiations that were initiated by the Retail Council of Canada, a trade association of the upstream suppliers.[31]

The bidding game was not perfectly symmetric, of course. Any asymmetry in the bidding game that Nielsen was able to create—to foreshadow the implications of the downstream contracts—acted to increase Nielsen's share of the increase in aggregate industry profits attributable to exclusivity.

4.2 Nielsen's Downstream Contracts

The terms of Nielsen's contracts with selected downstream purchasers of their information products jumped from less than 1 year (evergreen contracts terminable on 8 months' notice) to 3–5 years as soon as IRI attempted to enter the industry. The contracts contained liquidated damages payable to Nielsen if the customer terminated the contract. The Tribunal concluded that the strategic purpose of the shift in contract lengths was to deter the entry of IRI by "locking up" customers in long-term contracts (*Nielsen*, p.75).

The buyer externalities theory applies here because each client would view the probability of IRI entering as almost unaffected by its own decision to accept the long-term contract. A small "bribe" in terms of a lower price would be sufficient to induce the client to sign the long-term contract.

Recall that the first theory of downstream exclusionary contracts in our synthesis is the original Aghion–Bolton theory that these contracts can extract transfers from the entrant. This theory applies here. Each downstream buyer of Neilsen's information products accepted a stipulated damage clause because the expected cost to the buyer of accepting was small: even if the buyer anticipated that IRI might enter, IRI would have to offer a lower price to the buyer as a result of the stipulated damage. In this sense, IRI would effectively pay for a large part of the stipulated damage. By raising the stipulated damage, the incumbent and buyer in any downstream contract were implementing a transfer away from IRI, contingent on the event of successful entry.

In the application of both the horizontal externalities theory and the Aghion–Bolton theory, the ability of the incumbent to discriminate in long-term contract offers was an important ingredient in implementing exclusivity. Nielsen did not induce all customers to sign long-term contracts but instead targeted the Canadian subsidiaries of United States customers of IRI (*Nielsen*, p.73). It was the loss of these buyers to

31. *Nielsen*, p. 63.

which Nielsen was most vulnerable, and the gain from signing long-term contracts with them was the highest.

Finally, a vertical externality as analyzed in Section 2.5 of this article applies. The fact that Nielsen as the incumbent was able to enter the *downstream* contracts described, provided it with an asymmetric advantage over IRI in the *upstream* bidding game for the exclusive rights to the data. IRI's willingness-to-pay for the upstream data was surely reduced by the disadvantage it faced in overcoming the long-term contracts downstream. The long-term contracts downstream thus imposed a negative externality, and extracted a transfer, not just from IRI but also from upstream data suppliers in allowing Nielsen to win the upstream game with lower bids.

One effect of this vertical externality is to negate even the modest efficiency property that we claimed for the upstream bidding game. It no longer follows that Nielsen would be forced out of the market in the event that it was not the "right" monopolist: the advantage transferred from the downstream contracting game to the upstream game leads to the possibility of an Aghion–Bolton type of inefficiency in allowing an inefficient incumbent to remain as a monopolist.

4.3 Renegotiation and Staggered Contracts

Let us return to the upstream contracts. After signing contracts with identical (5 year) terms with all of the data suppliers, Nielsen recognized that 5 years later (in the summer of 1991) it would potentially face the identical bidding war with IRI for the rights to the essential inputs. The prospect was again competition for the right to be the monopolist—competition that shifted rents upstream. In 1989, Nielsen renegotiated contracts with two suppliers including Safeway, the largest supplier.[32] While the effect of contract staggering was not a monopoly—this market structure was already guaranteed by exclusivity whether contracts were staggered or not—the outcome was a barrier to entry *into the position of being the monopolist* in the market. In an internal document produced in the case, the President of Nielsen Canada stated

> "After we did our retailer deals five years ago, we recognized that we were vulnerable because virtually all of these agreements expired around the same time. We set ourselves a goal then to pursue a practice that would result in our retailer and distributor contracts expiring at different times. This would make it much more difficult for any competitor to set up a service unless he was prepared to invest in significant payments before he had a revenue stream." (*Nielsen,* p.66)

32. Nielsen was able to renegotiate the Safeway contract as a result of a merger between Safeway and Woodwards. The contract with Steinberg, a smaller supplier, was renegotiated the same year (*Nielsen*, p. 62).

Just as with Nielsen's ability to establish downstream contracts, discussed above, this staggering of contracts negates the modest efficiency property of the upstream bidding game. The social cost of this staggered contract strategy was, at a minimum, that the most efficient monopolist would not necessarily occupy the market.[33] The profitability of the staggered contract strategy is not explained simply by its profitability to Nielsen. The two suppliers voluntarily renegotiated their contracts. It is the external effect or transfer of wealth away from the other suppliers of data to the *pair* of parties undertaking any contract renegotiation that is the key to explaining the strategy.

4.4 Most-favored Nation Clauses

An additional issue that arose in *Nielsen* concerned preferred supplier contracts or most-favored nation (MFN) clauses in the upstream contracts. These were terms whereby Nielsen would be guaranteed that its price would not be higher than a price at which the data were subsequently sold to another buyer such as IRI.[34] Two of the contracts Nielsen entered in 1994 contained MFN clauses, in addition to exclusivity clauses as Nielsen apparently recognized the risk that the latter would be struck down. In some circumstances, an MFN clause is reasonable. It ensures, for example, that the first purchaser of the input is not disadvantaged in downstream competition with a rival who is able to strike a more favorable price. (Because of the zero marginal cost of the input there is a risk that a lower price might be struck subsequently with a rival.)

Suppose in this case that exclusivity were struck down in these contracts. Could the MFN clauses, if they were allowed, have the effect of exclusivity? An example shows that they could. To keep the analysis simple, imagine that there is a single upstream supplier of raw data, that the monopoly profits that could be earned with the data are 10 dollars and that the profits that could be earned by each duopolist in the market would be 3 dollars. (The monopoly profits thus exceed the sum of duopoly profits.) If the incumbent monopolist tried to bargain for a low price, say 5 dollars, for the input, then the MFN would not deter entry. The supplier of the raw data would willingly accept 3 dollars from the new entrant even with the MFN restraint leading to a reduction of 2 dollars in the incumbent's price. If the incumbent offered a price of 6.50, however, the entrant would be deterred. In short, the combination of MFN plus the offer of a

33. The strategy of staggered contracts was not in and of itself challenged by the government in the case, for an obvious reason. The prohibition of staggered contracts would be an unworkable remedy. Requiring a firm to coordinate the beginning and ending dates of its contracts with suppliers would be simply too intrusive and inefficient.

34. The preferred-supplier contracts specified a lower price conditional upon sale of the data to a second firm, rather than a guarantee of price matching (*Nielsen*, p. 62). The analysis is similar.

high price deters entry. The Tribunal, convinced of this argument,[35] struck down the MFN and preferred-supplier clauses, albeit with a time-limited order. The assessment of *high* prices in combination with the MFN clauses as exclusionary contrasts with the traditional legal view of *low* prices as exclusionary, as in predatory pricing cases.

4.5 Strategy and the Timing of Contract Offers in *Nielsen*

We represented the competition between Nielsen and IRI for rights to upstream data with a model in which the two firms offered simultaneous bids for exclusive and non-exclusive rights, rather than a model with a first-mover advantage to the incumbent. At least one retailer has requested bids on both an exclusive and non-exclusive basis in this market (*Nielsen*, p.36), but in representing market competition (in the standard way) as a simultaneous game, we abstracted from very interesting strategic interaction between the firms. In support of our no-incumbent-first-mover assumption, IRI was the first to offer exclusive contracts in the market and indeed signed up 10 of the 11 suppliers of retailer scanner data to exclusive contracts.[36] This fact was Nielsen's principal defense in the case:

> "Throughout the course of the proceedings counsel for Nielsen returned again and again to the origin of the present exclusive arrangements and the role of IRI to argue that, because IRI 'initiated' the practice of exclusives, Nielsen's use of exclusives cannot be anti-competitive. Nielsen's position was that it was forced to adopt exclusives in order to protect its legitimate business interests against the threat of being locked out of the emerging technology and to safeguard its existing tracking services." (*Nielsen*, p.68).

There is no doubt that Nielsen's decision to offer exclusive contracts in 1986 was the right business decision, notwithstanding the subsequent ruling in *Nielsen* that the contracts were illegal. Any antitrust challenge of the contracts was years away (8 years, as it turned out), the outcome of such a challenge was uncertain, and the impact of a potential loss by Nielsen in the event of a challenge was simply a requirement that the contracts be abandoned.[37] Yet Nielsen's defense of exclusionary contracts as a *necessary response* on its part to the use of these contracts by IRI was properly rejected by the Tribunal. In this civil matter, the issue was whether the continued use of the contracts by any party resulted in a

35. "For reasons discussed . . . and, in particular, Dr. Winter's model, we are of the view that the provisions in question allow Nielsen to set its payments at a level that would make entry by a rational would-be entrant unprofitable." (*Nielsen*, p. 67).

36. Expert Report of Ralph A. Winter in *Nielsen*, p. 40.

37. Section 79 of the Canadian Competition Act, R.S.C. 1985, c. C-34, under which Nielsen's contracts were challenged, allows the Tribunal to implement a remedy to practices that are deemed to result in a substantial lessening of competition. It did not at the time provide for the possibility of penalties to be imposed by the Tribunal.

substantial lessening of competition in the market,[38] not whether Nielsen as a practical and historical matter needed to adopt the contracts in 1986. "In the view of the Tribunal, retaining or obtaining a dominant position in order to defend another firm potentially becoming dominant is not an acceptable business justification." (*Nielsen*, p.68). Nielsen is an unusual case in that, as the Tribunal noted, Nielsen offered no efficiency explanation for its practice beyond self interest.[39]

If IRI signed up 10 of the 11 input suppliers, how did Nielsen end up as the respondent in this case having exclusives with all 11 suppliers? The answer is in the IRI contracts. The design of these contracts hinged on the strong complementarity of the inputs. To protect against ending up with only a subset of suppliers of data, and competing against Nielsen which at least had an established demand based on a complete set of pre-scanner information on retail outlets, IRI offered contracts that were conditional upon its success in signing *all* suppliers. Safeway was the hold-out. Nielsen was able to strike an exclusive contract with Safeway, presumably for terms generous to Safeway, and the IRI contracts unraveled. IRI's contractual strategy backfired. This is an example of the hold-out problem in the acquisition of complementary inputs, parallel to the land assembly problem for an urban developer. The characterization of the optimal mechanism design in this type of situation—the mechanism that IRI should have used—is an unresolved question in economic theory.

4.6 The Market Outcome in *Nielsen*: Exclusion via *Implicit* Contracts

Did the decision in this case transform the market for scanner-based information products from one with intense competition *for* the market to one with competition *within* the market, as in the United States? No. IRI competes in eight countries around the world, but the market for scanner-based information remains a Nielsen monopoly in Canada.

The Tribunal recognized that grocery retailers might decide to continue to offer their data to only one firm even after any exclusivity inducements by Nielsen were prohibited. In fact, this is exactly what has happened. The exclusivity agreements have continued in what economists would label *implicit contracts*: each grocery supplier of raw data has apparently recognized that if it were to break the implicit agreement by selling the data to

38. The Tribunal recognized that it had no direct authority over IRI in designing its remedy:

> "We do not have the authority to order IRI, which is not a party before us, to do anything. We acknowledge the undertaking given by . . . IRI to the Tribunal, stating that IRI will agree not to enter into exclusive arrangements with retailers if Nielsen is prohibited from doing so . . . We are confident that IRI, as a reputable public company, will comply with its undertaking." *Nielsen*, p. 97.

39. "We do not accept that self-interest constitutes [a business] justification. We note that Nielsen's experts also failed to provide any efficiency rationale for the exclusives." (*Nielsen*, p. 67).

IRI as well as Nielsen, then the downstream monopoly would soon be replaced by a duopoly of close substitutes in which marginal costs were close to zero. The monopoly rents would disappear—and, as we have discussed, these rents largely flowed upstream to the grocers as suppliers of the scarce data.

The Tribunal recognized that the likelihood of implicit contracts was increased by their decision to alter only the exclusivity clauses and not the current payments in the contracts. The Tribunal also recognized that in the event that the implicit exclusivity contracts were not sustained, Nielsen would be left paying a higher price for the data under its (still-enforceable) contracts than IRI:

> We do recognize . . . two problems that may result from striking the exclusivity clauses without touching the current payments, with the result that Nielsen may choose, or may be required by contract law, to continue to make those payments to retailers. [¶] The first problem is that while the retailers would be able to increase their revenues in the short run by selling their data to IRI while also accepting the current level of payments from Nielsen, they could choose to forgo the additional payments from IRI if they believe that dealing with IRI could reduce their earnings in the long run. The result would be at least some *de facto* exclusives . . . The second problem is that Nielsen might have to continue its current level of payments, without receiving the benefits of exclusivity the payments were intended to secure, while its competitor makes payments at a lower level.

The Tribunal properly did not attempt to set prices in the contracts. But in our view the Tribunal should have struck down the contracts entirely. New contracts would then have been negotiated. It is of course possible that even then the de facto exclusivity may have emerged. But sustaining cooperation in dynamic games, as one equilibrium among many possible equilibria, often depends on initial conditions or focal points. The likelihood of exclusivity as an implicit contract equilibrium was increased by the Tribunal's decision. This decision left the current payments intact, as a focal point for the emergence of an implicit contract equilibrium.

5 Conclusion

This article has synthesized the economic theories of exclusionary contracts. Three of these theories pertain to contracts with downstream buyers, in which incumbency in a market provides a first-mover advantage in contract offers. The fourth is a theory of exclusive contracts with upstream buyers. Downstream rivals are assumed to bid simultaneously for rights to inputs in this theory, reflecting the fact that incumbency need not confer a first-mover advantage in establishing with upstream suppliers. All four theories or incentive channels for exclusionary contracts are captured in *Nielsen*.[40]

With respect to competition policy towards exclusivity contracts or long-term contracts, the theories outlined here and applied to Nielsen capture only half the story. Exclusivity contracts can be (and usually are) efficient, and of course long-term contracts are almost always efficient. An exclusivity contract can, for example, be an efficient means of suppressing incentives for a party to invest in the ability to deal with alternative partners in the future. In an incomplete contract, investment in outside options such as alternative partners may be excessive as a means of simply strengthening a position in future negotiations within the contract.[41] Alternatively, an exclusivity contract can protect investments by an upstream supplier against free-riding by competitors on investments such as training that the supplier makes in retail relationships (Marvel 1982). Even when exclusivity contracts serve to strengthen or protect a dominant firm's market share, these contracts may increase total surplus. The derivative of surplus with respect to quantity purchased from a firm is given by the margin of price over marginal cost (Dansby and Willig 1979); because this margin is likely to be higher for dominant firms, a transfer of quantity to the dominant firm may be welfare increasing.

A special feature of *Nielsen* allows the case to serve as a stark illustration of the anticompetitive theories of exclusive contracts. The upstream data are produced at essentially zero cost as a by-product of grocery sales, and used internally for inventory purposes in any case. Incentives for the production of upstream raw data inputs are not compromised by a reduction in profits from the prohibition of exclusivity contracts. A competition policy constraint forcing input suppliers to distribute data to both the incumbent and entrant is efficient because once the data (a nonrivalrous input) are produced, allocation to multiple uses is efficient. And competition is intensified as a result. In other cases involving the nonrivalrous inputs, such as information or rights to the use of technology, the incentives for production of the information are sensitive to the return to production. In patent cases, for example, exclusivity would generally not be prohibited. A patent confers exclusive rights to the use of information, and

40. Consideration of market dynamics and innovation yields a fifth theory. Exclusionary contracts can be explained as implementing a transfer from future buyers to the current market participant. Suppose, for example, that in an evolving high-tech industry the probability of discovering the next generation technology is higher for firms operating in current market than firms outside the market. If the set of buyers changes to some degree over time, then exclusionary contracts today extract surplus from buyers in the market tomorrow. See Choi and Stefanidis (2001). Fumagalli and Motta (2010) present a model of exclusion via predation that relies on the same intertemporal transfer of surplus between different sets of buyers. The Aghion–Bolton perspective on exclusionary contracts is thus valuable beyond the static settings considered in this article.

41. Segal and Whinston (2000b) offer a theory that incorporates this argument, which is also closely related to the earlier "hold-up" literature (e.g., Klein et al. 1978; Williamson 1979).

an exclusivity contract simply transfers these exclusive rights. *Nielsen* is a superb illustration of the incentives for anticompetitive, exclusionary contracts developed in the economic theory literature, but competition policy in this area is much more complex than suggested by the case.

Appendix: Proofs of Propositions

Proposition 4. Under the assumptions of the buyer externality model, the incumbent's equilibrium strategy is to offer a contract (p_o, x) with $x < c_I$ to $m \in [1, n-1]$ buyers. The optimal contract yields expected surplus for contract buyers equal to that which would be earned in a market without long term contracts.

Proof: We start by deriving the pricing equilibrium following a contract (p_0, x) with $c_I < x < v$. We then show that any such contract is dominated for the incumbent, so that the optimal contract satisfies $x \leq c_I$. We then derive the pricing equilibrium following a contract with $x \leq c_I$ and show that the contract with $x = c_I$ is dominated.

Suppose that a contract with $x > c_I$ has been offered to and accepted by m buyers (the "contract buyers"). Table A1, explained below, describes the ex post pricing equilibrium for various realizations of c, under the hypothetical contract with $x > c_I$, as well as in the case of no-contract.

Table A1 lists the ex post pricing equilibria for ranges of cost realizations ranging from lowest to highest in the second column. We describe the table by starting with the last row. For realizations of c that would allow the incumbent to set v to all consumers in the absence of a contract (row 5), the prices with the contract are x to contract buyers—since they have purchased the option—and v to free buyers. If costs are just low enough that the incumbent would be constrained by potential entry in the absence of a contract (row 4), the prices with the contract remain at x and v since that pair of prices continues to satisfy (4). The fact that $x < v$ allows the monopolist to continue to set v to free buyers without attracting entry. But if the realized cost is lower, so that the monopolist must reduce p_f to keep the market, we enter row 3. This is the critical range of realized cost, c. In this range, a lower x in the contract allows the incumbent to extract a higher price, p_f, from free buyers without attracting entry. As the hypothesized realization of c drops further, charging a price x to all buyers, including free buyers, would attract entry. Here the incumbent sets a price lower than x for all consumers (row 2). Finally, if the cost realization is sufficiently low, an entrant will supply at cost (row 1).

Consider next to the choice of contract by the incumbent. Note that from Table A1 that the lower cost firm, the incumbent or an

Table A1. Equilibria of Ex Post Pricing Game, following a contract with $x > c_I$

	Realization of c in range:	Post-Contract (p_o, x) with $x > c_I$			No Contract	
		Supplier	p_c	p_f	Supplier	p
1	$[0, c_I - f/n)$	Entrant	$c+f/n$	$c+f/n$	Entrant	$c+f/n$
2	$[c_I - f/n, x - f/n)$	Incumbent	$c+f/n$	$c+f/n$	Incumbent	$c+f/n$
3	$[x - f/n, [mx+(n-m)v - f]/n)$	Incumbent	x	$(nc+f-mx)/(n-m)$	Incumbent	$c+f/n$
4	$[[mx+(n-m)v - f]/n), v - f/n]$	Incumbent	x	v	Incumbent	$c+f/n$
5	$[v - f/n, \infty]$	Incumbent	x	v	Incumbent	v

entrant, always produces in equilibrium. Therefore the deadweight loss $\Delta(x, m) = 0$. From equation (5) and Table A1, we have

$$\pi = S^* - m\bar{u} - s_f(x) = S^* - m\bar{u} - (n-m)\int_0^{x-f/n} [v - (c+f/n)]dG(c)$$
$$- (n-m)\int_{x-f/n}^{[mx+(n-m)v-f]/n} [v - (nc+f-mx)/(n-m)]dG(c). \quad \text{(A1)}$$

From equation (A1), at $x = c_I$, $\partial\pi/\partial x = -m[G([mx+(n-m)v - f]/n) - G(c+f/n)] < 0$. Hence any contract with $x > c_I$ is dominated by a contract with $x = c_I$.

For a contract with x in a small interval below c_I, the incumbent still faces the constraint (equation (4)) if it is to sell in the ex post market.[42] Table A2 provides the equilibrium prices and supplier in the ex post pricing game contingent upon a contract with $x \in (c_I - \varepsilon, c_I]$ for small ε.

For c low enough that $nc+f < mx+(n-m)c_I$, entrant captures the market, as is efficient. For $nc+f > nc_I$, the incumbent serves the market, as is efficient. But for c in the range that satisfies $c+f/n \in (mx+(n-m)c_I, nc_I)$, the incumbent serves the market inefficiently, selling at prices x for contract buyers and $p_f = (nc+f-mx)/(n-m)$. The ex ante deadweight loss from the contract with x slightly below c_I is $\Delta(x, m) = \int_{[mx+(n-m)c_I-f]/n}^{c_I-f/n} nc_I - (nc+f)dG(c)$. Note that $\partial\Delta(x, m)/\partial x = 0$ at $x = c_I$, consistent with the envelope theorem. The surplus to free buyers is, for x in this range,

$$s_f = (n-m)\int_0^{[mx+(n-m)c_I-f]/n} v - (c+f/n)dG(c)$$
$$+(n-m)\int_{[mx+(n-m)c_I-f]/n}^{[mx+(n-m)v-f]/n} v - (nc+f-mx)/(n-m)dG(c). \quad \text{(A2)}$$

42. For sufficiently low x, the incumbent would face a constraint arising from entry into only the free buyers' segment of the market. It is enough for our purposes to consider $x \in [c_I - \varepsilon, c_I]$, for small ε.

Table A2. Equilibria of Ex Post Pricing Game, following a contract with $x \in [c_I - \varepsilon, c_I]$

Realization of c in range:	Post-Contract (p_o, x) with $x > c_I$			No Contract	
	Supplier	p_c	p_f	Supplier	p
1 $[0, [mx+(n-m)c_I - f]/n)$	Entrant	$c+f/n$	$c+f/n$	Entrant	$c+f/n$
2 $[[mx+(n-m)c_I - f]/n, c_I - f/n)$	Incumbent	x	$(nc+f-mx)/(n-m)$	Entrant	$c+f/n$
3 $[c_I - f/n, [mx+(n-m)v - f]/n$	Incumbent	x	$(nc+f-mx)/(n-m)$	Incumbent	$c+f/n$
4 $[[mx+(n-m)v - f]/n), v - f/n]$	Incumbent	x	v	Incumbent	$c+f/n$
5 $[v - f/n, \infty]$	Incumbent	x	v	Incumbent	v

From equation (5) and (A2), we have at $x = c_I, \partial\pi/\partial x = -m[G([mx+(n-m)v - f]/n) - G([mx+(n-m)c_I - f]/n)] < 0$. This proves that in equilibrium $x < c_I$.

Proposition 5. If $\forall j \in \{1, \ldots, n\}$, $a_j^* = 1$ or 2, then either a^* is the unique allocation implemented by the bidding game or an equilibrium does not exist.

Proof: Assume that $\forall\, j \in \{1, \ldots, n\}$, $a_j^* = 1$ or 2. Suppose, *arguendo*, that there is an equilibrium to the simultaneous bidding game that implements an allocation $\hat{a} \neq a^*$. Then from the definition of a^*, we have

$$[\pi_1(a^*)+\pi_2(a^*)] - [\pi_1(\hat{a})+\pi_2(\hat{a})] \equiv \Delta > 0. \tag{A3}$$

Let the supposed bidding game equilibrium strategies for $i = 1, 2$ and $j = 1, \ldots, n$ be $(\hat{s}^1, \hat{s}^2, \hat{a})$ where $\hat{s}^i = \left(\hat{s}_1^i, \ldots \hat{s}_n^i\right)$ with $\hat{s}_j^i = \left(\hat{b}_j^i, \hat{e}_j^i\right)$ and $\hat{a} = (\hat{a}_1, \ldots \hat{a}_n)$ with $\hat{a}_j \in \{1, 2, B\}$ now being interpreted as the strategy of input supplier j. Given any strategies (s^1, s^2, a), denote the payment by downstream firm i to supplier j as $p_j^i(s^1, s^2, a) = e_j^i, b_j^i$ or 0 as $a_j = i, B$ or $k \neq i$ respectively, and let $P^i(s^1, s^2, a) = \sum_{j=1}^n p_j^i(s^1, s^2, a)$. For brevity, denote $\hat{P}^i = P^i(\hat{s}^1, \hat{s}^2, \hat{a})$. Denote the equilibrium payoffs of firm i under $\left(\hat{s}^1, \hat{s}^2, \hat{a}\right)$ by $H^i\left(\hat{s}^1, \hat{s}^2, \hat{a}\right) \equiv \pi_i(\hat{a}) - \hat{P}^i \geq 0$. The following lemma characterizes the relationship among $\hat{e}_j^1$, $\hat{e}_j^2$ and $\hat{b}_j^1 + \hat{b}_j^2$.

Lemma 1 In any equilibrium $(\hat{s}^1, \hat{s}^2, \hat{a})$:

(a) If $\hat{a}_j = B$, then $\hat{e}_j^1 = \hat{e}_j^2 = \hat{b}_j^1 + \hat{b}_j^2$.

(b) If $\hat{a}_j = 1$ or 2, then $\hat{e}_j^1 = \hat{e}_j^2 \geq \hat{b}_j^1 + \hat{b}_j^2$.

To prove (a), note that the optimality of j's choice implies that

$$\hat{b}_j^1 + \hat{b}_j^2 \geq \hat{e}_j^1 \text{ and } \hat{b}_j^1 + \hat{b}_j^2 \geq \hat{e}_j^2. \tag{A4}$$

Suppose that one of these inequalities (say, the first) were strict, so that $\hat{b}_j^1+\hat{b}_j^2 > \hat{e}_j^1$. Then for $\varepsilon > 0$, firm 2 could reduce $\hat{b}_j^2$ by $\varepsilon/2$ and $\hat{e}_j^2$ by ε, leaving both inequalities in (A4) strict. The response $\hat{a}_j = B$ would remain j's equilibrium action given the new set of bids. Firm 2 would have reduced its payment to j without changing the equilibrium action of j. To show that firm 2's payoff would increase, it is then sufficient to show that firm 2 can further adjust its strategy so as to ensure that no supplier other than j changes its strategy. For any input supplier $k \neq j$ that is indifferent between its equilibrium action $\hat{a}_k$ and another action, firm 2 can adjust its bids to k, raising its bids by at most $\varepsilon/4n$, to ensure that $\hat{a}_k$ would be dominant for k. Specifically, if $\hat{a}_k = 2$, then firm 2 could increase its bid $\hat{e}_k^2$ by $\varepsilon/4n$ to ensure that $\hat{a}_k = 2$ is dominant for k; if $\hat{a}_k = 1$, then firm 2 could set $(b_k^2, e_k^2) = (0,0)$ to ensure that $\hat{a}_k = 1$ is dominant for k; and if $\hat{a}_k = B$, then firm 2 could set $(b_k^2, e_k^2) = (\hat{b}_j^i+\varepsilon/4n, 0)$ to ensure that $\hat{a}_k = B$ is dominant for k. In summary, if $\hat{b}_j^1+\hat{b}_j^2 > \hat{e}_j^1$ then 2 could change its strategy so that the allocation $\hat{a}$ is unchanged, its payment to j is reduced by $\varepsilon/2$, and its total payment to other suppliers increases by no more than $(n-1)(\varepsilon/4n) < \varepsilon/4$. For ε sufficiently small, the total payment, $P^2(s^1, s^2, a)$, would fall and 2's payoff $\pi_2(\hat{a}) - P^2$ would increase. This contradicts the optimality of $\hat{s}^2$. A parallel argument shows that $\hat{b}_j^1+\hat{b}_j^2 > \hat{e}_j^2$ contradicts the optimality of $\hat{s}^1$, thus proving (a).

To prove (b) of the lemma, suppose $\hat{a}_j = 1$, the case $\hat{a}_j = 2$ being symmetric. We have $\hat{e}_j^1 \geq \hat{e}_j^2$, and $\hat{e}_j^1 \geq \hat{b}_j^1+\hat{b}_j^2$ from j's optimality condition. The strict inequality $\hat{e}_j^1 > \hat{e}_j^2$ is impossible, because if it held firm 1 could decrease $\hat{e}_j^1$ by $\varepsilon > 0$ and $\hat{b}_j^1$ by 2ε. For ε sufficiently small, the equilibrium allocation would not be changed, but the payment P^1 would decrease (and thus $H^1(s^1, \hat{s}^2)$ would increase), contradicting the hypothesis that $(\hat{s}^1, \hat{s}^2, \hat{a})$ is an equilibrium. Therefore, if $\hat{a}_j = 1$ or $2, \hat{e}_j^1 = \hat{e}_j^2$. ■

Continuing with the supposition that there is an equilibrium allocation $\hat{a}$ satisfying (A3), consider the strategies, for $i = 1, 2$, defined by

$$\tilde{s}^i \equiv \left(\hat{b}_j^i, \hat{e}_j^i + \frac{\Delta}{4n}\right)_{j=1}^{n} \text{ if } a_j^* = i \text{ and } (0,0) \text{ otherwise.}$$

It follows from the lemma that, given the rival's strategy, either firm i can implement a^* by adopting $\tilde{s}_j^i$. The total increase in P^i required to do so is no greater than $n(\Delta/4n) = \Delta/4$. It follows from (A3) that at least one of the following inequalities holds: $\pi_1(a^*) - \pi_1(\hat{a}) \geq \Delta/2$ and $\pi_2(a^*) - \pi_2(\hat{a}) \geq \Delta/2$. Therefore at least one of the firms has a deviation from $\hat{s}^i$ that would implement an increase in π_i of at least $\Delta/2$ with an increase in total payment of no more than $\Delta/4$. This would increase the firm's payoff, contradicting the supposition that $(\hat{s}^1, \hat{s}^2, \hat{a})$ is an equilibrium.

Proposition 6. Under symmetry, monotonicity and strong complementarity, the allocation $(1, \ldots, 1)$ is implemented uniquely by the bidding game if and only if the following conditions hold:

(a) $a^* = (1, \ldots, 1)$;
(b) ("no hold-out") there is no $m < n$ such that $\hat{\pi}_1(n, 0)/n < \hat{\pi}_2(n - m, m)/m$.

Proof: The necessity of (a) follows from the Corollary to Proposition 5. To prove the necessity of (b), suppose *arguendo* that there exists both m such that $\hat{\pi}_1(n, 0)/n < \hat{\pi}_2(n - m, m)/m$ and an equilibrium (s^{1*}, s^{2*}, a^*) that implements $(1, \ldots, 1)$. Denote by (b_j^{i*}, e_j^{i*}) the jth component of s^{i*}, for $i = 1, 2$. The supposition implies that

$$\hat{\pi}_2(n - m, m) - \left(\frac{m}{n}\right)\hat{\pi}_1(n, 0) > 0, \tag{A5}$$

and

$$\hat{\pi}_1(n, 0) - \sum_{j=1}^{n} e_j^{1*} \geq 0. \tag{A6}$$

The inequality (A6) is a condition of equilibrium since firm 1 could assure non-negative profits by setting all bids equal to 0. The inequality (A6) implies that there exists a set of input suppliers $\tilde{K} \equiv \{j_1, \ldots, j_K\}$ with $\#\tilde{K} = m$ such that $(\forall j \in \tilde{K})$, $e_j^{1*} \leq \hat{\pi}_1(n, 0)/n$. Given firm 1 's strategy, firm 2 could therefore attract all suppliers in $\tilde{K}$ with a bids $\hat{\pi}_1(n, 0)/n + \varepsilon/n$ for $\varepsilon > 0$. Firm 2's payoff from doing so is $\hat{\pi}_2(n - m, m) - m[\hat{\pi}_1(n, 0)/n + \varepsilon/n]$. If follows from the strict in equality (A5) that for ε positive but sufficiently small, this payoff is positive. This contradicts the supposition that s^{2*} is an equilibrium strategy.

We divide the sufficiency (for the existence and uniqueness of $(1, \ldots, 1)$ as an equilibrium allocation) of (a) and (b) together into two parts: the sufficiency of the two conditions for the implementability of $(1, \ldots, 1)$; and the sufficiency of these two conditions for the *non*-implementability of any allocation other than $(1, \ldots, 1)$. To prove that $(1, \ldots, 1)$ is implementable under (a) and (b), denote $\hat{e} = \hat{\pi}_1(n, 0)/n$ and consider the set of strategies $\hat{s}^1 = \hat{s}^2 = [(0, \hat{e}), \ldots, (0, \hat{e})]$ and, $\forall j$, $a_j = 1$. Each supplier is implementing a best response: firm 2 cannot do better than earning a zero payoff with $\hat{s}^2$ since ensuring a positive value for $\hat{\pi}_2$ would require submitting, for some subset of inputs $K = \{j_1, \ldots, j_k\}$ exclusivity bids $(e_1, \ldots, e_k)$ each greater than $\hat{e}$. Firm 2's payoff from this strategy would be

$$\hat{\pi}_2(n - k, k) - \sum\nolimits_{j=1}^{k} e_j < \hat{\pi}_2(n - k, k) - k\hat{\pi}_1(n, 0)/n.$$

The right hand side is nonpositive from the no-hold-out condition (b). Therefore firm 2's strategy is a best response. Firm 1 cannot increase profits by raising bids for any inputs since it is already winning all auctions. If it lowers bids for some subset of inputs $K = \{j_1, \ldots, j_k\}$, its payoff would change by

$$\begin{aligned}\Delta &\equiv [\hat{\pi}_1(n-k,k) - \hat{\pi}_1(n,0)] + k \cdot \frac{\hat{\pi}_1(n,0)}{n} \\ &< [\hat{\pi}_1(n-k,0) - \hat{\pi}_1(n,0)] + k \cdot \frac{\hat{\pi}_1(n,0)}{n} \\ &< 0.\end{aligned} \tag{A7}$$

The first inequality in (A7) follows from monotonicity and the second inequality follows from strong complementarity. Thus, firm 1's strategy at the proposed set of strategies is a best response and the proposed set of strategies is an equilibrium. The set of strategies obviously implements $(1, \ldots, 1)$.

To prove that any other allocation is not implementable under conditions (a) and (b) of the proposition, suppose *arguendo* that an equilibrium $(\tilde{s}^1, \tilde{s}^2, \tilde{a})$ implements an allocation $\tilde{a}$ with $\tilde{a}_j = i$ for $j \in K_i$ for $i = 1, 2, B$. Denote the jth element of $\tilde{s}^i$ as $(\tilde{b}^i_j, \tilde{e}^i_j)$. At least one of K_2 and K_B is nonempty. Denote $\tilde{m}_i \equiv \#K_i,\ i = 1, 2, B$. We know from Lemma 1 that

$$\begin{aligned}&\text{for } j \in K_2: \ \tilde{e}^1_j = \tilde{e}^2_j \\ &\text{for } j \in K_B: \ \tilde{e}^1_j = \tilde{e}^2_j = \tilde{b}^1_j + \tilde{b}^2_j.\end{aligned} \tag{A8}$$

The gross payoffs of the firms in the supposed equilibrium are $\hat{\pi}_i(\tilde{m}_1 + \tilde{m}_B, \tilde{m}_2 + \tilde{m}_B),\ i = 1, 2$.

Because firm 2 could easily achieve a payoff of 0, its payoff in the supposed equilibrium $(\tilde{s}^1, \tilde{s}^2, \tilde{a})$ must be nonnegative:

$$\hat{\pi}_2(\tilde{m}_1 + \tilde{m}_B, \tilde{m}_2 + \tilde{m}_B) - \sum_{j \in K_2} \tilde{e}^2_j - \sum_{j \in K_B} \tilde{b}^2_j \geq 0. \tag{A9}$$

From condition (a) of the proposition,

$$\hat{\pi}_1(n,0) > \hat{\pi}_1(\tilde{m}_1 + \tilde{m}_B, \tilde{m}_2 + \tilde{m}_B) + \hat{\pi}_2(\tilde{m}_1 + \tilde{m}_B, \tilde{m}_2 + \tilde{m}_B). \tag{A10}$$

Note that from (A8), firm 1 could implement $(n, 0)$ by increasing $\tilde{e}^1_j$ by ε/n for each $j = 1, \ldots, n$. The impact on its payoff would be

$$\hat{\pi}_1(n,0) - \hat{\pi}_1(\tilde{m}_1 + \tilde{m}_B, \tilde{m}_2 + \tilde{m}_B) - \sum_{j \in K_2} (\tilde{e}^1_j + \frac{\varepsilon}{n}) - \sum_{j \in K_B} (\tilde{e}^1_j + \frac{\varepsilon}{n} - \tilde{b}^1_j) - \sum_{j \in K_1} \frac{\varepsilon}{n} \leq 0,$$

where the inequality follows from the definition of equilibrium. Using (A8), this can be rewritten as

$$\hat{\pi}_1(n,0) - \hat{\pi}_1(\tilde{m}_1 + \tilde{m}_B, \tilde{m}_2 + \tilde{m}_B) - \sum_{j \in K_2} (\tilde{e}^2_j) - \sum_{j \in K_B} (\tilde{b}^2_j) - \varepsilon \leq 0. \tag{A11}$$

The inequalities (A11) and (A9) imply that

$$\hat{\pi}_1(n,0) < \hat{\pi}_1(\tilde{m}_1+\tilde{m}_B, \tilde{m}_2+\tilde{m}_B)+\hat{\pi}_2(\tilde{m}_1+\tilde{m}_B, \tilde{m}_2+\tilde{m}_B)+\varepsilon.$$

For ε positive but sufficiently small, this contradicts (A10). The supposition that an equilibrium exists that implements an allocation other than $(1, \ldots, 1)$ is contradicted.

References

Aghion, P., and P. Bolton. 1987. "Contracts as a Barrier to Entry," 77(3) *The American Economic Review* 388–401.

Bernheim, D. B., B. Peleg, and M. D. Whinston. 1987. "Coalition-Proof Nash Equilibria I. Concepts," 42(1) *Journal of Economic Theory* 1–12.

Bernheim, D. B., and M. Whinston. 1998. "Exclusive Dealing," 106 *Journal of Political Economy* 64–103.

Borel, E. 1921. "La Theorie du jeu les Equations Integrales a Noyau Symetrique", Comptes Rendus de l'Academie 173; English translation by Savage, L. (1953), "The Theory of Play and Integral Equations with Skew Symmetric Kernels," 21 *Econometrica*.

Bork, R. H. 1978. *The Antitrust Paradox*. New York: Basic Books.

Choi, J. P., and C. Stefanidis. 2001. "Tying, Investment, and Dynamic. Leverage Theory," 32 *RAND Journal of Economics* 52–71.

Chen, J., and Q. Fu. 2013. "Do Exclusivity Arrangements Harm Consumers?," Illinois State University Working Paper.

Dansby, R. E., and R. D. Willig. 1979. "Industry Performance Gradient Indexes," 69(3) *The American Economic Review* 249–60.

Fumagalli, C, and M. Motta. 2010. "A Simple Theory of Predation," CSEF Working Papers 255.

Holmes, O. W. 1897. "The Path of the Law," 10(8) *Harvard Law Review* 457–78.

Jing, R., and R. A. Winter. 2013. "Exclusionary Contracts," Available at SSRN: http://ssrn.com/abstract=2350954.

Klein, B., R. G. Crawford, and A. A. Alchian. 1978. "Vertical Integration, Appropriable Rents and the Competitive Contracting Process," 21 *Journal of Law & Economics* 297–326.

Lopatka, J. E., and P. E. Godek. 1992. "Another Look at Alcoa: Raising Rivals' Costs Does Not Improve the View," 35(2) *Journal of Law and Economics* 311–29.

Marvel, H. P. 1982. "Exclusive Dealing," 25(1) *Journal of Law and Economics* 1–2.

Mathewson, G. F., and R. A. Winter. 1987. "The Competitive Effects of Vertical Agreements: Comment," 77(5) *The American Economic Review* 1057–062.

Posner, R. 2001. *Antitrust Law*, 2nd ed. Chicago: University of Chicago Press.

Prat, A., and A. Rustichini. 2003. "Games Played Through Agents," 71(4) *Econometrica* 989–1026.

Rasmusen, E. B., M. Ramseyer, and S. John Wiley Jr. 1991. "Naked Exclusion," 81(5) *The American Economic Review* 1137–45.

Rey, P., and J. Tirole. 2007. "A Primer on Foreclosure," in Mark Armstrong, and Rob Porter, eds., *Handbook of Industrial Organization*. Vol. III. 2145–20. Amsterdam: North Holland.

Roberson, B. 2006. "The Colonel Blotto game," 29(1) *Economic Theory* 1–24.

Salop, S. C., and D. T. Scheffman. 1983. "Raising Rivals' Costs," The American Economic Review, May 1983, Vol. 73. No.2, *Papers and Proceedings of the Ninety-Fifth Annual Meeting of the American Economic Association*, 267–71.

Segal, I. R., and M. D. Whinston. 2000a. "Naked Exclusion: Comment," 90(1) *The American Economic Review* 296–309.

———. 2000b. “Exclusive Contracts and Protection of Investments,” 31(4) *RAND Journal of Economics* 603–33.

von Neumann, J., and O. Morgenstern. 1944. *The Theory of Games and Economic Behavior*. Princeton: University Press.

Whinston, M. D. 2006. *Lectures on Antitrust Economics*. Cambridge, MA: MIT Press.

Williamson, O. E. 1979. “Transactions-Cost Economics: The Governance of Contractual Relations,” 22(2) *Journal of Law and Economics* 233–62.