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Exclusionary contracts and competition for large buyers

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Abstract

This paper reconsiders the analysis of the competitive effects of buyer contracts. In contrast to the previous literature, we do not impose ex ante asymmetry on the contracting opportunities of firms. Rather, we consider a market composed of two segments involving small anonymous and large non-anonymous buyers. While the large buyers can contract with each other and any firm in the market, it is assumed that no such opportunities exist for the small buyers. That is, neither the large buyers nor firms can make contractual commitments with small buyers. Firms must supply these buyers based on arms-length (single price oligopolistic) competition. In this environment, we demonstrate that large buyers will have an incentive to form a coalition with a single firm so as to extract rents from the small customer segment. Market dominance results. The outcome is socially suboptimal as either production takes place at a higher cost than is otherwise possible or there is a monopoly for small buyers with an associated allocative loss.

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1. Introduction

A long-standing debate in industrial organization concerns the impact of incumbent-buyer contracts on market competition. Do such contracts constitute an entry barrier or raise rivals' costs, leading to losses in productive or allocative efficiency? The basic concern is that when incumbents 'lock-in' buyers to contracts, this may deter entry by firms that can no longer compete for those buyers. Nonetheless, the 'Chicago School' view suggests such reductions in competition may not be inefficient as buyers will recognise the potential anti-competitive effects of contracts and will not agree to those unless they are fully compensated (e.g. Posner, 1976; Bork, 1978).

There are several theories that maintain the 'Chicago School' standard of rational buyer choice but find that long-term buyer contracts can drive anti-competitive efficiency losses. One story is based on the existence of privately-stipulated damages. Aghion and Bolton (1987) argue that a liquidated damages clause makes a contract costly to renegotiate. In an environment where entry is uncertain a customer will sign such a contract because, despite a loss in rents when entry occurs, they receive a discount in the event that monopoly persists. Aghion and Bolton demonstrate that such contracts result in entry barriers that deter some efficient entry.[1] An alternative story is based on the use of selective discounting in a 'divide and conquer' strategy. Rasmusen et al. (1991) (hereafter RRW) demonstrate that buyers will be encouraged to purchase contracts for fear of being left to monopolistic market conditions. In equilibrium, buyer contracts generate those monopolistic conditions, thereby reinforcing the expectations of buyers (see also Innes and Sexton, 1993).

These formal stories have been criticized for their reliance on arbitrary assumptions regarding the nature of the contracting environment. Innes and Sexton (1994) summarize these difficulties. They highlight assumptions preventing entrants from contracting with buyers prior to entry and demonstrate that equalizing contracting opportunities could restore efficiency. Constraints on the ability of buyers to coordinate are also central to the RRW story. Finally, Innes and Sexton indicate that some results are driven by linear price restrictions and that allocative inefficiencies derived by RRW would be overcome with the use of non-linear pricing.

In this paper, our goal is to provide a model of contracting that leads to inefficiency essentially because of its anti-competitive effects but does not rely on the feature of previous models—asymmetric contracting opportunities for buyers and firms—that concerned Innes and Sexton (1994). To eliminate asymmetric contracting opportunities we impose the following rule: *any buyer that can sign a*

[1] Spier and Whinston (1995) demonstrate that this argument is not robust to the possibility of renegotiation between the incumbent and the entrant. However, when there are relationship-specific investments, the Aghion and Bolton conclusions can be restored.

contract with one firm can equally contract with other firms or other buyers who also face the same contracting opportunities. Therefore, while some buyers may be restricted in their contracting opportunities with all other agents, buyers who are unrestricted can freely contract with any agent (firms or similarly unconstrained buyers). In addition, contracts signed can be first-best efficient in that they can use non-linear prices if necessary and are not impeded by incompleteness or information asymmetries in the bargaining process.[2] This means that firms face symmetric contracting opportunities with buyers (i.e. there is no first mover advantage), buyers can potentially cooperate, and there is a wide range of contracting options. Finally, we maintain the assumption of rational buyer choice. In this respect, we confront the key concerns identified by Innes and Sexton (1994).

In our model, some buyers, in effect, form coalitions with a firm to extract monopoly rents from other buyers.[3] To this end, in contrast to the previous literature on buyer contracts, we assume there are two types of buyers, anonymous and non-anonymous, distinguished by their ability to enter into contracts. Only a subset of buyers, those who are *non-anonymous*, can be identified ex ante, and these are the only buyers that can enter into contracts with each other or with firms. In contrast, *anonymous* buyers cannot sign exclusive contracts ex ante and are restricted to trade at arms-length on the mass market.[4] Given certain reasonable assumptions about the effect of competition on firm profits and the contracting process, efficient production will never arise in equilibrium in our model. Rather, it pays non-anonymous buyers to choose one of the potential suppliers to form a coalition and extract rents from buyers who are unable to sign contracts. In contrast to previous models, our analysis does not rely on one firm being incumbent and the other firm being an entrant, but allows for identical potential

[2] The allocative efficiency approach adopted by RRW was criticized by Innes and Sexton (1994, p. 567) because 'price–quantity contracts are likely to be possible when exclusionary agreements are possible'. That is, allocative inefficiencies are the result of simple monopoly pricing in RRW and could be resolved through the use of non-linear pricing or perfect price discrimination. We accept Innes and Sexton's criticism for large buyers and allow firms to set general contracts for them. However, firms cannot contract at all ex ante with small buyers and, while it is not ruled out by our assumptions on profits, it is unlikely that firms would have the detailed knowledge of buyer willingness to pay to provide customer-specific non-linear prices when competing for this group of customers.

[3] This differs from a 'divide and conquer' strategy in that buyers who contract do not do so in order to avoid facing subsequent monopoly pricing. As noted earlier, that strategy is vulnerable to buyer coordination, something that we allow for.

[4] Katz (1987) considers the welfare effects of price discrimination among large and small buyers in intermediate goods markets. There, large buyers (a retail chain) have what amounts to greater bargaining power and hence, can receive a lower price than small buyers (local stores). Here we emphasise anonymity as a key distinction among buyers; something that likely relates to buyer volume. Nonetheless, despite segmenting buyers, Katz's model is distinct from ours in that it does not consider the potential competitive effects on upstream supply; focusing instead on the consequences of price discrimination.

suppliers.[5] Also, our focus is on efficient production rather than exclusion.[6] In equilibrium, both firms may compete for a subset of customers, but social welfare will not be maximized because one firm is unable to reach a minimum efficient scale of production.[7] In some circumstances, one firm will be excluded from production altogether.

Our analysis is partially motivated by the experience with electric utility deregulation in the United States. Shepherd (1997a,b) documents the practice of electricity utilities in the United States contracting to lock-in large customers to long-term contracts by offering them price discounts. For example, Boston Edison offered 20% price reductions to its 12 largest customers while Detroit Edison locked in the plants of the big three automakers in 10-year contracts with discounts of between 10 and 20%.[8] Shepherd viewed smaller customers as the losers from such arrangements.

> *The underbidding is presented by the utilities and customers in a favorable light, as being merely price cutting which keeps the large firms from moving away to other locations. But the locking up of major customers can make it uneconomic or impossible for smaller firms and new competitors to compete effectively. It nullifies the rhetoric and expectations about open access and mutual invasions of service areas. It also raises the likely future prices to other groups, particularly smaller customers* (1997*a*, *p*. 169).

The concern about large buyer contracts has led Public Utility Commissions in a number of States to query and, in some cases, deny such contracts. These contracts

[5] In particular, our model follows RRW in that both firms are potentially equally efficient and social welfare is maximised if both firms produce in equilibrium. This contrasts with Aghion and Bolton (1987) and Innes and Sexton (1994) who consider contracts that exclude a more efficient entrant. As Spier and Whinston (1995) note, an efficient entrant, that is one with lower production costs than the incumbent, will always enter regardless of any exclusionary contract signed between the incumbent and buyers. This is because the incumbent itself cannot commit not to purchase from the entrant in order to satisfy its contractual arrangements. Indeed, it has an incentive to resell the entrant's products to buyers as sub-contracting supply entails lower costs. Therefore, the initial incumbent-buyer contract will never deter entry and will not distort productive efficiency. Spier and Whinston (1995) demonstrate, however, that the existence of transactions costs, say because of non-contractable relationship-specific investments, could allow productive inefficiencies to arise again.

[6] In a recent paper, Bernheim and Whinston (1998) analyse incentives for manufacturers to deal exclusively with retailers. Section IV of their paper contains a set-up that is related to our own. There, manufacturers compete for an exclusive contract with a retailer in the shadow of potential competition for another retailer in the future. As such, in contrast to our paper, their model is one of first mover advantages on the part of a buyer. Nonetheless, they demonstrate that exclusion may arise so as to reduce competition in the future.

[7] In this sense our paper is related to the literature on 'raising rival's costs'. (See, for example, Salop and Scheffman, 1983, 1987.) Large buyer contracts with one firm impose costs on the other firm that is prevented from the scale necessary to minimize average costs. This is beneficial to the dominant firm who can use this cost asymmetry to extract monopolist rents from small buyers. Those rents are essentially shared with large buyers in ex ante contracting.

[8] See also Shepherd (1997a).

have also been tested before the courts. For example, in *Indeck Energy Services vs. Consumers Energy Co*. the district court in Michigan dismissed a complaint brought by an independent power company against a discount offered by the incumbent utility to General Motors. At the same time, other commentators have argued that large customer discounts can only benefit consumers (e.g. Hanzlik and Goroff, 1997).

While the current debate has focused on the electric utility industry, the arguments are equally applicable to other utility industries. Our model formalizes this debate to both capture the intuition presented by Shepherd and both analyze and clarify when large customer contracts may create a regulatory concern.

Given this, our categorization of buyers as 'anonymous' and 'non-anonymous' should not be interpreted literally. Rather, a buyer is anonymous if they are sufficiently small and/or transaction and negotiation costs are sufficiently high so that *no other party* is able to write an individual contract with this buyer. Firms know that these buyers exist, and may even know their identity ex ante, but individual contracting with these consumers is infeasible. In contrast, firms can write customer-specific contracts with any non-anonymous buyer and these buyers can also write contracts with each other. As an example, in the electricity, gas or telecommunications industries we may think of large business customers as non-anonymous while small residential customers are anonymous. In general, it does not pay a firm in any of these industries to negotiate individual contracts with specific residential customers due to the volume and uncertainty of their demand relative to contracting costs. In contrast, customer-specific contracts are common for large business customers (Shepherd, 1997b). Alternatively, one could view the anonymous group as future customers not currently known to firms in the industry. Nonetheless, for ease of exposition, hereafter we will refer to anonymous buyers as 'small' and non-anonymous buyers as 'large'. The key point, however, is that contracts with large buyers impose a negative externality on small buyers that, because their contracting opportunities are limited, remains uncompensated; potentially generating inefficient outcomes.

The result closest to ours in the literature is in Segal and Whinston (2000, Proposition 3). They show how entry deterrence may arise in the RRW framework when an incumbent can 'divide' customers by using discriminatory contracts. Unlike our model, however, the Segal and Whinston environment does not provide buyers with the same contracting opportunities in dealing with the entrant as are available to the incumbent.[9] In addition, as noted earlier, our model does not rely

[9] While Segal and Whinston consider coalition-proof equilibria this involves non-binding agreements between buyers after the entrant offers contracts. This contrasts with Proposition 1 which allows large buyers to make binding agreements before any firm offers contracts. Stefanadis (1998) also considers the role of selective contracting in intermediate input markets. This adds an additional externality among buyers—signing a low price contract allows the upstream monopolist to raise rivals' prices and hence, costs. Stefanadis also demonstrates that these contracting possibilities can also be used to deter upstream entry. However, his model relies on the fact that the upstream incumbent can offer contracts while the potential entrant cannot. Finally, see Ellingsen (1991) for another perspective on the role of strategic buyers.

on any asymmetry in the ability of firms to write contracts so that one of the two ex ante symmetric sellers endogenously assumes the role of 'exogenous incumbent' in the Segal and Whinston framework. Further, our model does not simply focus on exclusion but allows for both firms to produce in equilibrium despite social welfare being suboptimal.

The paper proceeds as follows. Section 2 outlines the model. In particular, we present the crucial assumption on competition for small buyers (A4) and provide examples where this assumption is satisfied. Section 3 presents two alternative bargaining games between large buyers and firms. The first (Section 3.1) allows large buyers to cooperate and write binding agreements to maximize each buyers payoff before approaching the firms. The second (Section 3.2) does not allow any interbuyer contracting but involves firms simultaneously bidding for large buyers. In both cases, we show that given the assumptions of the model, overall production will always be socially inefficient. A final section concludes.

2. The model

2.1. Customers and demand

We begin by formally modelling the demand conditions in the industry. There is a set of potential buyers N. These buyers are partitioned into two subsets, L whose elements are ex ante large buyers and S which contains ex ante small buyers. Each buyer $n \in N$, has an individual total willingness to pay for the good of $v_n(q_n)$ where q_n is the quantity of the good consumed by n. Assume that v_n is twice continuously differentiable for all n with $v_n' > 0$ and $v_n'' < 0$. For any uniform price $p_n \in [0, v_n'(0)]$, denote by $\tilde{q}_n(p_n)$ the quantity for consumer n such that $v_n'(\tilde{q}_n) = p_n$.[10] To simplify notation, we regard all large buyers as identical (but small buyers need not be identical), so that $v_n(\cdot) = v_l(\cdot)$ for all $n \in L$, and, in an abuse of notation, we simply denote the total number of large buyers by L.

A firm can enter into an individual contract with a large buyer. Denote a contract with buyer $l \in L$ by (q_l, T_l) where $q_l \geqslant 0$ represents the quantity of the good transferred to l and T_l is the net monetary payment by l to the relevant firm. T_l may be either positive or negative. The total payoff to the large buyer l from this contract is $v_l(q_l) - T_l$.

In contrast, firms can only set a uniform price for all small buyers. If a small buyer, s, faces a simple linear price, p, it will purchase $\tilde{q}_s(p)$ and receive a total payoff of $v_s(\tilde{q}_s) - p\tilde{q}_s$.

[10] In other words, $\tilde{q}_n(p_n)$ is the demand function for consumer n.

2.2. The firms

There are two identical firms that (potentially) can operate in the industry, denoted A and B. For expository purposes, we follow the technological assumptions of RRW. That is, we assume that:

A1. the average cost function of each firm $C(Q)$ is decreasing for $Q < Q^*$ and $C(Q) = \bar{C}$ for $Q \geq Q^*$, where Q^* is the minimum efficient scale of production;

A2. $Q^* > \Sigma_{s \in S} \tilde{q}_s(\bar{C})$. Serving only the small segment alone does not achieve cost minimization; and

A3. $Q^* \leq L\tilde{q}_l(\bar{C})/2$. There is no natural monopoly in the large segment.

The last assumption makes the problem interesting. If both firms produce, efficient production involves both firms reaching minimum efficient scale. Unlike RRW, however, we do not necessarily assume that $Q^* > \tilde{q}_l(\bar{C})$. That is, a firm may be able to reach minimum efficient scale by just serving a single large buyer.

2.3. Contracts and competition

We also make assumptions about the nature of competition. Assume that a large buyer is able to contract with other large buyers and with the firms. However, firms may not contract with each other due to standard antitrust laws against collusion.[11] Neither large buyers nor firms can write individual contracts directly with small buyers.

Firms and large buyers have an opportunity to contract before firms compete for uncontracted large buyers and for small buyers. We consider a number of models of this contracting process below. When firms compete for uncontracted and small buyers, the level of competition will depend on each firm's expectation of the total quantity sold to both buyer segments.

Let $\mathbf{Q}_i^L$ refer to the vector (with elements $Q_i^1, \ldots, Q_i^L$) of contracted sales from firm $i = A, B$ to large buyers. Given these contracted sales, the firms compete for uncontracted sales to large buyers and for sales to small buyers. Denote firm i's equilibrium profits from small buyer purchases, given *all* of its sales to large buyers, by $\pi(\mathbf{Q}_i^L, \mathbf{Q}_j^L)$. By symmetry, its rival's expected profit from small buyers

[11] There may also be antitrust restrictions on contracts between large buyers. However, the type of agreements that are relevant between large buyers here relate to cooperative buying. Given that there are only two sellers, agreements between large buyers to cooperate on purchasing negotiations are unlikely to be challenged under competition laws in many countries.

is $\pi(\mathbf{Q}_j^L, \mathbf{Q}_i^L)$. Let $\hat{\mathbf{Q}}^L$ be the vector with L elements, each equal to $\tilde{q}_l(\bar{C})$. Thus $\hat{\mathbf{Q}}^L$ is the vector of quantities demanded by large buyers when price equals minimum average cost $\underline{C}$. Let $\mathbf{0}$ refer to the L-dimensional vector with all elements equal to zero. Our results depend on two assumptions about the nature of profits that result from competition for small customers:

A4. $\pi(\mathbf{0}, \hat{\mathbf{Q}}^L)$ is the lowest profit any firm can make in the spot market and $\pi(\hat{\mathbf{Q}}^L, \mathbf{0}) - \pi(\mathbf{0}, \hat{\mathbf{Q}}^L) \geqslant \pi(\mathbf{Q_1^L}, \mathbf{Q_2^L}) - \pi(\mathbf{Q_2^L}, \mathbf{Q_1^L})$ for all $\mathbf{Q_1^L}$, $\mathbf{Q_2^L}$, ($>$ if any element of $\mathbf{Q_2^L}$ is strictly positive).

A5. $\pi(\hat{\mathbf{Q}}^L, \mathbf{0}) + \pi(\mathbf{0}, \hat{\mathbf{Q}}^L) \geqslant \pi(\mathbf{Q_1^L}, \mathbf{Q_2^L}) + \pi(\mathbf{Q_2^L}, \mathbf{Q_1^L})$ for all $\mathbf{Q_1^L}$, $\mathbf{Q_2^L}$, ($>$ if any element of $\mathbf{Q_2^L}$ is strictly positive).

A4 has two parts. Firstly, it requires that the lowest profit any firm can earn in the spot market occurs when it makes no sales to large customers and the other firm satisfies all large customer demand. Secondly, A4 requires that the difference between firm profits from small customers is greatest when one firm satisfies all large customer demand at minimum efficient scale in the contract market while the other firm makes no contract sales to large customers. Further, it is the firm that satisfies all large customer demand in the contract market that achieves the higher profit when competing for small customers. A5 requires that total industry profits from small buyers is maximized if one firm makes no sales to large buyers while the other firm contracts to satisfy all large buyer demand at minimum efficient scale.

To see how these assumptions might be satisfied, consider a simple model of competition for small and uncontracted buyers. Suppose that after contracting with large buyers each firm independently and simultaneously announces a uniform price for ‘spot’ sales. Customers buy all non-contracted quantities from the firm that sets the lowest price. If firms set the same price then we adopt a ‘tie breaking’ rule. If one firm has a strictly lower average cost (in the sense of having strictly higher contract sales) than the other firm then this firm makes all sales when both firms set an identical price.[12]

Now suppose that the total profit function for any individual firm acting as a monopoly for small customers is concave for any level of contract market sales. Denote the uniform monopoly price to small customers for a firm that has achieved minimum efficient scale by p_s^m. We assume that $C(\Sigma_{s \in S}\ \tilde{q}_s(p_s^m)) < p_s^m$. This assumption will mean that a firm selling as a monopoly to small customers

[12] This simply avoids the problem that the firm with the lower average cost wishes to just undercut the other firm, but such under-cutting is not well defined if firms can set any real price. It is also possible that the two firms set identical prices and have identical average costs. This can only arise if the two firms both reach minimum efficient scale in which case average cost for both firms equals $\bar{C}$ and the firms share the uncontracted sales equally.

will be constrained by potential production from a firm that can only sell to small customers. Finally, define $\underline{p} < p_s^m$ implicitly by $\underline{p}(\Sigma_{s\in S}\ \tilde{q}_s(\underline{p})) - C(\Sigma_{s\in S}\ \tilde{q}_s(\underline{p})) = 0$. Note that by assumption A2, $\underline{p} > \bar{C}$.

To investigate assumptions A4 and A5 in such a 'contestable' market, suppose that firm A makes no contracted sales to large customers, while firm B satisfies all large customer demand in the contract market. Then the Nash equilibrium will involve both firms setting a spot market price of $\underline{p}$. By definition, this is the minimum price that firm A could set and break even. Firm B has achieved minimum efficient scale and will match this price as it is below the monopoly price for firm B. Firm A will make zero profit and firm B will make profit $\pi(\hat{\mathbf{Q}}^L, \mathbf{0}) = (\underline{p} - \bar{C})(\Sigma_{s\in S}\ \tilde{q}_s(\underline{p}))$ from sales to small customers. Further, firm B's profit is the maximum profit that the firms in total can earn from small customers in the contestable market. To see this, note the price to small customers in equilibrium can never exceed $\underline{p}$ by assumption A1 and because the lowest amount of sales any firm can make to large customers (in either the contract or the spot market) is zero.[13] Also by A1, if firm A makes any sales to large customers then the Nash equilibrium price in the spot market must be lower than $\underline{p}$.[14] Thus, by concavity of the profit function for small customers, regardless of how sales are divided between the two firms, total firm profit cannot exceed $\pi(\hat{\mathbf{Q}}^L, \mathbf{0})$.

As $\pi(\hat{\mathbf{Q}}^L, \mathbf{0})$ is the highest profit both firms in total can achieve, it is also the highest joint profit of the two firms. A5 immediately follows. Further, as zero is the least profit that any firm can make in the spot market $\pi(\hat{\mathbf{Q}}^L, \mathbf{0}) - \pi(\mathbf{0}, \hat{\mathbf{Q}}^L) = \pi(\hat{\mathbf{Q}}^L, \mathbf{0}) - 0$ is the maximum difference in profit between the two firms. Both parts of A4 immediately follow.

It is useful to note that in the contestable model presented here, if firms were prevented from contracting with large buyers then the equilibrium price would be $\bar{C}$. The two firms would simultaneously set individual prices to sell to all customers and would both achieve minimum efficient scale. Social surplus would be maximized in this situation.[15]

3. Contracts to large buyers

Large buyers can sign contracts with firms and/or other buyers before competition for small buyers commences. We consider two alternative bargaining

[13] In other words, if small customers in the spot market ever purchase at a price exceeding $\underline{p}$ then this cannot be an equilibrium as it would always pay the other firm to undercut this price and make the relevant sales.

[14] This follows because average cost is decreasing in output so if firm A makes positive contract sales it can lower the price to spot customers below $\underline{p}$ by some positive amount ε without making a loss.

[15] While the contestable market model provides one situation that satisfies our assumptions, it is not the only situation. See our working paper (Gans and King, 2000) for an example based on Cournot duopoly.

situations below. The first allows for cooperation between large buyers before these buyers are approached by the firms. This avoids the potential for one firm to exploit 'buyer disorganization' as occurs in the RRW model or to use discriminatory contracts and 'divide and conquer' tactics as in Innes and Sexton (1993, 1994) and Segal and Whinston (2000). Secondly, we consider non-cooperative simultaneous bidding by the firms for large buyers. In each case, we show that the solution will involve only one firm achieving minimum efficient scale. If both firms continue to produce in equilibrium then production costs will not be minimised given the level of output. Further, regardless of whether or not both firms actually sell to small customers in equilibrium, it follows from assumption A4 that small customers will tend to face higher prices than if large customer contracts were not feasible. In this sense, large customer contracts can lead to inefficient production and can stifle competition for small customers.

3.1. Large buyer cooperation

To analyze this case, we begin with the simple assumption that there is a single large buyer and hence, no issue of cooperation. The game has the following stages.

1. The two firms independently and simultaneously offer the large buyer individual contracts (q_l, T_l).
2. The buyer chooses which contract(s) to accept or to wait to purchase from the mass market. In the case of a tie, the buyer randomly chooses the winning firm.
3. Firms compete for uncontracted buyers, production begins and transfers are made.

Two observations about the interaction of the firms and the large buyer follow directly from our model. Firstly, from A1, the surplus that is created from sales to the large buyer is maximized when the buyer purchases a total quantity $\tilde{q}_l(\bar{C})$ from firms that achieve minimum efficient scale. This outcome involves minimum cost production and equates the buyer's marginal value with the marginal production cost.[16]

Secondly, from A3, $\tilde{q}_l(\bar{C})$ exceeds $2Q^*$. In other words, both firms can jointly reach minimum efficient scale while selling the efficient quantity in total to the large buyer. However, from A5, total firm profits from small buyers is maximized if only one firm sells quantity $\tilde{q}_l(\bar{C})$ to the large buyer and the other firm makes no sales to it. Also, from A4, if the large buyer purchases $\tilde{q}_l(\bar{C})$ from only one firm and nothing from the other firm, this leads to the largest difference in profit between the two firms when competing for small customers.

It follows from these observations that total large buyer consumer surplus plus total firm profits from small customers is strictly maximised when the large buyer

[16] In this situation, $\hat{\mathbf{Q}}^L$ has a single element equal to $\tilde{q}_l$.

purchases $\tilde{q}_l(\underline{C})$ units from only one firm. This total surplus and profits is $v_l(\tilde{q}_l(\underline{C})) - \underline{C}\tilde{q}_l(\underline{C}) + \pi(\tilde{q}_l(\underline{C}), 0) + \pi(0, \tilde{q}_l(\underline{C}))$. This surplus is achieved when the gap in small-customer profits between the two firms is maximised. In other words, the maximum value of large buyer surplus and one firm's profit is also achieved when the large buyer purchases $\tilde{q}_l(\underline{C})$ units from only one firm.

Proposition 1. *All subgame perfect equilibria of the above game involve one* (*and only one*) *firm selling a total quantity of* $\tilde{q}_l(\underline{C})$ *units to the large buyer for a transfer of* $\underline{C}\tilde{q}_l(\underline{C}) - (\pi(\tilde{q}_l(\underline{C}), 0) + \pi(0, \tilde{q}_l(\underline{C})))$.

Proofs of all propositions are given in Appendix A. The intuition behind Proposition 1 follows directly from our observations. Any firm that acts as the sole supplier to the large customer maximizes its profits from small-customer competition. The firms compete through the bargaining process with the large customer to gain these small-customer rents. In so doing, they ensure efficient supply to the large customer and compete through transfers until all rents above minimum profits are transferred to the large buyer.

The contracts offered by the firms need not involve exclusive dealing. Rather, in our framework, having only one firm supply the large buyer in equilibrium is a result of the competition to seize small-customer profits. The excluded firm cannot 'bribe' the large buyer to let it sell more and reduce its average cost because this reduces total profits in the market for small customers.

Contracting in our model does not mean that one firm is excluded from all production. A firm might supply small customers even if they make no sales to large customers.[17] But, if both firms actually supply small customers in equilibrium, then production is inefficient. Profits from the small customers are at their highest feasible level given the nature of competition. The firms however do not benefit from these profits, and are no better off (and may be strictly worse off) than if they were unable to contract with the large buyer ex ante. The buyer is able to extract all of the rents from the small-market segment and force both firms to the lowest rational level of profits. This is because of the nature of the bargaining process and one could imagine more general bargaining solutions as relaxing this implication.

Turning to the situation in which there are L large buyers, we can modify the game to add a cooperation stage. The game has the following stages.

1. Large buyers cooperatively form bidding groups and contract to receive their Shapley value (i.e. they equalize their per large buyer payoff).

[17] This clearly depends on the nature of small customer competition. For example, in the contestable market example presented in Section 2.3, only one firm will make positive sales to small customers in equilibrium although the presence of the other firm will constrain the price to small customers.

2. The two firms simultaneously offer each group, g, a contract (q_g, T_g).
3. Each group chooses which contract to accept or to wait to purchase from the mass market. In the case of a tie, the group randomly chooses the winning firm.
4. Firms compete for uncontracted buyers, production begins and transfers are made.

We define a solution of the game as an outcome that maximizes the per large buyer payoff, given that the bidding behavior of the firms forms a subgame perfect equilibrium.

Proposition 2. *The solution of the above game involves a total quantity of* $L\tilde{q}_l(\bar{C})$ *units being sold from a single firm to all large buyers for a total transfer of* $L\bar{C}\tilde{q}_l(\bar{C}) - \left(\pi(\hat{\mathbf{Q}}^L, 0) - \pi(0, \hat{\mathbf{Q}}^L)\right)$.

When large buyers cooperate they act as a single agent and have an incentive to pursue any gains from trade with individual firms. These gains from trade involve exerting market power on small buyers. Given A5, these gains are maximized when one firm is prevented from reaching a minimum efficient scale. Even when each individual large buyer could allow a second firm to reach minimum efficient scale, as a group they have an incentive to prevent this from occurring. It is in the interests of large buyers and a single firm to enter into an exclusive arrangement so as to raise the costs of the other rival and maximize profits accruing to the more efficient firm in competition for small buyers.

The behavior presented in Proposition 2 may be viewed as predatory. One firm contracts to sell below cost to large buyers. In so doing, that firm denies its competitor sufficient market share to achieve minimum cost production. The competitor suffers lower profits in subsequent competition for small buyers and may choose not to produce at all, while the predator recoups its losses by extracting increased profits from small buyers. Further, the equilibrium contract to large buyers satisfies many rules used to test for predatory pricing. For example, the contract involves an average price to large buyers that is below both the average and marginal cost of the firm that sells to the large buyers. As such, it would be viewed as predatory under the well-known Areeda-Turner rule (1975). This said, as Hanzlik and Goroff (1997, p. 32) note, it would be difficult to prove that the behavior was predatory under current US law, as the seller who gains the large customers business does not do so ‘with the specific intent, first of forcing its rivals to leave the market place, and, following this, of recouping its shortrun losses by imposing monopoly rents’.

Unlike most alternative models, this predatory behavior does not rely on information asymmetries either between firms (e.g. Tirole, 1988) or between a firm and an outside party (e.g. Snyder, 1996). A key distinction between standard predation and the behavior presented in Proposition 2 is that it is initiated by one group of consumers who gain at the expense of other consumers. In equilibrium, the 'predator' firm is no better off than the 'victim' firm.

As we noted in the Introduction, the possibility of firms using 'strategic' contracts with large buyers has been an important issue in the deregulation of the electricity industry in the US. The equilibrium contracts under Propositions 1 and 2 may violate rulings by Public Utility Commissions or statutes in ~20 States including California, New Jersey and New York. In general, these States only allow incumbent electric utilities to discount to large customers if, even after the discount, the large customer is contributing 'sufficiently' to the recovery of fixed costs. It is unclear that the contracts set in Propositions 1 and 2 would involve 'sufficient' contribution.

3.2. Simultaneous bidding

The analysis above relied on the ability of large buyers to coordinate their behavior. Alternatively, suppose the game had the following stages where large buyers are unable to cooperate with each other prior to being approached by a firm.

1. Each firm simultaneously offers an individual contract (q_l, T_l) to each large buyer, l.
2. Each large buyer chooses which contract to accept or to wait to purchase from the mass market.
3. Firms compete for uncontracted buyers, production begins and transfers are made.

In equilibrium, each large buyer $l \in L$ will simply choose the contract that offers them the greatest individual utility. Proposition 3 shows that there is no Nash equilibrium where both firms always achieve minimum efficient scale.[18]

Proposition 3. *There is no equilibrium of the above game where both firms achieve minimum efficient scale.*

Proposition 3 shows that there cannot be an equilibrium where both firms achieve minimum efficient scale. The intuition behind this result is fairly straightforward. If contracts that allowed both firms to achieve minimum efficient scale were offered to large buyers, then it would always pay one firm to deviate and 'steal' the other firm's customers by offering those customers (1) an efficient quantity and (2) a lower transfer. One firm can always profitably offer these

[18] We ignore mixed strategy equilibria where both firms only achieve minimum efficient scale with positive probability less than unity.

contracts by funding the deviation through the increased profits that it will gain from impaired small customer competition.

Proposition 3 *does not* show that all equilibria involve excluding one firm from large buyers. Such a proposition would require analysis using a specific form of firm competition.[19] Nonetheless, Proposition 3 demonstrates that contracting with large buyers still tends to 'raise rival's costs' so that either one firm will not produce in equilibrium or, if both firms do produce, production is inefficient. In other words, initial contracting with large buyers will generally result in a market outcome that is inefficient from a social perspective.

4. Conclusion

The model presented in this paper answers a variety of criticisms that have been leveled at the formal literature on anticompetitive exclusive customer contracts. With rational buyers and no contracting asymmetries, our analysis shows that buyer contracts may be written that

1. effectively exclude one firm from selling to large customers even though neither firm offers exclusive dealing contracts;
2. prevent the excluded firm from achieving minimum efficient scale production despite there being no natural monopoly; and either
3. result in monopoly production to small buyers with an associated allocative inefficiency or
4. involve both firms producing for small customers but in a way that does not minimise production costs.

These contracts will arise if there is either a single large buyer or if large buyers can cooperate. Compared with either the social optimum or a contestable market benchmark, these outcomes are inefficient relative to the situation where both firms share large buyers and both achieve minimum efficient scale.

If large buyers cannot cooperate, then equilibria that completely exclude one firm from selling to large buyers can still arise, but the existence of such an equilibrium depends on the number of large buyers and the specific nature of small-customer competition. This said, Proposition 3 showed that there could not arise an equilibrium where both firms always achieve minimum efficient scale. In this sense, potential inefficiencies in the market for small customers, due to either monopoly provision or inefficient production, will generally arise.

Our results depend on the ability of one firm to raise its rival's costs by excluding that rival from sales to large customers. However, unlike previous work, the main beneficiaries are the large customers themselves. Because there is no ex

[19] For example, the specific form of contestable market competition introduced in Section 2.3.

ante asymmetry between firms, bidding by firms for large buyers' custom tends to transfer the profit gains back to those buyers. Because of this, in the equilibria explicitly examined in this paper, the profits of both firms are driven to a minimal level. In other words, not only small buyers, but the firms themselves can be made worse off due to the ability to contract with large buyers.

Our underlying assumptions shed light on when the problem of inefficient buyer contracts is likely to arise. A key assumption is the separation of large (non-anonymous) and small (anonymous) buyers. If all buyers are able to directly contract with either firm and with each other then there is little likelihood of inefficient contracts. Rather, anticompetitive effects are more likely to be observed when there is a natural division of buyers; for example into industrial and household users. Shepherd's (1997a) observation of potentially undesirable contracts in the deregulating US electricity industry is a natural consequence of our model.

The model focuses attention on the relative size of the two buyer segments. For exclusive contracting to raise anticompetitive concerns, the 'small' buyer segment of the market must be insufficient to allow two firms to achieve minimum efficient scale. At the same time, the market as a whole cannot be a natural monopoly if competitive production is socially desirable. Further, if the 'small' buyer segment is insignificant compared to the 'large' buyer segment, then any social loss from anticompetitive contracting will also be insignificant.

The nature of competition, as summarized by assumption A5, is also critical. Loosely speaking, if competition is more intense for the small buyer segment of the market, then the gains that can be achieved by undermining this competition through exclusive contracting with large buyers will be greater. In contrast, if competition for small buyers is relatively benign, so that joint firm profits tend to rise rather than fall as one firm achieves economies of scale, then the anticompetitive rents that large buyers seize through exclusive contracting will disappear.

In contrast to other literature in this area, our model does not require any firm asymmetries. There is no 'incumbent' or 'entrant' in our model. While we believe that the lack of any imposed firm asymmetry is a significant advantage of our model, there are clearly some practical situations where these distinctions are important. While beyond the scope of this paper, the analysis above could be extended to consider issues of incumbency advantage (that is, the role of sunk costs and first mover effects).

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Appendix A

A.1. Proof of Proposition 1

We first need to show that in equilibrium the large buyer will only purchase from one firm. To see this, suppose that it was not the case so that the large buyer accepted contracts involving positive quantities from both firms. In this situation each firm i's total expected profit is Π_i. Note that $\Pi_i \geq \pi(0, \tilde{q}_l(\bar{C}))$ otherwise it would pay a firm to deviate and not offer a contract to the large buyer.

We need to show that a firm can always deviate with a contract that will be preferred by the large buyer and earn greater profits. But by our observations this is trivial. If that firm offers the contract $(\tilde{q}_l(\bar{C}), \bar{C}\tilde{q}_l(\bar{C}) - (\pi(\tilde{q}_l(\bar{C}), 0) - \pi(0, \tilde{q}_l(\bar{C}))) + \Pi_i + \varepsilon)$ where $\varepsilon > 0$ but sufficiently small, then this makes the firm better off by ε if the offer is accepted. But accepting this contract alone strictly maximises total surplus to the large customer and small-customer profits while minimising the profit of the other firm. Hence, there exists a value of $\varepsilon > 0$ such that the large buyer strictly prefers to accept this contract. Thus it cannot be an equilibrium where the large customer purchases positive quantities off both firms.

Secondly, we need to show that having the identifiable buyer purchase $\tilde{q}_l(\bar{C})$ units from a single firm for a transfer of $\bar{C}\tilde{q}_l(\bar{C}) - (\tilde{q}_l(\bar{C}), 0) - \pi(0, \tilde{q}_l(\bar{C})))$ is an equilibrium of the game. To see this, suppose that one firm offers this contract to the buyer. Its rival knows that if the large buyer accepts this contract, it will achieve profits $\pi(0, \tilde{q}_l(\bar{C}))$ with $\pi(\tilde{q}_l(\bar{C}), 0)$ going to the contracted firm. However, that firm's total profits when the contract is accepted are also $\pi(0, \tilde{q}_l(\bar{C}))$ due to the transfer in the contract. Thus, both firms make identical (and minimum) profits if the contract is accepted. Further, from our observations above, if the large buyer accepts the contract then the buyer maximises the gains that it can make from trade. So the buyer will always accept the contract if it is offered. As the large buyer chooses randomly if indifferent between contracts, the non-contracting firm is just indifferent to matching the contract offer and gains no benefit by deviating from increasing that offer. Hence, both firms offering these contracts forms a subgame perfect Nash equilibrium of the bidding game.

Finally, to show that all equilibria involve offer and acceptance of these contracts, consider any other simultaneous contract offers. If a contract with a positive probability of acceptance has a quantity other than $\tilde{q}_l(\bar{C})$ then (by our first observation) this contract does not maximise the surplus that can be achieved by selling to the large buyer. The firm offering that contract can profitably deviate and alter the quantity to equal $\tilde{q}_l(\bar{C})$ and raise the transfer so that the contract is still accepted by the large buyer with the same probability. Thus, any contract with a positive probability of acceptance must involve quantity $\tilde{q}_l(\bar{C})$.

Given that all equilibrium contracts will involve a quantity $\tilde{q}_l(\bar{C})$, the large buyer will simply accept the contract with the smallest transfer. This transfer will either equal or exceed $\bar{C}\tilde{q}_l(\bar{C}) - (\pi(\tilde{q}_l(\bar{C}), 0) - \pi(0, \tilde{q}_l(\bar{C})))$ as otherwise the offering firm makes below minimum profits and would deviate. But, suppose that the lowest transfer strictly exceeds $\underline{C}\tilde{q}_l(\underline{C}) - (\pi(\tilde{q}_l(\underline{C}), 0) - \pi(0, \tilde{q}_l(\underline{C})))$. The other firm will make profit $\pi(0, \tilde{q}_l(\underline{C}))$ overall if this contract is accepted. It pays that firm to deviate and offer a contract with a strictly lower transfer. This deviant contract will then always be accepted and by continuity there exists a transfer that will give the deviant firm profits greater than $\pi(0, \tilde{q}_l(\underline{C}))$. Finally, if both firms are offering identical contracts with transfers strictly greater than $\underline{C}\tilde{q}_l(\underline{C}) - (\pi(\tilde{q}_l(\underline{C}), 0) - \pi(0, \tilde{q}_l(\underline{C})))$ it is trivial to show that one firm will still deviate by offering a lower transfer contract that is always accepted. Thus, all equilibrium contracts that have a positive probability of acceptance involve a quantity of $\tilde{q}_l(\underline{C})$ and a transfer of $\underline{C}\tilde{q}_l(\underline{C}) - (\pi(\tilde{q}_l(\underline{C}), 0) - \pi(0, \tilde{q}_l(\underline{C})))$.

Finally, it is trivial that the large buyer will never prefer to deviate and wait for the mass market competition. □

A.2. Proof of Proposition 2

Suppose that all large buyers have formed one bidding group. Then, the outcome of the bidding game must be identical to the outcome under Proposition 1, except that total purchases by large buyers are now $L\tilde{q}_l(\underline{C})$ units. Further, by Proposition 1, this outcome maximizes the total possible payoff to large buyers as a group and so it maximizes per large buyer payoff and is a solution of the game.

Any other solutions to the game must result in the same per large buyer payoffs. But, it follows from assumption A5 that if the large buyers purchase positive quantities off both sellers, then their total payoff must be strictly lower. Thus in any solution, the large buyers will only purchase from one firm. The proposition immediately follows. □

A.3. Proof of Proposition 3

Suppose such an equilibrium exists. Firstly, without loss of generality we can assume that in such an equilibrium, all large buyers satisfy all their demand in the contract market. To see this consider an equilibrium where buyer l purchases from firm B in the spot market. If l pays a price that exceeds $\underline{C}$ then the buyer and firm B are not maximizing their gains from trade and firm B can offer l a contract that l will prefer to participating in the spot market and that raises firm B's profit given firm A's contracts. Thus, it cannot be an equilibrium where buyer l buys from firm B at a price greater than $\underline{C}$ in the spot market when firm B achieved minimum efficient scale. If, however, buyer l pays price $\underline{C}$ in the spot market then both firm B and the buyer are indifferent to l buying from B at a contract price of $\underline{C}$. This will have no effect on the game or any players payoff. Thus we can concentrate on equilibria where any large buyer l only buys from a firm in the contract market.

Denote the profits of firms A and B in the putative equilibrium by Π_A and Π_B, respectively, and let v_l^* represent the (gross) value received by large player l. Note that $\Pi_i \geqslant \pi(\mathbf{0}, \hat{\mathbf{Q}}^{\mathbf{L}})$ by A4. By A5,

$$\sum_{l\in L} v_l^* + \Pi_A + \Pi_B < Lv_l(\tilde{q}_l(\bar{C})) - L\bar{C}\tilde{q}_l + \pi(\hat{\mathbf{Q}}^L, \mathbf{0}) + \pi(\mathbf{0}, \hat{\mathbf{Q}}^L). \quad \text{(A.1)}$$

Suppose firm A deviates from the putative equilibrium and offers all large buyers the contract $(\tilde{q}_l(\bar{C}), v_l(\tilde{q}_l(\bar{C})) - v_l^* - \varepsilon)$. Then all buyers will accept this contract rather than the equilibrium contract as it makes them strictly better off by ε. It remains to show that offering such contracts is a profitable deviation for firm A.

Under these contracts, firm A's profit is

$$\Pi_A^d = Lv_l(\tilde{q}_l(\bar{C})) - \sum_{l\in L} v_l^* - L\varepsilon - L\bar{C}\tilde{q}_l(\bar{C}) + \pi(\hat{\mathbf{Q}}^L, \mathbf{0}).$$

But by (A.1), $\Pi_A^d > \Pi_A + \Pi_B - \pi(\mathbf{0}, \hat{\mathbf{Q}}^L)$ for ε positive but sufficiently small. But by A4, $\Pi_B - \pi(\mathbf{0}, \hat{\mathbf{Q}}^L)$ is a non-negative number so that $\Pi_A^d > \Pi_A$ so that deviation by A is profitable.

As we have shown a profitable deviation for A from the putative equilibrium where both firms achieve minimum efficient scale, the equilibrium does not exist and there is no equilibrium of the simultaneous contracting game where both firms achieve minimum efficient scale. □

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