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Oligopoly intermediation, relative rivalry and market conduct ☆

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ABSTRACT

We consider two firms that compete against each other jointly in upstream and downstream markets under two pricing games: Purchasing to stock (PTS), in which firms select input prices prior to setting consumer prices; and purchasing to order (PTO), in which firms sell forward contracts to consumers prior to selecting input prices. The antitrust implications of the model depend on the relative degree of oligopoly rivalry in the upstream and downstream markets. Firms strategically precommit to setting prices in the less rivalrous market, which serves to soften competition in the more rivalrous market, resulting in anticompetitive effects. Bertrand prices emerge in equilibrium when the markets are equally rivalrous, while Cournot outcomes arise with upstream monopsony or downstream monopoly markets. The slope of firm reaction functions depends on relative rivalry, a feature we use to derive testable hypotheses for antitrust analysis of a wide variety of industry practices.

1. Introduction

Firms selling final products in common downstream markets often compete with rivals to procure common inputs from upstream suppliers. Under conditions in which firms face competition from rivals in procurement as well as in sales, price-setting behavior in downstream consumer markets has important implications for the ability of firms to exercise market power over suppliers in upstream markets. For example, the use of fixed-price forward contracts in consumer electricity markets significantly impacts the ability of distribution companies to arrange favorable buying terms from suppliers on the wholesale market (Bushnell, 2007). In this paper, we extend the oligopoly model to consider circumstances in which the prices set by firms in one market jointly impact the supply and demand conditions facing rivals.

Our analysis follows Stahl (1988) in examining two forms of sequential price competition: *(i)* "purchasing to stock" (PTS), in which the firms select input prices prior to setting output prices; and *(ii)* "purchasing to order" (PTO), in which the firms sell forward contracts to consumers prior to selecting input prices. Our point of departure from Stahl (1988) is that we vary the intensity of the oligopoly interaction in the upstream and downstream markets by considering product differentiation in each market. Such would be the case when firms rely on specialized inputs to produce differentiated consumer goods.

We demonstrate the outcome of the oligopoly model to be sensitive to the relative intensity of the strategic interaction between firms in the upstream and downstream markets. Our analysis reveals that firms have an incentive to select input prices prior to choosing output prices in the PTS game when the downstream market is relatively rivalrous, but to select output prices prior to choosing input prices in the PTO game when the upstream market is relatively rivalrous. In both cases, committing to prices in the less rivalrous market is a facilitating practice to soften competition in the market where the oligopoly interaction with rivals is more intense, resulting in anticompetitive effects that harm consumers and suppliers. Such behavior is clearly of interest to antitrust authorities; indeed, the Federal Energy Regulatory Commission (FERC) recently proposed changes to its horizontal market power screens that would account for forward contract commitments (Federal Energy Regulatory Commission, 2003).

Our main results can be summarized as follows. First, we demonstrate that Bertrand merchants emerge under circumstances in which the upstream and downstream markets are equally rivalrous. We thus generalize the outcome of Stahl (1988) to the case of differentiated

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products and show that it continues to hold in any industry in which the supply-side and demand-side diversion ratios of a price change are equal. Thus, the underpinning of the Bertrand outcome is determined by the relative degree rather than the absolute degree of rivalry in markets.

Second, we show that Cournot outcomes emerge whenever firms face independent monopsony (monopoly) markets. Our analysis therefore nests the capacity-constrained pricing model of Kreps and Scheinkman (1983) as a special case of PTS that arises when supply functions in the upstream "capacity" markets are independent of rivals' choices.[1] We generalize this result to the case of differentiated products and establish that it also holds under PTO when the demand functions are strategically independent in the downstream markets, as is commonly the case in retail electricity markets.

Third, our model produces a continuum of outcomes that range from Cournot to Bertrand according to the relative rivalry of markets. As relative rivalry decreases from monopsony conditions in the upstream market towards greater competition with the rival for inputs, the oligopoly equilibrium converges from Cournot oligopoly to Bertrand under PTS, and then tends towards Cournot oligopsony under PTO as the upstream market becomes relatively rivalrous. In general, the slope of firms' reaction functions depends on the relative rivalry of the markets.

Fourth, our oligopoly framework provides testable hypotheses that can be used to evaluate antitrust implications for a wide variety of industry practices. It is well-known since at least Fudenberg and Tirole (1984) and Bulow et al. (1985) that the effect of various industry practices on market performance depends on the slope of firms' reaction functions, a detail of the market microstructure that a government is unlikely to get right (Krugman, 1993). The inability of regulators to observe the strategy space of firms in a particular industry poses a problem for antitrust evaluation of a wide variety of strategic choices, including entry deterrence, capacity limitation, vertical control, multimarket oligopoly, tying arrangements, and most favored customer clauses.[2] Our model thus provides general guidance for antitrust scrutiny of industry conventions by generating necessary conditions for strategic choices to be facilitating practices that depend on industry-specific primitives of supply and demand functions.

We illustrate the policy implications of the model for the case of slotting allowances between retailers and manufacturers. Slotting allowances, which involve lump-sum payments from manufacturers to retailers in exchange for shelf space, can serve as a facilitating practice to elevate retail prices. Slotting allowances were recently examined by the Federal Trade Commission (Federal Trade Commission, 2001) without resulting policy guidance, and the report cited the need for further investigation on the efficiency effects of the practice. We show that a necessary condition for slotting allowances to serve as a facilitating practice is a sufficiently "small" degree of relative rivalry in the upstream and downstream markets, and that slotting allowances result in pro-competitive effects whenever the supply-side and demand-side diversion ratios differ substantially in a given industry. We numerically characterize these policy outcomes for perturbations in relative rivalry under linear supply and demand conditions.

The remainder of the paper is structured as follows. In the next section we present the model and characterize equilibrium prices under PTS and PTO. In Section 3, we compare the outcomes for firm and industry profits, classify the Pareto dominant Nash equilibrium according to the relative degree of rivalry in the upstream and downstream markets, and characterize the equilibrium outcomes in terms of industry profits and welfare. In Section 4, we extend these outcomes to consider games with endogenous timing under symmetric market conditions. In Section 5, we characterize conditions for reaction functions to slope downwards (upwards) and derive antitrust implications for various strategic choices to serve as facilitating practices. In Section 6, we numerically illustrate the implication of our findings for the case of slotting allowances between retailers and their upstream product manufacturers, and in Section 7, we conclude. The proofs of all propositions appear in the Appendix A.

2. The model

Consider duopoly firms who compete against each other in prices in an upstream input market and a downstream output market. The firms procure specialized inputs from price-taking suppliers in the upstream market and sell differentiated finished goods derived from the inputs to consumers in the downstream market.

To clarify the strategic implications of the model, we limit attention to the case of firms with fixed proportions technology. Specifically, letting x^i denote the quantity of the input purchased in the upstream market by firm i, we scale units such that $y^i = x^i$ denotes the quantity of the output available for sale by firm i.[3]

The firms set prices both in a downstream finished goods market and in an upstream input market. The firms have oligopoly market power in the downstream market and oligopsony market power in the upstream market. Manufacturers and retailers often offer attractive working relationships with suppliers, for instance by providing suppliers with technical expertise, logistical and accounting support and information processing, which can contribute to the exercise of market power in the upstream market.

Let p^i denote the output price of firm i with the vector of output prices denoted by $\mathbf{p} = (p^1, p^2)$. Consumer demand for product i is given by $D^i(\mathbf{p})$, with $D^i_i \equiv \partial D^i/\partial p^i < 0$ and $D^i_j \equiv \partial D^i/\partial p^j \geq 0$.[4] We assume that there exists $\overline{p} > 0$ such that $D^i(p, p) = 0$ for all $p \geq \overline{p}$ and $D^i(p, p) > 0$ for all $p < \overline{p}$.

Let w^i denote the input price of firm i with the vector of input prices denoted by $\mathbf{w} = (w^1, w^2)$. The supply facing firm i in the upstream market is given by $S^i(\mathbf{w})$, with $S^i_i \equiv \partial S^i/\partial w^i > 0$ and $S^i_j \equiv \partial S^i/\partial w^j \leq 0$.[5] We assume that market supply is zero when input prices are zero, $S^i(0, 0) = 0$.

We impose standard stability conditions for differentiated-product oligopoly and oligopsony (Vives, 2001): $\Delta \equiv D^i_i D^j_j - D^i_j D^j_i > 0$ and $\Sigma = S^i_i S^j_j - S^i_j S^j_i > 0$. We also impose the following mild regularity conditions on the second order derivatives of demand and supply. For all symmetric output prices, $D^i_{ij} + min\{D^i_{ii}, D^i_{jj}\} \geq 0$; and for all symmetric input prices, $S^i_{ij} + max\{S^i_{ii}, S^i_{jj}\} \leq 0$.

To streamline the exposition, we suppress inventory-holding behavior and the destruction or removal of goods.[6] Without the possibility of holding inventory, the demand and supply functions facing each firm are linked by the material balance equations,

$$\mathbf{D}(\mathbf{p}) = \mathbf{S}(\mathbf{w}). \tag{1}$$

Let $\overline{r}$ denote the price such that $\mathbf{D}(\overline{r}, \overline{r}) = \mathbf{S}(\overline{r}, \overline{r})$. Each firm's output price is chosen from the interval $[\overline{r}, \overline{p}]$, while each firm's input price is selected from the interval $[0, \overline{r}]$.

[1] Our analysis in this paper abstracts from inventory-holding considerations. Specific analysis of the second stage pricing outcomes of the two-stage Kreps and Scheinkman (1983) game with differentiated products and inventory-holding behavior is contained in Hamilton and Lepore (2015).

[2] For a good discussion on the antitrust implications of these practices, see Tirole (1988, Ch. 8).

[3] Throughout the paper, we use superscripts to denote the scalar value (or function) of an individual firm and subscripts to denote partial derivatives of functions.

[4] We omit writing price arguments from functions hereafter in cases where it does not create confusion.

[5] Product differentiation in the upstream market can be formally modeled by considering a representative supplier with a multi-product cost function, $c(x^1, x^2)$, characterized by increasing differences, or by considering an input procured from locationally-differentiated suppliers under FOB destination pricing.

[6] For an analysis of inventory-holding behavior in differentiated product oligopoly markets, see Hamilton and Lepore (2015).