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## Industry profits and free entry in input markets

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### Abstract

When upstream firms compete in quantity and freely enter the input market, competition among downstream firms reduces the input price (the marginal cost of downstream firms). The industry profits of downstream firms competing in quantity may increase with the number of downstream firms.

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### 1. Introduction

In the standard Cournot model of oligopoly, as the number of firms competing in the market increases, industry profits (the sum of the firms' profits) decrease through increased product market competition. The nature of the relationship between the number of firms and industry profits influences the incentives for firms. For instance, when firms collude in a product market, they control their own quantities supplied like a monopolist, because their monopolistic behavior maximizes the industry profits.

In this paper, we show that, under free entry into input markets, the relationship between industry profits and the number of downstream firms depends on fixed costs (the ease of entry) in the input markets. When the fixed costs are large, industry profits can increase with the number of

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downstream firms. We also show that, as the number of downstream firms increases, the input price decreases.

Naylor (2002) also shows a situation in which industry profits increase as the number of downstream firms increases. However, the structure of his model is quite different from ours. Naylor (2002) considers a quantity-setting model in which input prices are not exogenous but are determined by bargaining in a bilateral oligopoly. A pair made up of a labor union (an upstream firm) and a downstream firm bargain for the wages of the laborers (the wholesale price). The bargaining structure is similar to that in Horn and Wolinsky (1988) who discuss Nash bargaining.

On the contrary, in our model, upstream firms compete in quantity and freely enter into input markets. Each upstream firm faces the derived demand of downstream firms for input. The wholesale price is determined by the quantities supplied by upstream firms. Negotiations between upstream and downstream firms do not exist.

The driving force of our result is as follows. The number of downstream firms affects the derived demand for input. The increase in the number of downstream firms enhances the derived demand and attracts potential entrants to the input market. The additional entries reduce the input price and are beneficial to the downstream firms. Under some conditions, the reduction of the input price has a significant effect on industry profits.

As mentioned earlier, in our model, as the number of downstream firms increases, the input price decreases. This property is related to that in Lahiri and Ono (1995). They introduce the Cournot oligopoly to the Heckscher-Ohlin model and show that free trade reduces the oligopoly price and increases welfare under free entry. Free trade enlarges the market size for the oligopolists and induces additional entries. The entries reduce the oligopoly price. The mechanism of their result is similar to that of ours, but they do not consider industry profits and a vertical relationship between upstream and downstream firms.

The rest of the paper is organized as follows. Section 2 contains the basic model. Section 3 has the main results. Section 4 concludes the paper.

## 2. The model

The setting of the model is somewhat similar to those in Salinger (1988) and Lin (2006). There are  $m$  upstream firms and  $n$  downstream firms. As discussed later,  $m$  is endogenously determined, and  $n$  is exogenously given. All downstream firms buy an input from the upstream firms and then transform it into the final product. One unit of the final product requires exactly one unit of input. The unit cost of producing the input is  $c$ . For simplicity,  $c$  and the cost of transforming the input into the final product are normalized to zero. The demand for the final product is given by  $p = a - bQ$ , where  $Q$  is the quantity supplied by the downstream firms. Upstream firms freely enter the input market. When an upstream firm enters the market, it incurs a fixed cost,  $F$ . Free entry into input markets is not considered by Salinger (1988) and Lin (2006).

The input price is determined by Cournot competition at both levels of the industry: The downstream firms choose their output levels given the input price, leading to the derived demand for input; the upstream firms then compete in a Cournot fashion with respect to the derived demand.

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