

Effects of Downstream Entry in Supply Chains with Spot Markets

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1. Research Problem. In an oligopoly market, market entry intensifies competition which benefits consumers but hurts incumbents¹. In a supply chain context, however, Tyagi (1999)² reveals that downstream entry encourages the strategic supplier to charge a higher contract price of the intermediate good, and this "input-cost" effect dampens the competition effects of entry, decreases the total output, and as a result, increases the consumer price of the final product. The upstream supplier constantly benefits and the incumbent downstream firms might either benefit or hurt from downstream entry.

In reality, many product inputs, such as commodity-type raw materials and standard components are procured through not only long-term contracts, but also spot markets. Trading flexibility in spot markets can help managers to better match demand and supply. However, spot trading also exposes firms to price volatilities. Contract transaction is typically maintained by supply chain members to hedge against the spot price volatility. Kleindorfer (2009)³ indicates that joint contract and spot market procurement is a prominent feature of industries in the e-commerce era, including electric power, logistics service, natural gas, metals, IT components, chemicals, and agricultural and food products.

In such a supply chain structure, do the findings about entry observed in a traditional supply chain (such as the one studied by Tyagi 1999) continue to hold? With two sale channels (e.g., contract and spot market), upstream suppliers need to decide whether to sell through the contract channel only, the spot market only, or both. How does downstream entry affect the capacity allocation of the supplier between contract channel and spot market? Similarly, downstream buyers need to decide on their procurement portfolio to balance the spot price risk and procurement flexibility. Buyers may also speculate in the commodity market and this speculative behavior affects their contract procurement decisions, which in turn influence the input (contract) pricing decisions of supplier. How does spot trading affect the competition and input-cost effect when downstream entry occurs?

¹ Seade, J. 1980. On the effects of entry. *Econometrica* 48 (2) 479-489.

² Tyagi, R. K. 1999. On the effects of downstream entry. *Management Science* 45 (1) 59-73.

³ Kleindorfer, P. R. 2009. Integrating physical and financial risk management in supply management. In *Risk Management in Commodity Markets: From Shipping to Agriculture and Energy*. John Wiley and Sons.

2. Key Methodology and Assumptions. We consider a two-echelon supply chain that consists of an upstream supplier and n downstream manufacturers. Manufacturers procure an intermediate good via forward contract from the supplier, and use it as a one-to-one input to produce a homogeneous final product and engage in a Cournot competition in the final product market. A fully liquid spot market exists in which both the supplier and manufacturers can trade the intermediate good. Supply chain members need to limit their risk exposure while maximizing profits. We use the mean--variance method to measure risk aversion. Our model comprises three stages: (1).The supplier sets her contract price of the intermediate good. (2). Manufacturers simultaneously decide their contract procurement quantities of the intermediate good. (3) The demand potential of the final product and spot price of the intermediate good are realized. Manufacturers receive the delivery of the contract procurement and decide their outputs of the final product. The supplier and manufacturers can buy or sell the intermediate good in the spot market according to the realized demand and spot price. We use backward induction to solve the multi-stage game and conduct equilibrium analysis.

3. Summary of Major Results and Implications. (1). We find that the input cost effect disappears when manufacturers adjust their inputs by trading in the spot market. As a result, downstream entry always increases the total output of the final product and decreases the expected consumer price. (2). With the presence of spot markets, we demonstrate that the downstream manufacturers have to consider the production-need, risk-hedging and speculative quantities when they make their contract procurement decisions. Downstream entry always increases the contract price in a low-volatility spot market, but may decrease the contract price in a high-volatility spot market. Specifically, downstream entry is more likely to decrease contract price if the number of incumbents is small and the manufacturers are more risk averse than the supplier. Further, the contract price emerges to the expected spot price if entry leads to an infinite number of manufacturers. (3). The upstream supplier may speculate in the high-volatility spot market and sell more than her production capacity through contract. Downstream entry discourages this

speculative behavior. With an infinite number of manufacturers, the supplier only trades in the contract channel. (4). In a low-volatility spot market, we identify a situation where downstream entry can lead to a “three-win” situation: the supplier, the incumbent manufacturers, and the final consumers all benefit from entry. However, this “three-win” zone diminishes when the number of downstream manufacturers goes to infinity. We also identify situations where downstream entry will hurt the supplier, who is suggested to watch for downstream entry in a high-volatility spot market when the manufacturers are more risk averse than the supplier and when the number of incumbents is small.

Our results provide practical guidelines for supply chain managers working in an industry structure with a supplier selling to several downstream buyers with the presence of a volatile spot market. First, the supplier and manufacturers should know the demand uncertainty in the final product market and the price volatility in the spot market from historical data. The data allow market participants to identify the type of spot market they are working with, namely, low volatility vs. high volatility market. Market participants should adopt different pricing and contract procurement strategies according to the type of market they identify when downstream entry occurs. Second, manufacturers should know their degree of risk aversion as compared to the supplier, and the number of manufacturers in the downstream market. The downstream firms should welcome the new entry if they are more risk averse than the supplier and the downstream market is less competitive; otherwise, they should block the new entry. Third, aside from the number of manufacturers in the downstream market and the degrees of risk aversion, the supplier should also confirm her relative capacity level by comparing her capacity with the maximum expected demand in the final market. Supplier should block the new entrant if the downstream market is less competitive, the manufacturers are more risk-averse, and her relative capacity is low. For policy makers, spot market weakens the influence of a strategic upstream supplier, and downstream entry always benefits the end consumers.