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Forward trading and storage in a Cournot duopoly

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Abstract

A dynamic game is presented that models the effects of forward trading and storage in an imperfectly competitive market. It is shown that the pro-competitive effects of forward trading found in previous work are weakened by the addition of storage, but not eliminated. The price level lies between that of a Cournot game and that of a game with forward trading but without storage.

JEL classification: D43; L13; G13

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1. Introduction

Forward trading and storage are two dynamic choices made by firms in many commodity markets. When these markets contain imperfectly competitive producers these dynamic choices may be made strategically. This paper presents a dynamic game of forward trading by duopolists who produce a storable commodity. The objective is to examine the interaction between the use of forward contracts and inventories for strategic purposes.

The notion that forward trading by imperfectly competitive producers of a good can lead to lower prices than would otherwise obtain has been discussed by Allaz (1991, 1992), Allaz and Vila (1993), and Thille and

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Slade (2000). Forward trading for a perishable good leads to aggressive sales behavior on the part of producers as the level of maturing forward positions affects producers' marginal revenue, thus affecting sales decisions. The net result is an equilibrium price that is lower than the price in a Cournot equilibrium. Allaz and Vila (1993) show that this effect is enhanced as the number of periods in which forward trading is allowed is increased. As this work has limited its attention to perishable goods, it is interesting to ask to what extent the pro-competitive nature of strategic forward trading is affected by the possibility of storage. Most commodities for which forward trading occurs are storable to some extent and many of the commodities for which imperfect competition may be a concern, such as oil, non-ferrous metals, and coffee, clearly are storable.

Storage may also lead to strategic behavior, as a unit available for sale from inventories need not be produced in the current period. If marginal production cost is increasing in output, this will lower the marginal cost of sales for a firm, providing it with a temporary cost advantage over its rivals. The primary question addressed in this paper is the extent to which the potential for the strategic use of storage will offset or enhance the pro-competitive effects of forward trading.

Allaz (1991) represents a first attempt at answering this question. He uses a two-period game in which storage and forward trading decisions are made in the first period and sales decisions made in the second. He finds that the possibility of forward trading removes all strategic elements of the inventory choice, although he does not examine whether or not strategic forward trading is increased or lessened by storage. The use of a two-period game renders this result open to question. Storage behavior in a two-period game is sensitive to the treatment of inventories remaining at the end of the game—the second period in this case. Whether "leftover" inventories are costless to dispose of or not will affect the producers' strategies. Allaz (1991) assumes that any inventories held in the second period are sold at that time, hence storage represents a firm commitment to a minimum level of sales. The effect of not requiring the sale of all stocks on the spot market in the final period would be to reduce the commitment value of inventories, reducing their strategic value. In order to abstract from the influence of the assumption about what is done with inventories in the final period, this paper presents an infinite-horizon, discrete-time dynamic game of forward trading with storage. It is shown that the strategic effects of inventories do differ from those in Allaz (1991). In fact, the opposite conclusion is reached. The addition of forward trading does not appreciably affect the strategic aspects of inventory choice.

The game is described in the next section after which a numerical solution is presented and analyzed. Evidence of the robustness of the results to different parameter values is then discussed.