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Procedia Economics and Finance 14 (2014) 507 – 514

Procedia Economics and Finance

www.elsevier.com/locate/procedia

International Conference on Applied Economics (ICOAE) 2014

Research Joint Ventures and Cartelization of Industries

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Abstract

The aim of this paper is to investigate the impact of the firms' behavior in the product market on their decisions at the R&D stage. We compare the consequences of the Stackelberg-type competition of two firms for the R&D investments with the situation of a cartelized industry under the assumption of quadratic cost functions. Numerical analysis shows that the lowest values of R&D efforts occur when the companies form a research joint venture. Moreover, greater R&D expenditures can be observed when a research joint venture is formed in a cartelized industry rather than under a Stackelberg-type duopoly.

Selection and/or peer-review under responsibility of the Organizing Committee of ICOAE 2014

Keywords: **research joint ventures; duopoly; cartelization of industries; quadratic cost functions**

1. Introduction

R&D cooperation of firms in the high-tech industries is widespread. It takes place within institutionalized frameworks of special consortia, as well as in an informal way through the exchange of information between employees of different companies. As a result, the investments of one company to improve technology and to reduce the costs of production create positive externalities (knowledge spillovers) for the other firms in the industry by helping them to decrease their manufacturing costs.[†] The extent of spillovers becomes the largest in the case of research joint ventures, which allow for a complete mutual exchange of technological advancements.

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[†] See, e.g., Geroski, 1995.

Selection and/or peer-review under responsibility of the Organizing Committee of ICOAE 2014
doi:10.1016/S2212-5671(14)00742-4

Research joint ventures may help eliminate duplication of activities and allow for technological improvements at the lower investment expenditures. The creation of a research joint venture, or the existence of a less formal exchange of knowledge and experience does not determine the extent of efficiency-enhancing investment outlays of individual firms. Companies may decide about the size of their expenditures in a noncoordinated way, or could jointly set the level of research spending by forming an R&D cartel.

The situation in a given industry depends, also, on the type of competition in the market for the final good. The same firms, that undertake cooperation at the R&D stage, may apply different scope of coordination for their behavior on the final product market. Among a variety of possible actions, we may consider noncooperative, or collusive behavior of companies at the sales stage.

The aim of this paper is to investigate the impact of the firms' behavior in the final product market on their decisions at the R&D stage, with a special consideration of research joint ventures. We first analyze the Stackelberg-type competition of firms on the market, and identify the consequences of such noncooperative rivalry for the R&D decisions. Next, we consider the impact of cartel creation on the R&D investments, and compare it with the noncollusive situation.

Analogously to the models introduced by d'Aspremont and Jacquemin, 1988, and by De Bondt and Veugelers, 1991, the analysis is conducted in a two-stage game with two firms as players. In the first stage, the companies simultaneously choose the level of R&D investments, and in the second stage they meet on the market for the final good. However, the type of noncooperative behavior analyzed by these authors has been limited to the Cournot model.[‡]

In this paper, we extend the analysis by introducing the Stackelberg competition in the product market. Unlike the previous literature, we assume that the production process is characterized by the quadratic cost functions, rather than the linear ones, i.e. the marginal costs are increasing.[§] We investigate whether the replacement of the linear costs by a quadratic function will have any impact on the key conclusions about the behavior of firms in the R&D stage. Since the algebraic solutions to the models discussed in this paper are hard to obtain, we limit our considerations to a numerical analysis.

The rest of the paper is organized as follows. The next section focuses on the noncooperative competition of duopolists in the case of Stackelberg leader-follower behavior in the final product market. In section 3, we consider the conduct and performance of firms in a fully cartelized industry, i.e., in the case of collusion at the R&D stage as well as in the final good market. Based on the comparison of the above cases, we formulate conclusions regarding the cost-reducing investments of firms in section 4. The paper ends with a brief summary and conclusions.

2. Quantity leadership

Consider an industry with two firms, denoted 1 and 2. Each firm i $(i = 1, 2)$ manufactures q_i units of an identical product. An inverse demand function for the good is given in a linear form:

$$p = a - Q, \tag{1}$$

where p denotes the market price, Q $(= q_1 + q_2)$ is the total quantity demanded, and a $(a > 0)$ is a given parameter.

[‡‡] These models have been further developed by, e.g., Kamien et al., 1992, who also considered the case of Bertrand competition.

[§] The Stackelberg competition in the context of R&D investments and cartelization of industries has been first considered by Prokop and Karbowski, 2013. These authors, however, assumed the linear cost functions.