ELSEVIER

International Journal of Industrial Organization
21 (2003) 39–55

International Journal of Industrial Organization

www.elsevier.com/locate/econbase

Comparing Cournot and Bertrand equilibria in a differentiated duopoly with product R&D

George Symeonidis*

Department of Economics, University of Essex and CEPR, Wivenhoe Park, Colchester CO4 3SQ, UK

Abstract

This paper compares Bertrand and Cournot equilibria in a differentiated duopoly with substitute goods and product R&D. I find that R&D expenditure, prices and firms' net profits are always higher under quantity competition than under price competition. Furthermore, output, consumer surplus and total welfare are higher in the Bertrand equilibrium than in the Cournot equilibrium if either R&D spillovers are weak or products are sufficiently differentiated. If R&D spillovers are strong and products are not too differentiated, then output, consumer surplus and total welfare are lower in the Bertrand case than in the Cournot case. Thus a key finding of the paper is that there are circumstances where quantity competition can be more beneficial than price competition both for consumers and for firms.

JEL classification: L13; D43

Keywords: Product R&D; Price versus quantity competition; Welfare

1. Introduction

The standard view that Bertrand competition is more efficient than Cournot competition has recently been challenged by a number of theoretical models. A common feature of these models is the idea that firms compete both in variables

*Tel.: +44-1206-87-2511; fax: +44-1206-87-2724.
E-mail address: symeonid@essex.ac.uk (G. Symeonidis).

0167-7187/03/$ – see front matter
PII: S0167-7187(02)00052-8

that can be easily changed in the short run, such as price or output, and in variables that constitute longer-term commitments, such as capacity or R&D expenditure. Much of this literature has specifically focused on expenditure in process R&D as the long-run decision variable. Product R&D, although empirically more important (see Scherer and Ross, 1990), has received little attention in these studies.

This paper compares Bertrand and Cournot equilibria in a differentiated duopoly with substitute goods and product R&D. Vives (1985) and Singh and Vives (1984) found that Bertrand competition results in higher consumer surplus, lower profits and higher overall welfare than Cournot competition in a duopoly model where goods are substitutes and the firms' only choice variable is either price or output. Motta (1993) found price competition to result in higher consumer surplus, profits and overall welfare than quantity competition in the context of a vertically differentiated duopoly with either fixed or variable costs of quality improvement. Although the case of fixed costs of quality improvement can be naturally interpreted as product R&D, the study by Motta did not allow for R&D spillovers. On the other hand, Delbono and Denicolo (1990) found that the welfare comparison between Bertrand and Cournot is generally ambiguous in the context of a homogeneous product duopoly with process R&D in the form of a patent race, although R&D investment is higher in the Bertrand equilibrium (in fact, it is even higher than the socially optimal level). Finally, Qiu (1997), who used the Singh and Vives (1984) linear demand structure but introduced a stage of process R&D competition prior to the price or quantity-setting stage, found that R&D expenditure is higher under Cournot than under Bertrand; that the opposite is true for consumer surplus; that the Bertrand equilibrium is more efficient than the Cournot equilibrium if either R&D productivity is low, or spillovers are weak, or products are very differentiated; and that the Bertrand equilibrium is less efficient than the Cournot equilibrium if R&D productivity is high, spillovers are strong, and products are close substitutes.[1]

This paper addresses these issues in the context of a model with both horizontal and vertical product differentiation, the latter of which is due to product R&D. An important difference between process and product R&D is that the latter directly affects gross consumer surplus. This is because product R&D raises product quality, and quality enters directly into each consumer's utility function. On the other hand, process R&D affects gross consumer surplus only indirectly, through a reduction in marginal cost and a consequent increase in output. Thus it is not clear whether the results from models with process R&D carry over to the case of product R&D. Moreover, the present model differs from models of 'pure vertical differentiation', such as the one used by Motta (1993), in important ways,

[1] Bester and Petrakis (1993), who also analysed a game of investment in process R&D using a linear demand structure, obtained results different from those of Qiu (1997) because in their model only one firm was allowed to invest in R&D.