Effect of credible quality investment with Bertrand and Cournot competition

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Summary. We show how credible revelation and ability to commit to quality choice affect equilibrium qualities and welfare when product market is either Bertrand or Cournot competition. We show that results depend on the type of competition but not generally on the cost of quality function. We show that with Bertrand competition, the equilibrium qualities are lower with credible commitment. Competition is moderated and producer surplus is higher and consumer surplus lower. With Cournot competition, higher quality will be better but lower quality will be worse with credible commitment. Consumer surplus is always greater with credible commitment and if cost does not increase too quickly with quality, producer surplus will also increase. Thus credible commitment is a collusive device with Bertrand competition but it can improve social welfare with Cournot competition.

Keywords and Phrases: Vertical quality differentiation, Bertrand and Cournot competition, Commitment, Sequential vs. simultaneous choices.

JEL Classification Numbers: L1, D4, C7.

1 Introduction

The purpose of this paper is to analyze the effect of credible revelation and ability to commit to quality choice on equilibrium qualities, profits and welfare. We focus on product markets with Bertrand and Cournot competition and assume that the cost of quality investment is a monotonically increasing function of quality. We consider a sequential game where firms invest in quality first and then choose output levels. We show that credible revelation and commitment can affect equilibrium qualities and welfare even when the cost of quality function is not considered.

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We show how they depend on the nature of product market competition, Bertrand (price competition) or Cournot (quantity competition), when cost of quality is, 

\[ C(q) = kq^n, \]

where \( q \) is the quality level, \( k \) is a positive constant and \( n \) is any integer greater than 2. Product market competition matters because qualities are locally strategic complements with Bertrand competition but are locally strategic substitutes with Cournot competition in the relevant range. One expects that it may be more profitable to produce the inferior quality if rate at which cost increases with quality (parameter \( n \)) is large. Surprisingly, we find that our results are robust to size of \( n \) (with one exception). In equilibrium, since the cost function is smooth, any reduction of higher quality is accommodated by reduction of the lower quality.

We employ a duopoly game with two stages – the quality-setting first stage and the second stage in which sales are made. Products are vertically differentiated in quality. We compare situation where one firm can credibly reveal and commit to its quality choice (sequential move) and where this is not possible (simultaneous move) in the first stage. We compare the subgame perfect equilibrium qualities under the two timing scenarios in the first stage and their welfare implications. The comparison is done with Bertrand second stage and Cournot second stage.

With Bertrand competition, profitability is determined by the relative distance of the two qualities i.e., extent of quality heterogeneity since firms price to compete for the marginal consumer. Both increase in high quality and decrease in low quality increase the distance of qualities or the heterogeneity and this is profitable for both firms due to reduced competition. Thus depending on if the firm produces higher or lower quality, second stage equilibrium profit will be increasing or decreasing in own quality and decreasing or increasing in rival quality. With Cournot competition, increase in own quality will always increase the market clearing price while increase in rival quality always decreases the price. Thus second stage equilibrium profit is increasing in own quality and decreasing in rival quality, independent of if the firm produces higher or lower quality.

With both types of competition in the second stage, the first mover will choose to be the high quality firm in equilibrium. Recall that with both types of competition, high quality firm’s profit is decreasing in low quality. Thus whether if the first mover increases or reduces own quality compared to simultaneous move is determined by if qualities are strategic complements or substitutes for the low quality (second mover). With Bertrand second stage, low quality firm’s marginal profit with respect to own quality is negative because improvement of own quality reduces the difference in qualities. This negative effect is reduced when qualities are farther apart, i.e., cross derivative is positive (reduces absolute value of negative marginal profit). In order to reduce second mover quality, first mover reduces quality compared to the simultaneous choice.

Previous analyses of endogenous quality choices have been confined to simultaneous choices (Gabszewicz and Thisse, 1980; Shaked and Sutton, 1982; Bonanno, 1986; Boyer and Moreaux, 1987; Motta, 1993). Motta has an upper bound \( \bar{v} \) of qualities. This actually is a bound on revenue relative to cost. Thus \( \bar{v} \) is the inverse of \( k \) in our paper. To be precise, \( \bar{v} = \frac{2}{k} \).