Optimal R&D policy and endogenous quality choice

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Abstract

In a quality-differentiated duopoly where (i) quality is endogenously chosen before production, (ii) fixed costs are increasing and convex in quality, and (iii) variable production costs are insubstantial, an R&D subsidy for the firm producing a high-quality product improves social welfare, irrespective of whether the ensuing product–market competition is Bertrand or Cournot, while an R&D subsidy for the firm producing a low-quality product improves social welfare only if Bertrand, and not if Cournot.
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1. Introduction

In high-technology industries, such as automobiles, computers, consumer electronics, and others, the firms engage in Research and Development (R&D, hereafter) activities to develop new products and improve product qualities, i.e. product R&D. Since oligopolistic competition prevails in such industries, the firms invest strategically in product R&D. In that case, socially optimal product qualities are not necessarily chosen by an individual firm. But there are many cases where governments have used various policy measures to affect R&D activities. In

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particular, R&D subsidies and government-sponsored research projects have been popular in Japan and European countries.

A micro-theoretic rationale for subsidising R&D investments to improve product quality is that the social benefit of the resulting quality improvement is higher than the incremental profit it generates, as only the former, and not the latter takes the increase in consumers' surplus into account. From a socially optimal point of view, such R&D should be motivated by more than the firm's profit incentives. A natural yet non-trivial question springs from this observation: what if there are multiple firms competing in a vertically differentiated product oligopoly? Assuming that policy measures can be tailored to subsidize or tax each firm separately, should a firm producing a high-quality product (a higher quality firm, hereafter) be subsidized or taxed? What about a firm producing a low-quality product (a lower quality firm, hereafter)?

Although there are many theoretical models addressing process R&D activities, we know a few studies analyzing the economic implications of product R&D activities under imperfect competition, e.g. Symeonidis (2003). There are a few papers closely related to ours: Lahiri and Ono (1999) and Zhou et al. (2002). Firstly, Lahiri and Ono have examined the structure of optimal R&D taxes-cum-subsidies, by considering endogenous R&D investments by Cournot duopolists with an initial cost differential. In their model, R&D investments reduce the marginal costs of production, i.e. process R&D. Lahiri and Ono have found that under Cournot competition in a homogenous product market, the firm with a lower (higher) primary marginal cost invests more (less, respectively) in process R&D and thus takes the larger (smaller, respectively) market share; that the government should subsidize the larger firm with lower marginal initial costs and tax the smaller firm with higher marginal initial costs in order to maximize social welfare. Their conclusion implies that the distribution of output and profits among the firms under Cournot competition is an essential factor in the maximization of social welfare. In other words, helping an efficient firm and eliminating an inefficient firm eventually leads to increases in consumer surplus and producer surplus (Lahiri and Ono, 1988).

Secondly, using a standard vertically differentiated product model, Zhou et al. (2002) have examined the implications of a 'strategic trade policy' targeted at investments in quality improvements of exported products. It is assumed in their model that the firm producing a higher (lower) quality product locates in a (less, respectively) developed country, and that the two firms compete in a third country's market. Zhou et al. have shown that under Bertrand (Cournot) competition, the developed country's government should tax (subsidize, respectively) the higher quality firm, while the less developed country's government should subsidize (tax, respectively) the lower quality firm.

We will present a standard version of vertically differentiated product models, where: (i) quality is endogenously chosen before production, (ii) fixed costs are increasing and convex in quality, and (iii) variable production costs are insubstan-