Optimal Licensing in Markets with Quality Innovation

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Abstract

We study a research lab's optimal licensing of a quality-improving innovation. Prior to the quality innovation, firms produce homogeneous goods with a low quality and compete in quantity. Consumers are heterogenous in their tastes for quality and each has a unit demand. In equilibrium, consumers purchase in the market when their taste parameters are above a threshold an exit the market, otherwise. A research lab develops a quality-improving innovation which upgrades the goods' quality to a higher level. The lab wishes to maximize its revenue by licensing the technology to the firms through auction. We characterize the optimal number of licenses the lab should auction off and analyze how the lab's optimal licensing strategy affects the market structure, firms profit and consumer surplus.

Extended Abstract

Quality innovation is the key to success in many industries ranging from software, smartphone, personal computer and pharmacy. It is very common that a quality innovation is developed in an outside lab who then licenses the technology to firms in the product markets. For example, Synaptics is a leading company in human interface. It developed the pattern recognition techniques to build the world's first touchpad which can make laptops thinner and greatly improves user experience. The technology was first adopted by Apple and subsequently adopted by many other leading computer manufacturers of the time, including Compaq and Dell. The outside lab's licensing strategy not only affects its profit, but also determines the market structure of the final products and consumer welfare. If the lab auctions off its technology to all the firms in the final market, it upgrades the quality of all the products in the industry. Alternatively, the lab can auction off only one license and turns the licensee into a monopoly in the high-end market while leaving the rest of the firms in the low-end market. This paper studies a revenue maximizing lab's optimal licensing strategies and explores its welfare implications.

We consider a market with N homogenous firms competing in quantity to sell a low-quality product to a unit mass of consumers. Consumers have heterogenous tastes for quality. In the equilibrium without the quality innovation, consumers purchase the product when their taste parameters are above a threshold and exit the market, otherwise. A research lab develops a quality-improving innovation and auctions off licenses to firms who can use the technology to upgrade their qualities to a higher level.

The lab chooses the number of licenses to maximize its revenue. For a small number ($n<N$) of licenses purchased by firms, the product market is divided into a high-end market with n firms producing the high-quality good and a low-end market with N-n firms producing the low-quality good. In each market, firms compete in quantity. A firm's maximum willingness to pay for the license is the difference between its profits in the high-end and the low-end markets. When the lab offers more licenses, it intensifies the competition in the high-end market and hence reduces licensees' profits. A lower high-end market price will drive down the price in the low-end market and hence leads to a lower industry profit in the low-end market. When the lab auctions off

sufficient many licenses, it can drive down the low-end market price below the cost of production and hence eliminates the low-end market. We characterize the condition under which it is optimal for the lab to have both the high-end and the low-end market. We found that the optimal number of licenses decreases in the quality differential. Hence, if the innovation leads to a very big quality improvement, the lab will auction off very few licenses, rendering licensees great market power.

Patent licensing is a longstanding literature. Most of the existing literature studies the licensing of cost reduction innovations. As a result, the lab's licensing activities have no impact on the demand side of the market. This strand of the literature including Katz and Shapiro (1985, 1986), Kamien and Tauman (1984, 1986) and Kamien et al. (1992). One exception is Stamatopoulos and Tauman (2008) who studied quality innovation. Our paper differs from Stamatopoulos and Tauman (2008) in many aspects. First, we consider a general model with N>2 firms whereas Stamatopoulos and Tauman (2008) study a duopoly model. Second, we consider quantity competition in markets with vertically differentiated products whereas Stamatopouos and Tauman (2008) consider price competition in markets with both vertically and horizontally differentiated products.