ESSAYS ON PATENT LICENSING & TECHNOLOGY TRANSFER

SYNOPSIS

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Synopsis

We address the problem of the outside innovator (independent research lab), who wishes to license a new cost reducing innovation to the competing firm(s) in a duopoly market under spatial competition. The firms are not symmetric on their costs of production and the product is horizontally differentiated. We capture the horizontal product differentiation through the well-known linear city model (*a la* Hotelling, 1929) where firms are located at the end points of a unit interval and consumers are uniformly distributed over the interval. Each consumer buys exactly one unit of the product, hence the demand is inelastic. We assume the market is fully covered; hence the total market demand is fixed.

Consider two firms, firm A and firm B located in a linear city represented by a unit interval [0,1]. Firm A is located at 0 whereas firm B is located at 1 that is at the two extremes of the linear city. Both firms produce homogenous goods, which is horizontally differentiated, with constant but different marginal costs of production and compete in prices. We assume that consumers are uniformly distributed over the interval [0,1]. Each consumer purchases exactly one unit of the good either from firm A or firm B. The transportation cost per unit of distance is t and it is borne by the consumers.

The first chapter is an endeavour to provide detailed review of theoretical work on patent licensing and technological transfer with our motivation for current dissertation. In the second chapter, we address how the outside innovator commercialize its cost-reducing innovation. In licensing, first, the innovator decides how many licenses to offer (one or two) when there are two potential licensees with a once-for-all type offer. The innovator considered various available licensing schemes in this environment: fixed fee, auction, and royalty and finally decides the optimal licensing contract. Licensing will occur in a two-stage game structure. In the first stage of the game, the innovator has to decide on the number of licenses to offer, that is, to decide whether license a single firm (exclusive licensing) or both firms (non-exclusive licensing). The innovator licenses the technology by “once-for-all offer” (same as take-it or leave-it offer).

Our main findings of the study are as follows. Under fixed fee licensing, if one license is offered, the innovator will always choose to license the efficient firm. The main result under fixed fee licensing is to license both firms for smaller size of innovations, otherwise license only to the efficient firm. In the case of auction, when one license is auctioned, it will be always won by the efficient firm, and is also better than auctioning two licenses for the innovator. Comparing between fixed fee and auction, we get ‘by-an-large’ if the initial cost difference between firms is sufficiently high then fixed fee licensing to the efficient firm is optimal whereas if the cost difference is not that high then auctioning of the license to the efficient firm is optimal. In case of pure royalty licensing, if one license is being offered, it will be always offered to the efficient firm. However, it is optimal to the innovator to offer two licenses under pure royalty. As far as the overall optimal licensing for the innovator is concerned, we arrived at a very robust finding, namely, offering pure royalty contracts to both firms is always optimal, and it is true irrespective of the size of innovation, drastic or non-drastic; or the degree of cost asymmetry of the licensees. A complete diffusion of technology also happens in the equilibrium as both firms get the new technology. Thus, this result also explains the overall dominance of royalty contracts in practice. We further extend our analysis to see if instead of licensing, the innovator wishes to transfer the technology by selling the right of the new innovation to one of the firms.

Interestingly, when it comes to selling, we find that the innovator will always choose the inefficient firm to sell the technology. Transferring the new technology to an inefficient firm only, is a new finding that was not identified before in the literature of patent licensing. In literature, where selling the technology is considered with asymmetric licensees, either it is sold to the efficient firm only (Sinha 2016) or sold to any firm, i.e., cost asymmetry did not matter (Banerjee and Poddar 2019) unlike what we got here. This implies the nature of competition and the structure of the game (once for all contract) really matters. The kind of innovation we assume in this chapter is 'common' innovation in the sense that after licensing per unit cost falls by same amount from both firms' respective unit costs. In the next chapters we explore the implication non-uniform cost reduction.

The third chapter aims at investigating in both theoretical and policy perspective of patent licensing of an innovation which is only beneficial to the inefficient firm, in oligopolistic markets. In the light of non-uniform cost reduction, we explore the issue of shelving of innovation, often known as "killer acquisition" or "acquisitions for sleep". This is the case where a firm sometimes pays to acquire new technologies (patents), however, does not use them in production process but shelves them. The acquirer firm does so, to prevent its competitor from using it, and thus maintain its strategic advantage in the market. This may be undesirable from consumers' point of view as the innovation does not reach the market and defeats the purpose of innovation. One of the recent works on shelving a patent is found in Stamatopoulos and Tauman (2009). They consider only two licensing schemes namely exclusive auction and fixed fee under a duopoly Cournot structure where the outside innovator licenses an innovation which reduces the marginal cost of the inefficient firm only. We also consider the same assumption regarding the innovation in a different market structure of Hotelling's spatial competition where asymmetric firms produce a horizontally differentiated good. Firms (licensees) are located at the end points of a unit interval and consumers are uniformly distributed over the interval. Each consumer buys exactly one unit of the product (inelastic demand) and we assume the market is fully covered. The game structure is as follows. For the licensing game, in the first stage, we allow the outside innovator to decide on the licensing schemes. Licensees (firms) decide whether to accept or reject the offer. In case of non-exclusive license to one firm, the offer goes to the rival firm after rejection by one firm. In the second stage, firms produce and compete in prices in the product market. Similar game structure is assumed in the selling game. We first analyze the licensing game and later take up the selling game. In the licensing game, first we look between two schemes, fixed fee licensing and auction, find the optimal licensing contract and address the issue of technology shelving. Then we consider other licensing schemes, namely royalty and two-part tariff licensing to find the overall optimal licensing contract and avoid the shelving issue. Finally, we introduce the selling game and find the most profitable mode of technology transfer of the innovator in this environment and discuss the benefits (or no benefits) to the consumers from the innovation.

The main results are as follows: under fixed fee licensing, since the inefficient firm benefits from it only, the innovator will always license technology to the inefficient firm and technology diffusion takes place. When the innovator auctions-off an exclusive license, we show that the efficient firm wins the auction, however, shelves the innovation. This is equivalent to a killer acquisition. Moreover, for the innovator, auctioning-off the license is more profitable than fixed fee licensing, hence the outcome under exclusive auction will always prevail in this environment. A new technology is shelved prohibiting any further benefit of innovation to the firms and consumers. By looking into two other possible licensing schemes further, we find optimal licensing policy essentially is either pure royalty or two-part tariff and the inefficient firm will acquire it. In particular, for relatively small innovation royalty licensing is optimal, otherwise the optimal licensing scheme is two-part tariff. Now given a choice between selling the right and licensing, interestingly the innovator would optimally choose to sell the new technology to the efficient firm. It is to be noted that the efficient firm buys the right of the new technology, and in this case cannot not shelve it, but further licenses it to the inefficient firm.

However, the benefit of the new innovation goes on to the consumers in terms of lower price of the good (i.e., higher consumer surplus) occurs only under the optimal two-part tariff licensing. Consumer surplus remains unchanged to the pre-innovation level under the optimal pure royalty licensing; thus, consumers do not get any additional benefit after innovation. In case of selling the consumers do not get the benefit of the new innovation because of higher prices compared to pre-technology transfer and the consumers are better-off (at least weakly) under optimal licensing policies than selling.

The fourth chapter of this dissertation discovers the implications of asymmetric absorptive capacity on optimal licensing in a spatial competition with inelastic market demand. We characterize asymmetric absorptive capacity of the licensee firms in terms of reduction in their per unit cost due to the adoption of a new technology in their production process. Licensees can acquire a cost-reducing process innovation from an outside innovator and implement it in production as per their absorptive capacity level. Precisely this absorptive capacity is the ability of the firm to implement the innovation in production process. Depending upon various circumstances this ability may vary from firm to firm. Here we deviate from the existing literature and assume that the difference in absorptive capacity can be reflected as difference in cost reduction of the licensee firms (Chang et al., 2016).

There is a notion that efficient firm should always have a better absorptive capacity due to better skill than its competitor. But it is not always true. This kind of presumption may overlook a situation where an efficient firm has lower absorption of technological benefits than inefficient firm. We consider this kind asymmetry in absorptive capacity in this chapter. As the efficient firm has already achieved a high level of efficiency in technological front, additionally from a particular new technology there is a very little scope of improvement (absorption) for efficient firm, whereas inefficient firm can be benefitted much more from the same technology than the efficient firm. Therefore, efficient firm's cost reduction will be lower than that of inefficient firm. But the inefficient firm will be unable to leapfrog its competitor by adopting this cost-reducing innovation in production process.

Now first we discuss the results of optimal strategies of the innovator under each of the four available licensing schemes then discuss the overall optimal licensing scheme. We find that under fixed fee and auction policy innovator's optimal decision does not depend much on absorptive capacity. Whereas royalty and two-part tariff licensing policies are sensitive to the asymmetry in absorptive capacity of the licensee firms. In exclusive royalty licensing, for small to medium innovation size and lower cost difference between the firms, the inefficient firm can get the license from the innovator if the absorptive capacity of the efficient firm is very low, otherwise efficient firm will get the license. In case of higher efficiency level of the efficient firm, the licensor will always offer the exclusive royalty licensing to it irrespective of its absorptive capacity and innovation size. Between exclusive and non-exclusive royalty licensing, the innovator will choose to transfer the technology to both the firms either when innovation size is small, or innovation size and cost difference both are sufficiently large. For large innovation and low to medium cost difference between the licensee firms, innovators decision, on how many royalty license(s) to offer, is contingent upon the asymmetry in absorptive capacity. Similarly, non-trivial effect of asymmetric absorptive capacity is also found in exclusive and non-exclusive two-part tariff licensing. Although for optimal two-part tariff licensing, the significance of absorptive capacity varies with initial cost difference and innovation size. Finally, after comparing all the licensing schemes for all innovation size and cost difference, we obtain the fixed fee licensing to the efficient firm as the overall optimal licensing policy by the innovator. This robust finding is similar to the result of Stamatopoulos and Tauman (2009) paper, though they have considered only auction and fixed fee licensing.

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