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Choosing a licensee from heterogeneous rivals ☆

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ABSTRACT

We examine a firm that can license its production technology to a rival when firms are heterogeneous in production costs. We show that a complete technology transfer from one firm to another always increases joint profit under weakly concave demand when at least three firms remain in the industry. A jointly profitable transfer may reduce social welfare, although a jointly profitable transfer from the most efficient firm always increases welfare. We also consider two auction games under complete information: a standard first-price auction and a menu auction by Bernheim and Whinston (1986). With natural refinement of equilibria, we show that the resulting licensees are ordered by degree of efficiency: menu auction, simple auction, and joint-profit-maximizing licensees, in (weakly) descending order.

1. Introduction

We examine the licensing of production technology to a rival firm in a product market while relaxing the standard assumption that the rivals are homogeneous in their production technologies. Specifically, we assume that firms engage in Cournot competition and differ in their constant marginal costs of production, and that a technology transfer reduces the licensee's marginal cost to the level of the licensor.[1] We are interested in the direct effects of licensing; so, to abstract from any possible effects of collusion, we adopt the standard assumption in the literature that the production decisions of firms remain independent after transfer. We focus on a setting of complete information where a single licensor chooses an exclusive licensing partner from heterogeneous rivals, resulting in negative externalities of licensing to third-party firms.[2] We allow for the possibility of some third-party firms' shutting down after the transfer. We analyze first the gains in joint profit for the licensor and a licensee from licensing, and then the social welfare gains. Then, we consider two auction games to determine the licensee.

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[1] This implies that the size of the technology transfer varies with the licensee's efficiency (a less efficient rival receives a larger transfer).

[2] For example, Jehiel et al. (1996) and Jehiel and Moldovanu (2000) in examining a single transfer allow for the presence of private information at the auction stage. In this paper, we analyze auction methods in licensing, but we concentrate on the effects of (negative) externalities on auction outcomes.

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We begin, following the seminal work by Katz and Shapiro (1985), by analyzing whether such a transfer is always jointly profitable in a Cournot model.[3] Katz and Shapiro (1985) have shown that a complete technology transfer (where the licensee ends up with the same cost as the licensor) could reduce joint profit in a duopoly if the licensor has a near-monopoly position, because the transfer would reduce the licensor's near-monopoly profit. La Manna (1993) shows that when there are at least three firms in the market, a complete technology transfer to another firm is always joint profit improving if the demand is linear. We show that La Manna's result extends even if we allow for weakly concave demand. This is not a trivial exercise: we can neither explicitly calculate equilibrium nor use simple comparative static techniques, because a partial technology transfer can reduce joint profit.[4] Nevertheless, by introducing artificial markets as a device, we can show that a complete technology transfer is always jointly profitable if the demand curve is weakly concave and there are at least three firms in the market after the transfer (Theorem 1). That is, a complete transfer is always jointly profitable independent of its absolute size and the relative efficiency of the licensor.[5]

We then focus on which partner would maximize joint profit. At first glance, one might expect that this would be the most inefficient rival. We find that for weakly concave demand, neither the very inefficient nor the very efficient rival maximizes joint profit (Observation 1). With heterogeneous firms, the less efficient the licensee is, the greater the technology transfer will be. On the one hand, a technology transfer to a nearly equally efficient rival is very small and holds little benefit for the rival's profit, although such a transfer does not substantially reduce the market price and the licensor's profit. On the other hand, a technology transfer to a very inefficient firm benefits the licensee greatly but reduces the licensor's output and profit through a large reduction in the market price. Given that profit is convex in output, the licensor's profit reduction is large if the technology transfer is made to a very inefficient firm. Hence, the licensor is better off choosing a partner who is neither very efficient nor very inefficient.

Turning to the welfare effects of a technology transfer, it is known that making an inefficient firm slightly more efficient can actually reduce welfare (Lahiri and Ono, 1988). This implies that, as a corollary of Theorem 1, a jointly profitable transfer can reduce social welfare if there are more than two firms and if both the licensor and licensee are sufficiently similar and inefficient (Observation 2). In contrast, Katz and Shapiro (1985) find that profitable transfers never reduce welfare in a duopoly, which underlies the importance of considering non-duopoly markets. Katz and Shapiro (1986) and Sen and Tauman (2007) find that with homogeneous firms, licensing always raises welfare, so heterogeneity is important in evaluating the welfare implications of licensing. Although a transfer from a sufficiently inefficient licensor can reduce welfare, we show that if the most efficient firm makes a complete transfer then social welfare always increases under general demand (Theorem 2). However, a joint-profit-maximizing licensee is not necessarily a social-welfare-maximizing licensee, because the joint-profit-maximizing selection does not take into account the negative externalities imposed on other firms. Since technology transfers affect the rival firms' production decisions, including those of efficient rivals, total costs can be lower with a *more* efficient licensee. The conclusion for the policy maker whose goal is to maximize social welfare is that the most efficient firm should not be discouraged from licensing its technology to rivals; but technology transfers between marginal firms should bear some scrutiny.

Analyzing the joint-profit-maximizing licensee is a natural benchmark because it allows comparisons to Katz and Shapiro (1985) as well as work that examines fixed-fee setting licensing (e.g., Kamien and Tauman, 1986), and, as we will see, it is useful for later analysis.[6] However, when there is more than one rival, licensing to a joint-profit-maximizing partner does not exploit the entire possible gains for the licensor if the licensor can credibly threaten to find a new partner during negotiations. That is, competition among potential licensees over the technology transfer should be more profitable in the presence of externalities. Katz and Shapiro (1986), and others since,[7] have taken this into account when they examine an auction game in a homogeneous licensee environment by endogenizing the number of licenses. We follow their approach, but do so in a setting with heterogeneous firms, and ask which firm would win the right to use the technology and how much the licensor would collect from licensing. Specifically, we examine what happens when the most efficient firm (the natural analogy to homogeneous rivals) uses first-price auction mechanisms to sell the right to use its technology. In the first-price auction method (a simple auction game), which is a modification of the method used by Katz and Shapiro (1986) to take into account a heterogeneous firm environment, each potential licensee submits a bid and only the winner pays for the bid. Since there are many Nash equilibria and most of them are not very plausible, we refine the set of Nash equilibria by stipulating that non-licensees would not be worse off if the licensor happens to choose it: truthful Nash equilibrium (TNE in simple auction). Roughly speaking, this is akin to a "trembling-hand" refinement. In this refined set of Nash equilibria, the licensing fee can be pinned down, and the licensee is the partner that maximizes the joint profit of the licensee, the licensor, and any other potential rival.

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[3] This is also equivalent to fixed-fee licensing, examined by Kamien and Tauman (1986).

[4] See Creane and Konishi (2009b).

[5] The licensor does not have to be the most efficient firm for this result to hold.

[6] This can also be justified by noting that often a licensee is selected and then the two parties negotiate the contract. Since negotiating a technology transfer is not trivial, it may be too costly for the licensor to credibly threaten to license to a different firm, and so the fee should be determined as a function of the increase in their joint profit. In this case, the joint-profit-maximizing licensee should be selected by the licensor as the recipient of the technology.

[7] For a review of auctions in licensing, see Giebe and Wolfstetter (2008).