Economic Modelling 59 (2016) 278–284

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

How does a mixed ownership firm license a patent?☆

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ARTICLE INFO

Article history:
Received 26 April 2016
Received in revised form 25 July 2016
Accepted 25 July 2016
Available online xxxx

JEL classification:
L13
L40
L41

Keywords:
Cournot
Patent licensing
Mixed duopoly
Fixed fee
Royalty

ABSTRACT

This paper demonstrates that a cost disadvantaged innovator increasingly relies on licensing with a fixed fee as its public ownership share grows. Moreover, when the innovation is drastic, a cost disadvantaged innovator frequently licenses by fixed fee when it has a public share even as a fully private firm will never use a fixed fee. As the fixed fee improves welfare, these results suggest that the licensing method of a partial public firm helps correct the market failure of imperfect competition.

1. Introduction

This paper examines the incentives of a mixed ownership firm (one with partial public ownership) to license its cost reducing innovation to a competing private firm. It shows that a cost disadvantaged innovator increasingly relies on licensing with a fixed fee as its public ownership share grows. Moreover, when the innovation is drastic, a cost disadvantaged innovator frequently licenses by fixed fee when it has a public share even as a fully private firm will never use a fixed fee.

Licensing encourages patentees to distribute their innovation. Yet, the size of the rents earned and so the incentive to license ultimately depends on the form of the patent licensing. Moreover, the choices of how to license and to whom to license also influence the likelihood of collusion, the success of competition after the patent expires and the antitrust response (see Rockett, 1990 and Eswaran, 1994). As a consequence, it is not surprising that a huge literature in economics explores how firms license patents.

We make a novel demonstration that the choice of the innovator to license to its rival by fixed fee, royalty or two-part fee depends critically on its ownership structure. A fully private firm that enjoys equal efficiency with its rival prior to innovation, prefers to license to rivals by royalty (see, among others, Wang, 1998; Kamien and Tauman, 2002; Sen and Tauman, 2007).[1] That same fully private firm will use a fixed fee when suffering a large initial cost disadvantage, a two-part fee when suffering an intermediate initial cost disadvantage and a royalty when suffering a small initial cost disadvantage (Poddar and Sinha, 2010; Wang et al., 2013 and Fan et al., 2015).

We show that the fixed fee will be used for ever more modest initial cost disadvantages as the public share grows. Conversely, the range of cost disadvantages for which the two-part fee or royalty will be used shrinks with the public share of the innovator. Moreover, when the innovation is drastic, the mixed ownership innovator will frequently use a fixed fee which a private innovator never adopts. As the innovator's public share grows, it puts greater weight on social welfare and so relies more on the fixed fee which increases total output in the market by not disadvantaging the rival firm. It is the creation of this competitive disadvantage that motivates the licensing choice of the fully private firm and which loses salience as the firm has a public ownership share. The

☆ The authors thank Matthew McGinty for useful conversations when starting this paper and thank David A. Malueg, Zheng Wang and the referees for valuable comments on earlier drafts.

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[1] The finding that insiders prefer royalties has proven reasonably robust as it applies not only in a Cournot-Nash model but in a differentiated product framework (Wang, 2002), in a Hotelling "locate then price" model (Poddar and Sinha, 2004) and in a model with leadership (Filippini, 2005). Also, see Heywood and Ye (2011) and Lu and Poddar (2014) for models set in spatial contexts and Heywood et al. (2014) for a model with incomplete information on the cost reduction associated with adopting a patented innovation.

http://dx.doi.org/10.1016/j.econmod.2016.07.018
0264-9993/

finding that the mixed ownership innovator tends to adopt a fixed fee indicates that firms with partial public ownership not only produce more in response to non-competitive markets but that they license in such a way as to encourage the private rival to produce more as well. This is an additional potential social benefit to such firms.

Our assumption that the partially public firm could face a production cost disadvantage prior to innovation fits well with the literature on mixed oligopolies (see among others Pal, 1998; Wang and Mukherjee, 2012 and Gelves and Heywood, 2013). Matsumura and Matsushima (2004) provide theoretical support for such a cost disadvantage while Megginson and Netter (2001) provide supporting empirical evidence. Yet, while the results for a cost disadvantage are particularly interesting, we ultimately present results for a mixed ownership firm with any degree of cost disadvantage or cost advantage.

There are at least two views of the partially public firm that we study. First, there is the literal view of an enterprise with ownership that is divided between a government and private shareholders. Many countries in the world retain large sectors of publicly and partially publicly owned firms (Bortolotti et al., 2003). Indeed, Florio (2014) presents evidence that the extent of public ownership in both goods producing and service industries actually rose over the past decade among OECD countries. Moreover, mixed ownership of firms has been identified as "more widespread globally than one might think" and as potentially "an optimal ownership structure from a welfare perspective" (OECD, 2012, p. 5) since it mitigates the inefficiencies of government ownership while allowing the pursuit of public welfare. Thus, Volkswagen, Airbus, Deutsche Telekom (T-mobile) and many companies in a host of European countries have historically had partial governmental ownership. These firms hold many patents with Deutsch Telekom filing a new patent every three days and Airbus among the 100 firms filing the most patents in the US.[2] This raises the interesting theoretical question of how partial government ownership might influence the licensing of patents.

The transition economy in China provides a particularly important case study in the evolution of mixed ownership firms and patent licensing. Initially, technology was imported from foreign markets into state owned enterprises (Kang and Yang, 1991) but this was soon supplemented by technology acquired in the domestic Chinese market through patent licenses (Liu and White, 1997). Hu and Jefferson (2004) show that state owned and partially state owned companies in China increasingly engage in their own R&D and earn significant returns on that R&D. Zhang et al. (2003) demonstrate that partially state owned companies in China have both greater R&D and productive efficiency than fully state owned enterprises. They argue that these mixed ownership firms were created to attract capital and improve firm performance through monitoring by shareholders while retaining the ability to pursue governmental objectives (Zhang et al., 2003, p. 447).[3] More recently, Li (2010) confirms that state owned and partially state owned enterprises continue to represent a large share of domestic research and development and that they now license their technology not only domestically but to foreign firms operating outside of China (Ye, 2012).[4] Thus, even if private firms are more efficient in research on average (Zhang et al., 2003), mixed ownership firms do substantial R&D, come up with discoveries and license them. Our paper fills a void by addressing just such situations.

A second view of the mixed ownership firm we study recognizes that many innovations often reflect a substantial degree of governmental involvement and that this involvement may influence licensing. A large literature isolates the process and product innovations that would not have taken place without public research (Mansfield, 1991; Breise and Stahl, 1999; Salter and Martin, 2001). This public research can be done by governmental labs, universities or by private firms with governmental funds or by combinations of all three.[5] The incentives surely vary with this variety but profit maximization should not be taken for granted. Thus, the national laboratories of India which were traditionally dependent entirely on public funding have increasingly been reliant on licensing revenue associated with their growing portfolio of US patents (Choudhury and Khanna, 2009). More immediate to our research, government labs and universities have increasingly been involved in R&D collaborations with private firms (Kong, 2014). Economists have studied these networks with Zikos (2010) developing a model of endogenous network formation in which a publically owned collaborator is found to be instrumental in overcoming the potential conflict between individual and collective incentives for R&D collaboration. Kong (2014) extends the network model to involve universities. A critical point is that the objective of licensing in circumstances of governmental involvement may not be the same as that of a private firm. As a dramatic example, Canadian government scientists were critical in developing what is seen as among the most successful Ebola virus vaccines. The government and the private firm manufacturing and marketing the drug have been involved in an intellectual property dispute in which the government may revoke the firm's patent under a compassionate use clause citing too little progress in making the vaccine widely available in light of the African crisis (Attaran and Nickerson, 2014). While far from a typical case, this suggests that the objectives of governmental and private partners need not be the same. The mixed ownership firm we model pursues a weighted objective function of private profit and public welfare and so can be seen as one way of incorporating these different objectives.

Thus, one might anticipate that public and mixed ownership firms license differently from fully private, profit maximizing firms. Indeed, surveys by Jensen and Thursby (1998, 2001) and Thursby et al. (2001) demonstrate that university technology managers balance complex faculty and administrative objectives when licensing technologies and that profit maximization is almost never their objective. Moreover, they find that an extremely high share of university agreements, 84%, include an upfront fee (Jensen and Thursby, 1998). This share appears to exceed that in private sector agreements (see Rostoker, 1984, and Macho-Stadler et al., 1996).

Despite the potential importance of patent licensing by public and mixed ownership firms, it has received only modest theoretical consideration. There exists a strand of literature that examines R&D rivalry in mixed oligopolies. It frequently reaches the conclusion that such oligopolies invest more in R&D than otherwise equal private markets (Gil-Molto and Poyago-Theotoky, 2008; Ishibashi and Matsumura, 2006; Gil-Molto et al., 2011) yet the form of licensing is not at issue in these models. Chen et al. (2014) consider licensing in a domestic mixed oligopoly but with only the private firm as an innovator. Ye (2012) provides an exception that focuses on the form of licensing by a fully public firm licensing technology to a private foreign firm. The public firm maximizes domestic welfare and so weighs lower costs for its rival (which helps generate additional sales and consumer surplus) against any profit gains its rival repatriates out of the country. The

[2] See Intellectual Property Owners Association (2014, June 10), *2013 top patent owners,* retrieved from http://www.ipo.org/index.php/publications/top-300-patent-owners/ and Telekom. (2014, March 25), *A new patent every three days*, retrieved from http://www.telekom.com/company/219848.

[3] It may be thought that the issue is simply one of the majority of ownership but both the theoretical and empirical literature shows that partial private ownership brings about changes even when far short of majority status. Thus, Gupta (2005) and Bhaskar et al. (2006) find that even modest privatization creates managerial discipline creating "competition" that increases efficiency and profitability.

[4] Sinopec alone earned 1.5 billion RMB from licensing technology in 2008 (Ye, 2012, p. 1192).

[5] The early 1980s saw a sea change in US federal government policy toward public research. Prior to this period, public research was to be left in the public domain but legislation and executive directives at that time have resulted in a system that promotes patenting federally-sponsored inventions that occur in government, university, or private firm settings. The objectives of the change included increasing collaboration and the number of inventions that made it to market while improving the relative position of US based firms (see Eisenberg, 1996).