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# Exclusive versus non-exclusive licensing strategies and moral hazard

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**Abstract**

An upstream firm can license its innovation to downstream firms that have to exert further development effort. There are situations in which *more* licenses are sold if effort is a hidden action. Moral hazard may thus *increase* the probability that the product will be developed.


*Keywords:* Licenses; Innovation; Monopoly; Private information

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## 1. Introduction

Consider an upstream monopolist who has invented a new technology. The innovator is specialized on basic research and is not able to develop a product based on the new technology. There are two firms in the downstream market that have the abilities to potentially develop the new product, provided they get a license from the upstream monopolist. The probability that a downstream firm successfully develops the product depends on its development effort, which might be a hidden action. Should the innovator sell an exclusive license to one firm or should both firms get licenses? In the latter case, both firms might be successful in developing the product, so that competition at the downstream market would lead to smaller profits.

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Following Innes (1990), it is assumed that all firms are risk-neutral but subject to limited liability. It will turn out that there are circumstances under which the upstream monopolist sells licenses to *both* downstream firms when their effort decisions are hidden, while under symmetric information she would have sold an exclusive license to *one* firm only. Hence, the fact that effort is unobservable can *increase* the probability that the final product will ultimately be developed.

This finding is interesting, because usually the presence of asymmetric information tends to reduce the quantities traded.[1] A related result has been obtained in Schmitz (2002) in an adverse selection model, where a downstream firm had precontractual private information about the monopoly profit that it could make on the downstream market. In contrast, in the present paper the firms' downstream profits are verifiable, while their effort decisions may be hidden.

From a methodological perspective, the present paper illustrates the close relationship between adverse selection and moral hazard models. Roughly speaking, adverse selection problems where an agent has private information about his costs can often be solved if one derives the optimal allocation in the case of symmetric information and then replaces the true costs by the so-called "virtual costs," which are adjusted upwards (see e.g. Laffont and Martimort, ch. 3). It is illustrated here that the concept of "virtual costs" can also be fruitfully applied in moral hazard models.

There is by now a large literature on licensing.[2] Katz and Shapiro (1986) have analyzed the profit-maximizing number of licenses issued by an innovator when there is symmetric information and the licensees do not have to exert effort in order to develop a final product. In fact, most papers in this literature do not consider development efforts subsequent to basic technology licensing. An important exception is Bhattacharya, Glazer, and Sappington (1992), where firms exert unobservable development efforts after innovative knowledge has been licensed to them. However, the questions studied there are quite different from the present analysis, which is focused on the number of licenses that maximizes the innovator's expected profit.

Finally, it should be noted that the present paper is also related to the literature on tournaments (see Lazear and Rosen, 1981).[3] When there is moral hazard, the principal may prefer a tournament between two agents exerting low effort (even if she preferred employing a single hard-working agent in the absence of moral hazard), because her agency costs would be higher in the case of an exclusive agent who must be induced to work hard.

## 2. The model

Consider an innovator (principal) who can license a patent to two downstream firms (agents). An agent who gets a license can exert effort in order to develop a marketable final product. The development effort will lead to a success with probability $p_H$ if the agent works hard and with probability $p_L \in (0; p_H)$ if he

[1] See e.g. Laffont and Martimort (2002, ch. 5), who point out that the rent-extraction versus incentives trade-off in the case of risk-neutrality and limited liability considered here usually leads to a reduction of the volume of trade.

[2] See Kamien and Tauman's (1986) and Katz and Shapiro's (1986) pioneering work and see the many extensions discussed in the surveys by Reinganum (1989) and Kamien (1992). In a more recent contribution, Aoki and Tauman (2001) show that the presence of spillovers can increase the number of licenses sold. See also Bessen (2005), who analyzes the impact of patents on the market for licenses.

[3] See also Bhattacharya and Guasch (1988), who study tournaments in the presence of limited liability, and Roy Chowdhury (2005) and Mukherjee (2006), who analyze effects of tournaments in the context of R&D competition with spillovers.