Pricing Licensing of Technology

Conventional pricing theory not applicable to licensing pricing; an examination of workable concepts, implications

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Price is a familiar concept. Although one does not normally refer to the "price" of a license as such, the term is readily understood to mean the value of the consideration to be paid by the licensee. The consideration can take a variety of forms, the commonest being a royalty payment of some kind, but in all cases it can at least be represented as a specific payment for a benefit received.* In this respect the price of a license does not differ conceptually from any other transaction price.

The concept merits examination, however, for the circumstances of licensing are very different from those of most other market activities. The licensing market bears little resemblance to other markets and it would be surprising indeed if the concept of a license price could be properly examined in the context of conventional price theory. In fact, conventional price theory affords little insight into the significance of a license price, how it is determined, or how it may affect the utility of that which is licensed.

The purpose of this paper is to examine the concept of price as it relates to the licensing of technology, and to examine the implications and consequences of a license price.

THE UTILITY OF A LICENSE

The utility of a license may be defined simply as the benefit for which the licensee is prepared to pay a purchase price. The definition is consistent with the meaning of "utility" as that term is used in other economics contexts. In the case of a license in a market-based economy, however, the benefit is simply the potential profit from the licensed production, that is to say, revenue from sales less cost. Thus,

$$Utility = Revenue - Cost$$

The cost may be simply a production cost. More generally, however, it will include an opportunity cost corresponding to the loss of profit which might have been realized from alternative production, since in order to exploit the license the licensee must commit resources which could have been employed in some other way. In the alternative production the licensee might still have made a profit and this must be taken into account in an evaluation of the license. In other words, the benefit from a license must be measured against any benefit that would have been realized in any case.

Now the utility of a particular license will depend upon the level of production set by the licensee, which in turn may depend not only upon the licensee's cost schedule but also upon the way in which the license price is formulated. The licensee's net profit is given by

$$Net\ Profit = Revenue - Cost - License\ Price$$

since the license price represents part of the licensee's total cost. If this function is maximized by selecting an optimal level of production, the latter will depend not only upon the manner in which revenue and cost are related to output but also the manner in which license price is related to output. As we shall note later, in practice the formulation of the license price may affect the utility of the license. For a given price formulation, however, the utility of the license is simply:

$$R_m - C_m$$

R_m and C_m are, respectively, the revenue and cost corresponding to the licensee's most profitable level of production.

It is important to note that, since the cost C_m includes an opportunity cost, the utility of the license is a direct measure of the competitive superiority of the licensed technology with respect to available alternatives, and does not depend upon existing market advantage. Thus, the gross profit from the licensed production may be attributable in some cases not only to the particular technology which is licensed but also in part to the exploitation of market power which the licensee could have exploited in any event. However, by taking into account the opportunity cost represented by loss of profit from alternative production, and compounding this cost with the actual production cost, we can directly relate the profitability of the licensed production to the competitive superiority of the technology which is licensed. This is a most important consideration, for it enables us to ignore existing market imperfections even though in the real world most producers are imperfect competitors.

Related Consideration

A related consideration is that the profit from a licensed production, which is apportioned between the licensor and the licensee, represents an income which

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*In this paper all related revenues, costs and payments will be considered in terms of their "present values" as of a given date, for example the date of the license.

would not be available if there were no license. The profit as such represents a producers' surplus not a consumers' surplus, admittedly, but the producers' surplus is achieved without imposing any new cost on consumers. In other words, the profit from the licensed production represents a net addition to the wealth of the economy as a whole. As to whether the net addition to the general wealth would be greater were the technology not a proprietary resource in the first place, that is an entirely different question which we shall examine subsequently; for the present it is sufficient to note that if a technology is appropriated, its social usefulness depends on the extent to which it is profitably exploited.

It follows from these considerations that the utility of a license, as defined above, corresponds directly to the utility of the technology which is licensed.

PROPRIETARY TECHNOLOGY

A prerequisite of any licensing situation is that the licensor should have proprietary control over the technology which is licensed. In order to gain access to the technology the licensee must pay a price which, so far as it represents a cost to the licensee, must somehow be passed on to the consumer. It is therefore a matter of importance to know how, if at all, the price of a license may affect the utility of the technology from the standpoint of the final consumer. In a case where the technology is fully appropriated, the greatest benefit will obviously be realized if it is exploited to the most profitable extent, but this does not answer the question of whether the proprietorship itself serves any useful social purpose, for one might expect any loss of producers' surplus from reduced proprietory control to be more than offset by a gain in consumers' surplus.

However, a consumers' surplus at best represents no more than an increased demand for consumers' products. It does not represent an investment resource and cannot afford the means by which the increased consumption demand can be met. An increase in consumption demand can only be met by an increase in productive capacity, the prerequisite of which is producers' surplus from which the appropriate investment may be made, and which may thus stimulate consumption demand through the generation of new income. A consumers' surplus as such can serve no useful purpose whatsoever.

This is really a digression from the main discussion, which is not intended as a defense of the industrial property system as such. The point is nevertheless relevant and of considerable importance, for there are many critics of the industrial property system who, purely on the basis of conventional microeconomic considerations, look upon the profits from industrial property as being the product of an artificial scarcity rather than the product of a productive resource, namely the technology whose appropriation does not deprive the public of anything which it already had but is necessary in order that the technology may yield benefits to the public.

In a two-party situation a negotiated license price must obviously lie between the lowest price the licensor is willing to accept and the highest price the licensee is willing to pay. In principle these prices are quite determinate, each being the limiting price at which the respective party would not expect to lose by the transaction. Thus, the licensor must consider the cost of relinquishing his exclusive position while the licensee must consider the advantage to be gained by taking a license, having regard to alternative opportunities. In practice, of course, neither party will have all the market information necessary for a precise determination, and consequently the limiting prices will generally be different from their theoretical values.

Indeed, for lack of information the respective limiting prices might be such as to prevent the transaction of a license which otherwise could have turned out to be satisfactory to both parties. For the present, however, we shall ignore the problem of uncertainty and assume that the limiting prices do in fact correspond to their theoretical values. Thus, we shall consider the ideal situation in which the parties' decision are those which they would make if fully informed of the relevant market conditions.

In general, the licensor's minimum price and the licensee's maximum price will be different. Assuming that the latter is higher than the former, since otherwise a license would not be transacted, there is a finite range of price over which the transaction of a license would be beneficial to both parties. However, if both parties are profit maximizers, neither party will wish to concede to the other more than is necessary, so it is by no means clear where in the permissible price range the negotiated transaction price should lie. The final transaction price, in a strictly two-party system, is apparently indeterminate. In this case the licensor is faced with a monopsonic situation and must make the best of it.

Changed Situation

The situation is entirely changed if there are more than one potential licensee who are competitors in the same market; in this case competition for the license will affect the determination of the license price. This can best be understood by considering the special case in which two firms are contending for an exclusive license. The two firms will generally have different production schedules and so the most profitable level of production will be different for each firm. Let us suppose that the revenue of the first firm, operating at the optimum level of production would be R_1 corresponding to a cost C_1. Let the corresponding revenue and cost of the second firm be R_2 and C_2. Furthermore, let us suppose that the licensor's minimum price in a two-party situation would be P_0, where:

$$P_0 < R_1 - C_1 < R_2 - C_2$$

Clearly, it will be more profitable for the licensor to grant a license than not to do so. Neither of the contending firms can afford to decline a license at the licensor's minimum price P_0, but the second contending firm cannot afford to decline a license at a price $R_1 - C_1$, for it would still be profitable for the first firm to accept a license at a price which is only marginally lower. In this case the price $R_1 - C_1$ must become the licensor's minimum price, for it represents the licensor's opportunity cost.

On the other hand, since the first firm cannot bid a price higher than $R_1 - C_1$ there is no inducement for the second firm to do so. Accordingly, the price $R_1 - C_1$ must become the natural license price. One can obviously extend this argument to a situation involving any number of contending firms and conclude that, in general, the natural price of an exclusive license will be the limiting price of the second highest bidder, the license going to the highest bidder at that price.

Trivial as the argument might appear, it leads to the important conclusion that an exclusive license will be granted to the firm most eligible to operate the exclusive license and that the license price will ensure maximum license utility. This, of course, is assuming that the firms concerned are profit maximizers and are in possession of all the relevant market information.

THE GENERAL LICENSE

Actually, an exclusive license may be regarded as a special case, the more general situation being that in which a license is available to all firms who are prepared to pay the license price set by the licensor. In the case of a general license involving n licensees whose respective optimal revenues are $R_1, R_2 \ldots R_n$ and whose respective optimal costs are $C_1, C_2 \ldots C_n$, the utility of the licenses is:

$$\sum_{K=1}^{K=n} (R_K - C_K)$$

The licensor's profit, or license income, is:

$$\sum_{K=1}^{K=n} P_K$$

where P_k is the price paid by the kth licensee.

The utility of the licenses in a general licensing situation, therefore, depends on the number of licensees, which in turn depends on the license price set by the licensor. In order to be eligible for a license a firm must expect to receive a surplus of revenue over cost which is at least sufficient to cover the license payment. Thus, assuming that the license is available to all eligible firms, and arranging the firms in order so that:

$$R_1 - C_1 > R_2 - C_2 > \cdots R_n - C_n$$

then the number of licensees is determined by the price P_n to the nth licensee, which lies in the range

$$R_n - C_n > P_n > R_{n+1} - C_{n+1}$$

Even a general license, therefore, has a degree of exclusivity.

It is important to note that the production schedules of the various licensees are modified by competition, so that each licensee is faced with a competition product price, a limited share of the market at that price, and a limited share of the available resources for his production. Each licensee is therefore faced with less revenue, and usually a higher unit cost, than in an exclusive situation.

Since each licensee will attempt to maximize his net profit (i.e. profit remaining after the license payment) the modification of his production schedule by competition from other licensees will adversely affect the utility of his license and so reduce the price which he will find acceptable. If the licensor is to maximize the license income, therefore, he must set a price which will not admit more licensees than the market can support having regard to the effects of competition on their respective production schedules. Depending on the nature of the market the number of licensees may be small, and in the limiting case there may be only one licensee who, if the market is especially sensitive to competition, may require an assurance that his right to technology will be exclusive.

The granting of an exclusive license may therefore be to the licensor's advantage in special circumstances.

PROFIT MAXIMIZATION

Since the utility of a general license depends upon the number of licensees, which in turn depends on the license price, and also on the way in which the respective production schedules are affected by competition, it is not immediately obvious how the utility of the license may be related to the price set by the licensor. In this connection it is important to bear in mind that the licensor's aim is to maximize the license income, while the aim of each licensee is to maximize net profit; it is not the aim of any of the firms involved to maximize license utility as such.

In practice an ideal licensing arrangement is precluded since businessmen must make their decisions on the basis of incomplete information. Nevertheless, the concept of an ideal licensing arrangement resulting from decisions made on the basis of perfect information is a useful tool and, an aid to understanding how the price mechanism of the licensng market works.

Actually, it is a simple matter to show that the aggregate utility of a general license will be maximized if the license income is maximized, assuming that the licensees are also profit maximizers. (See Appendix). What this means, stated simply, is that the market for a proprietary technology is best served by a limited number of firms selected on the basis of eligibility. If the market were opened up to every firm it might not be served at all. If the number of firms is too limited, however, the available productive capacity will not be sufficient to satisfy the market requirements.

In practice, in order to ensure that the technology will be utilized to the greatest extent, it is necessary to make a trade-off between productive efficiency, represented by a minimal number of elite firms, and productive capacity, represented by a larger number of firms. The optimal trade-off is determined automatically by the price mechanism of the licensing market, being determined by the license price which maximizes license income and at the same time restricts the license to the optimal number of licensees.

The obvious conclusion to be drawn from this is that consumers are not well served by laws which restrict the freedom of firms to negotiate profit maximizing license arrangements by prohibiting seemingly anticompetitive conditions which are in fact aimed at profit maximization.*

*This topic is discussed at some length by W. S. Bowman in his book "Patent and Antitrust Law", Univ. of Chicago Press, 1975.

LICENSE PRICE STRUCTURE

As previously noted, the consideration for a license can take a variety of forms. From the foregoing considerations it will appear that the utility of a license should not be affected by the form of the consideration, whether it be a specified payment, a royalty based on sales, or a combination of the two, since the license utility is in any case maximized if the license income is maximized. However, this is assuming that the license is equally available to all eligible firms and that those firms have all the market information they need to make an accurate evaluation of the license. In practice these conditions are not met.

Owing to a general lack of information about available license opportunities there are usually fewer prospective licensees than there might otherwise be. Furthermore, owing to the impossibility of knowing what the future might hold in store, there is a considerable risk in making a future commitment on the basis of a present evaluation. For these reasons different license price have their respective advantages and disadvantages.

On the one hand, if there are too few prospective licensees, a one-time payment has the advantage that it does not represent an ongoing cost and so does not affect a licensee's production schedule; it does, however, have the decided disadvantage of presenting the licensee with a substantial risk when he cannot know what his surplus will be. A one-time payment is hardly appropriate where the licensee is not in a position to make such a commitment or where the relevant market is highly competitive. On the other hand, a royalty payment has the advantage that it minimizes the licensee's risk. It does, however, represent an ongoing cost to the licensee and so affect the licensee's production schedule with the result that the surplus from the licensee's production is less than it would otherwise be. Accordingly, if the number of licensees is less than optimal, the effect of a royalty is to reduce the utility of the general license to something less than optimal.

Compromise

In practice many license price structures effect a compromise. The most obvious example of such a compromise is the so-called "minimum royalty" requirement which often features in exclusive licenses. Although this requirement is usually made to reduce the licensor's risk, and can quite properly be made where it would not present the licensee with an undue risk, its effect is to bolster the utility of the license by transferring part of the licensee's ongoing cost to a front-end payment. A less obvious example of such a compromise is the case in which the royalty rate is reduced for sales beyond a certain level.

In this case the license price is structured as an ongoing cost to the licensee, but the marginal ongoing cost diminishes as the marginal revenue diminishes. With such an arrangement it is possible in principle to structure the price so that the licensee's optimal level of production is higher than would be the case with a flat royalty rate. A special case of the latter arrangement would be a "maximum-royalty" provision by which the licensee would not be required to pay any royalty on sales beyond a specified level.

CONCLUSION

Proprietary technology, although a marketable commodity, differs fundamentally in character from practically all other commodities. The difference is more subtle than one might suppose. It is not that the market in technology is merely a consequence of the industrial property system, for all markets are but a consequence of proprietary rights. Nor is it that technology, unlike other products, is potentially unlimited in supply, for the usefulness of a given technology is strictly limited according to the availability of other resources to which it may be applied. Contrary to what is generally supposed, technology is not a "free good". Thus, the more obvious characteristics of technology, considered as an economic good, are those which are common to all economic goods. The one distinguishing characteristic, however, is that it affords the means to create an economic surplus. This characteristic takes technology entirely outside the compass of conventional price theory, which takes no account of surplus resulting from technological change.

According to the conventional theory an economic surplus is typified by profit realized through monopoly pricing, which is not a real surplus at all since it is necessarily associated with the inefficient use of resources. According to the theory the ideal market condition is pure competition wherein no producer can receive a surplus. But obviously, such a theory can tell us nothing about the economic significance of a new technology whose only utility lies in its capability of creating a surplus through the re-employment of resources released from previous employment commitments.

It is important to note that the surplus from new technology is wholly attributable to the more efficient utilization of resources and has nothing to do with monopoly pricing. The industrial property right is an exclusive right, of course, but so is any property right. It is also true that the proprietor of a useful technology can make a profit, but this represents actual earnings and is not a mere cost transfer of the type normally associated with monopolistic market structures.

It follows that the economic surplus associated with a proprietary technology is a direct measure of the usefulness of the technology. It equally follows that, if technology is marketed, the ideal market condition is not that which one would expect from purely microeconomic considerations, but rather is the one that will permit a price structure that will maximize the resultant surplus. Since this can only be a producers' surplus, then if all firms are profit maximizers and have equal access to the market, the ideal market condition must be represented by the price structure which selects licensees so as to maximize the licensor's profit. In this case the licensees' aggregate profit will also be maximized and, more important from the standpoint of the general welfare, the greatest benefits for the economy as a whole will be realized.

APPENDIX

The General License

Let us consider a general license involving n licensees whose respective revenues are $R_1, R_2 \ldots R_n$, whose respective costs are $C_1, C_2 \ldots C_n$, and whose respective license payments are $P_1, P_2 \ldots P_n$. The utility of the license is represented by

$$\sum_{K=1}^{K_n} R_K - \sum_{K=1}^{K_n} C_K$$

which corresponds to license income plus aggregate net profit.

The license income is given by

$$\sum_{K=1}^{K_n} P_K$$

and since this depends on the number of licensees as well as their respective outputs, the license income will be maximized if

$$\sum_{K=1}^{K_n} \frac{\partial P_K}{\partial Q_K} . dQ_K + \sum_{K=1}^{K_n} \frac{\partial P_n}{\partial n} dn = 0 \text{----------}(i)$$

The net profit of the kth licensee is

$$R_K - C_K - P_K$$

corresponding to a production level Q_k, but since we must take into account the effect of competition on the licensees' production schedules, the aggregate net profit will be maximized when

$$\sum_{K=1}^{K_n} \frac{\partial}{\partial Q_K}(R_K - C_K - P_K) dQ_K + \frac{\partial}{\partial n} \sum_{K=1}^{K_n} (R_K - C_K - P_K) dn = 0$$

$$\text{i.e. } \sum_{K=1}^{K_n} \left(\frac{\partial R_K}{\partial Q_K} - \frac{\partial C_K}{\partial Q_K} - \frac{\partial P_K}{\partial Q_K} \right) dQ_K + \sum_{K=1}^{K_n} \left(\frac{\partial R_K}{\partial n} - \frac{\partial C_K}{\partial n} - \frac{\partial P_K}{\partial n} \right) dn$$
$$+ (R_n - C_n - P_n) = 0$$

But in an ideal situation the nth license is a marginal licensee, and so we have

$$R_n - C_n - P_n = 0$$

and therefore by subtraction

$$\sum_{K=1}^{K_n} \left(\frac{\partial R_K}{\partial Q_K} - \frac{\partial C_K}{\partial Q_K} - \frac{\partial P_K}{\partial Q_K} \right) dQ_K + \sum_{K=1}^{K_n} \left(\frac{\partial R_K}{\partial n} - \frac{\partial C_K}{\partial n} - \frac{\partial P_K}{\partial n} \right) dn = 0 \text{ ----}(ii)$$

combining (i) and (ii) we find

$$\sum_{K=1}^{K_n} \left(\frac{\partial R_K}{\partial Q_K} - \frac{\partial C_K}{\partial Q_K} \right) dQ_K + \sum_{K=1}^{K_n} \left(\frac{\partial R_K}{\partial n} - \frac{\partial C_K}{\partial n} \right) dn = 0$$

This is clearly the condition in which the utility of the license is maximized, and therefore the condition in which the technology will be exploited to the greatest advantage of the economy as a whole.