

14 Economic Analysis of Synergy Effect of Multilateral Protection by Different Industrial Property Rights^(*)

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Trademarks convey information about the quality and function of products to consumers. On the other hand, patents sometimes convey information about products and firms to consumers and the form of utilization of patents as a tool (signal) is actually observed. However, "patent signal" has not been made subject to analysis much in economics. In this study, we take up the situation where one product is protected multilaterally by different industrial property rights (trademark right and patent right), and analyze the effect of utilization of patent signals, in addition to trademarks, on the profits of firms from the perspective of economics. Different factors, such as the brand power of a firm established by a trademark, difference in the degree of a patented invention's contribution to the quality of products, and difference in industry, are considered to be affecting the effect of multilateral protection of profits of firms. In this study, we classified these factors into three categories, "firm's characteristics," "product characteristics," and "environmental characteristics," and clarified the mechanism whereby each factor increases the profits of firms from patent signals.

I Introduction

Trademarks, such as firm names and brand logos, are attached to products and their packages. Those trademarks convey information about the quality of products to consumers. For example, consumers may wish to purchase "AQUOS," etc., not other flat-screen televisions, and may wish to purchase "Prius," etc., not other automobiles. This is probably because consumers guess, based on trademarks, that the quality of products is high.

However, trademarks *indirectly* convey information. This is because whether the quality of a product is "truly" high and whether a consumer is sufficiently satisfied with the product remain unclear to the consumer until he/she actually consumes (uses) the product. Indirect communication like this is called *signal* in economics.

Trademarks do not exclusively work/serve as signals. For example, many patented inventions are used in electric appliances, such as digital cameras. When the patented inventions are essential to the function and characteristics of the product, a marking to the effect that "a patent has been obtained" and a statement of a patent number can directly show the high quality and high performance of the product. On the other hand,

even if no patented invention is directly related to the function and performance of the relevant product, consumers may guess that the product is high-quality and high-performance. In the latter case, patent exactly conveys the quality of the product as a signal.

Although Silverberg and Verspagen (2007) pointed out that many registered patents did not have high value as inventions, patents may have value as signals from the perspective of an appealing effect to general consumers. However, compared to trademarks, the effect of patent signals is not very obvious. That is, it is not clear whether patent signals increases the profits of firms. The reason is that firms have already generally utilized trademark signals.

In reality, a firm will use patent as a signal together with a trademark that it already possesses. If both a trademark and a patent convey similar information as signals, the patent as a signal may be meaningless. Still more, this is so especially if utilization of a patent signal causes additional costs.

In this study, we argue the following three points about the impact of patent signals on the profits of firms.

- Where a firm has already been using a trademark signal, is the firm always able to

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gain additional profits from a patent signal?

- What are the characteristics of firms that are able to gain additional profits from patent signals?
- Under what conditions are firms able to gain additional profits from patent signals?

In the sense that this study examines the situation where a patent signal and a trademark signal are concurrently used, it argues over the relationship between two different industrial property rights. This relationship is a point that has been hardly argued in economics, and is the new point of view of this study.

The conclusion is as follows. First, although both trademarks and patents serve as indicators of the ability of firms, firms are able to gain profits from patent signals, because the source of signals differs between trademarks and patents. Secondly, difference in the ability of firms has a great impact on the success of inventions and the quality of products, and patent signals increase the profits of firms more for firms whose reputation established by trademarks is worse. Thirdly, where a patented invention significantly contributes to the quality of the relevant product or where not many license agreements are concluded between firms, patent signals increase the profits of firms.

The composition of Chapters that follow is as follows. Chapters II and III provide an overview of the way of thinking of trademarks and patents from the perspective of economics. Chapter IV introduces a framework for analyzing the benefits of patent signals in economics. Chapters V and VI examine the profits of firms from patent signals. Chapter VII analyzes the impact of license agreements on the profits of firms from patent signals. Chapter VIII is the conclusion.

II Trademarks in Economics

Under the trademark system, a trademark is provided a source representing function and self-distinguishing function if it is protected by law. Hereby, business confidence of the user of the trademark is improved, and consumers' interests are also protected. That is, the trademark system is one that increases the benefits of both firms and consumers. This is consistent with economics or the view of trademarks that is leading in law and economics.

According to Landes and Posner (1987), firms have a motive to maintain the high quality of products after obtaining trademarks. The reason thereof is explained as follows. If the quality of products deteriorates after a trademark is obtained

for the product, consumers will consider the value of the products, to which the trademark is attached, to be as low as that of "non-brand" products. This will lead investment costs which the relevant firm has spent to obtain the trademark to be wasted. If things go further wrong, a bad reputation arising from deterioration in the quality of the products may cause losses to the firm. In order to avoid such situation, firms wish to keep the quality of products to which a trademark is attached above a certain level.

Moreover, if consumers know that a trademark has the quality assurance function, they can also guess, for products they have never purchased, that the quality of the products is high. In this sense, it can be said that trademarks communicate to consumers the information that "this product is of high quality." In other words, trademarks work/serve as the signals of the quality of products. In this regard, trademarks as the signals of quality are similar to advertising, such as TV commercials.

III Patents in Economics

Under the current patent system, inventors are granted the exclusive right (protection of inventions) for a certain period in exchange for the publication of their technological inventions (utilization of inventions). Inventors granted the exclusive right can exclusively sell products to make great profits by using the relevant technology. Economic benefits of "protection of inventions" are generally considered to serve as a significant incentive for people making intellectual creations. On the other hand, as technological inventions are published, people other than inventors can develop further new technology by the use of the published new inventions. As a result of that, technological progress and industrial development are promoted.

Even if the original purposes of the patent system are "protection of inventions" and "utilization of inventions," for firms, there is likely a method of utilizing patents, that is, utilizing "patents as signals." For example, if a patentee places the wording "a patent has been obtained" or a patent number on the package of his/her products when selling products using his/her invention, consumers may guess the quality of the products therefrom. In this case, the patent indirectly communicates information about the quality of the products to consumers, and the patent can be said to be working/serving as a signal. Then, are patents actually being utilized by firms as signals?

The Institute of Intellectual Property conducted a questionnaire survey targeting firms within Japan on whether they are utilizing patents as signals (Institute of Intellectual Property (2010) “Utilization of Intellectual Property Rights in New Business Environment”).

According to the results of this questionnaire survey, firms which cited “utilization of patent rights and patent applications as technology benchmarks” firstly or secondly as forms of utilization that make a high contribution to business accounted for 31.9%. Therefore, serving as signals can be said to be one of the roles of patent rights that are sufficiently recognized in the actual industry.

The point that patents work/serve as signals to consumers can also be seen from the text of law. Section 292 of the U.S. patent law imposes a fine not more than 500 dollars on the false marking of a patent with the intent of deceiving the public for individual violations. The Japanese Patent Act also prohibits the false marking of a patent (Article 188), and a person who fails to comply is to be punished by imprisonment with work for a term not exceeding three years or a fine not exceeding 3,000,000 yen (Article 198). Furthermore, dual liability is set for the false marking of a patent, and in addition to the offender, the juridical person is to be punished by a fine not exceeding 100 million yen (Article 201). If patents do not at all work/serve as signals, penal provisions like this are probably completely unnecessary.

Horstmann et al. (1985) pointed out the possibility that the act of obtaining a patent itself will communicate the market information the firm has to other competing firms. However, there has been no study, which analyzes patents’ working/serving as signals to consumers, in the field of economics and the field of law and economics. Therefore, there arises the question of whether patents as signals actually provide benefits to firms or in what situations benefits are provided. In order to answer these questions, the framework of economics for analyzing patent signals is presented in the next Chapter.

IV Framework for Analysis

We assume that many firms that differ in *ability* are manufacturing and selling the same kind of products in the market.

The *ability* refers to a synthesis of “tangible resources, such as persons, things, and money, and intangible resources, such as know-how and information.” Here, we assume that ability can be evaluated in one dimension in the same manner as

temperature and weight. Figure 1 is an example expressing two-dimensional elements, specifically, tangible resources (persons/things/money) and intangible resources (know-how/information), in one dimension.

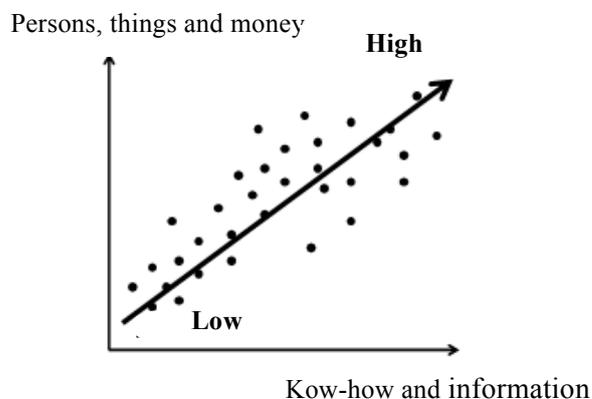


Figure 1 Ability of firms in one dimension

Firms’ activities consist of two processes (or sectors), “research and development (R&D)” and “manufacturing and selling.” We think of R&D first.

R&D is a process of developing technology for manufacturing products. Development of a new technology does not necessarily succeed, and the probability of success thereof depends on the ability of a firm. We assume that **the higher the ability is, the higher the probability of succeeding in development of a new technology, and that the lower the ability is, the lower the provability of success is.**

Also we assume that, if a firm succeeds in developing a new technology in the process of R&D, **the technology is necessarily protected by patent.**

Next, we think of manufacturing and selling. If a firm succeeds in technological development in R&D, it can utilize the relevant new technology to manufacture products. On the other hand, if a firm fails in technological development, it must manufacture products using the existing old technology.

Although every firm manufactures the same kind of products, the “quality” of the products differs depending on the firm. There may be cases where products sold by a firm are of high quality while products sold by another firm are of low quality. However, it is assumed that the quality of products manufactured by one firm is kept uniform. That is, the situation where some products sold by one firm are of high quality and others are of low quality is left out of consideration. In addition, it is

assumed that the quality of products is unclear to consumers until they purchase the products.

Quality is decided in a probabilistic manner, depending on ability and success in developing manufacturing technology (existence of a patent).

A firm with high ability that has succeeded in technological development has a high probability of manufacturing high-quality products. On the other hand, a firm with low ability that has also failed in technological development has a low probability of being able to manufacture high-quality products. The point that requires attention here is that even if a firm has high ability and has succeeded in technological development, it is not necessarily able to manufacture high-quality products. This is the meaning of the “probabilistic manner.” This relationship that exists among the ability of a firm, success in technological development, and the quality of products is shown in Table 1.

	Technological development	Success	Failure
Ability of a firm			
High		High	Middle
Low		Middle	Low

Table 1 Probability of high-quality products being manufactured

We assume that, although firms correctly understand their *ability* and *quality*, they are unknown to consumers unless there are patent or trademark signals. Such information is called the *private information* of firms. However, it is assumed that all consumers share common knowledge about what level of firm ability and product quality is possible in what probability (put mathematically, the probability distribution of these variables).

At the end, we think of the process of products being sold to consumers. Firms sell all products to many consumers through the (competitive) market. Assuming that there are sufficiently many consumers compared to firms, the price of products settles at the maximum price (**perceived value**) that consumers do not mind paying for the products (the price is decided by Walrasian auctioneer). As it is assumed here that all consumers are identical, it is necessary to pay attention to the point that it is not that different prices are presented to individual consumers.

Then, how is consumer perceived value decided? As mentioned above, consumers do not

have any information about the ability of firms and quality of products in advance. However, when consumers purchase products, they will be able to observe product names and firms’ logos. In addition, firms that have succeeded in technological development in R&D can describe “patent numbers” and a statement to the effect that technology is used on the package of their products in a form that is observable to consumers (like the “browning brewing method of ‘KIRIN’”). Consumers form a perceived value based on these kinds of information brought by trademarks and patents.

Lastly, we assume that the framework is common knowledge among all firms and all consumers (**assumption of common knowledge**).

Before moving on to the analysis of patent signals and trademark signals, we state three remarks on the framework.

First, in the framework, we assumed that the quality of products can be evaluated objectively and in one dimension, based on such concepts as “high” and “low.” Since *quality* consists of many elements, including the durability, functionality, and convenience of products, the level of quality may not be evaluated in one dimension. However, here, scales that can be evaluated objectively and in one dimension, such as the failure rate of products, are assumed as quality. Needless to say, it is technically possible to consider quality in multidimension. However, introduction of multidimensional quality complicates analysis, and is likely to make the role of patent signals, which this study intends to analyze intensively, hard to see. Therefore, in this study, we use scales of quality that can be evaluated objectively and in one dimension.

Next, it was assumed that firms that are more likely to succeed in technological development in R&D are more likely to manufacture high-quality products. According to this assumption, firms with high ability are more likely to exert their ability in both of the two processes. In reality, there are probably firms that are not good at product development despite having abundant know-how in technological development, and vice versa. However, for example, if, for two firms that have the same level of know-how for technological development, one’s financial assets far exceed the other’s financial assets (money), the one having more money is more highly likely to succeed in the R&D process. That is, it is not unnatural to think that firms that have sufficient resources, including persons and money, can perform all business activities more advantageously than firms that do

not. Therefore, in this study, a simplified assumption is adopted that firms with high ability are more likely to exert their ability in both of the two processes.

Lastly, it was assumed that firms that have succeeded in inventing manufacturing technology have necessarily obtained patent rights. In reality, there are possible cases where the inventor does not file a patent application for strategic reasons, as pointed out in Horstmann et al. (1985). For example, a firm tends to keep its technology secret in cases where costs for obtaining a patent (costs for the procedures related to obtainment of a patent) are sufficiently high and where competing firms are presumed to catch up to the firm's technical level due to publication of the technology. That is, in these cases, the company chooses not to file a patent application as costs for obtaining a patent exceed the benefits therefrom for the company. However, if the period subject to analysis is short, such issue of catch-up will not occur.

Benefits of firms from utilization of patent signals are analyzed below. For this purpose, examination is carried forward through comparison of benefits in cases where firms do not utilize patent signals (Chapter V) and benefits in cases where firms utilize patent signals (Chapter VI).

V Analysis of Cases Where Firms Do Not Utilize Patent Signals

This Chapter examines the benefits that firms can gain in cases where they do not utilize patent signals. In this case, whether a firm has succeeded in inventing manufacturing technology is completely unclear to consumers. However, consumers can use trademark signals as information for determining the quality of products, as mentioned below.

Trademarks provide consumers with information about the ability of firms. Firms have a history of business unless they are completely newcomer firms. It is believed that consumers have some recognition of the ability of firms on the basis of the products which firms have supplied to the market in the past. Firms that have supplied a large amount of high-quality products probably have high ability while firms that have supplied only low-quality products must have low ability. In other words, reputations indicated by trademarks work/serve as the signals of ability.

Here, **given success or failure in technological development**, firms that have higher ability have a higher probability of supplying high-quality products (see Table 1). Then, the higher the probability of products being of high quality is, the

higher consumer perceived value will be. That is, firms that have a high trademark-based reputation make high profits while firms that have a low reputation make low profits. In other words, success or failure in technological development, which is information that is unobservable for consumers, has no impact on the profits of firms, and firms gain profits in proportion to their trademark-based reputations.

It is necessary to make a supplementary statement with regard to newcomer firms. As mentioned above, a trademark works/serves as a signal of a firm's ability for the firm's history of business. As newcomer firms do not have such history, special handling is required for their trademark-based reputations. There are two different types of possible handlings. Those are the method based on the idea that the reputations of newcomer firms belong to the lowest category and the method based on the idea that they are at the average of the reputations of firms existing in society. Which method is appropriate differs depending on the social trend of the time and the industry.

VI Analysis of Cases Where Firms Utilize Patent Signals

Next, we examine the benefits that firms can gain in cases where they utilize patent signals.

In this case, patents, including their marking, are protected by law; therefore, not only unauthorized use of the relevant technology but also a false statement of a patent number and a false marking, like "a patent has been obtained," are not permitted. Therefore, consumers can correctly recognize the fact that the firm has succeeded in inventing technology, on the basis of a patent number stated on the package of the product and marking of the patent.

As consumers also know that firms with higher ability are more likely to succeed in inventing technology, the following becomes clear based on the conditional probability theory that is known as **Bayes' theorem**. That is, the **true (actual)** ability of firms that have succeeded in inventing technology is higher, on an average, than that of firms that have failed to do so. In other words, patents provide consumers with information about ability. While communication through trademarks requires a history of business (reputation) of firms, even completely newcomer firms can communicate their ability through patent signals. As a result, consumers guess that the quality of products supplied by such firms is high, and the consumer

perceived value of the products increases, as in the preceding analysis of trademarks.

The foregoing discussion has revealed that both trademarks and patents work/serve as the signals of the ability of firms and of the quality of products. Then, are patent signals completely meaningless as they duplicate trademark signals?

The answer is no. This is because the source of an indicator of ability differs between trademarks and patents though the high quality of products is indicated by the high ability of a firm. Therefore, the profits of firms from patent signals arise independently of the profits of firms from trademarks signals.

In addition, the impact of patents on consumer perceived value (and profits of firms) is not only that. It should be recalled that, **given the ability of firms**, firms that possess newer manufacturing technology have a higher probability of supplying high-quality products (see Table 1). That is, **patents also work/serve as direct indicators of the quality of products** (not as signals). Through a combination of both of these functions, firms can gain high profits from patent signals. The sources of profits of firms from trademark signals and patent signals are summed up in Table 2.

Trademarks	Ability based on reputation
Patents	Ability to create inventions Improvement of the quality of products based on inventions

Table 2 Sources of profits of firms from signals

Next, we examine the size of profits from patent signals.

The size of profits from trademark signals is in proportion to reputation based on trademarks. In order to examine the size of profits from patent signals, it is necessary to distinguish relationships among some variables (Figure 2).

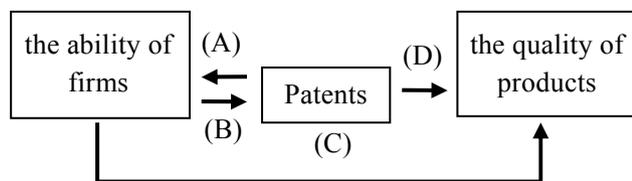


Figure 2 Relationships among variables

First, consumers can understand from a patent that a relevant firm has succeeded in inventing technology. According to the Bayes' theorem, the ability of firms that possess patents is, on an average, higher than that of firms that do not;

therefore, patents work/serve as the signals of ability (Figure 2(A)).

Then, the strength of a patent signal depends on the degree of contribution of ability to success in creating an invention (Figure 2 (B)). If the degree is small, it is hard for consumers to believe firmly that the firm has high ability even if they witness the fact that the firm possesses a patent. Therefore, consumers cannot sufficiently guess the quality of products, and the perceived value does not increase much. Consequently, the patent signal does not increase the profits of the firm much. After all, it can be said that **a patent signal increases the profits of a firm more as the difference between the rate of firms with high ability succeeding in creating an invention and the rate of firms with low ability doing so is larger.**

Next is the relationships between ability and the quality of products (Figure 2(C)). Even if it is understood, from a patent signal, that the ability of a firm is high, profits from the patent signal will not be very large if the relationships between ability and the quality of products are weak. This is because the ability of a firm is not a (very) important factor in consumers' guessing the quality of products. After all, it can be said that **a patent signal increases the profits of a firm more as the difference between the probability of firms with high ability manufacturing high-quality products and the probability of firms with low ability doing so is larger.**

Lastly, we examine the degree of contribution of technological inventions to the quality (Figure 2(D)). If the degree of contribution is small, the profits of a firm from a patent signal are not very large. This is because, even if consumers can firmly believe, owing to a patent, that the firm possesses a new technology, it cannot be said that the quality of products becomes higher owing to the technology and the consumer perceived value is thus also not increased. After all, it can be said that **a patent signal increases the profits of a firm more as the difference between the probability of firms having failed to invent technology manufacturing high-quality products and the probability of firms having succeeded in inventing technology doing so is larger.**

However, in fact, even if a patented technology does not contribute to the quality of products at all, if consumers are under the impression that "the probability of products being of high quality increases owing to the patented technology," the firm can, after all, gain profits from the patent signal. That is, if a firm is able to make consumers aware of positive relationships between a patented

technology and the quality of products through advertising, such as TV commercials, patent signal becomes a useful tool for the firm.

This point at issue is very important because the current situation, where many patents whose value as inventions is not high have been registered, has been considered to be a mystery from the perspective of economics for many years. That is, as pointed out in Silverberg and Verspagen (2007), registering a patent that has no value as an invention (or has a low value) is apparently unreasonable for firms, taking registration fees for patents into account. However, as this study advocates, such (apparently unreasonable) registration of a patent can be explained if thinking that patents can be utilized as signals.

With regard to the profits of firms from patent signals, we point out another very important point. As seen above, the profits of firms from patent signals arise independently of the profits of firms from trademark signals, and also arise additionally. This offers an important suggestion with regard to the question of to what firms patent signals are beneficial. We think of firms which have a low trademark-based reputation. Such firms cannot gain high profits from trademark signals. Therefore, if a firm with a low trademark-based reputation succeeds in inventing technology, benefits from a patent signal will be **relatively** large. On the other hand, for firms for which a sufficiently high reputation has already been established based on trademarks, additional profits from patent signals are relatively unimportant.

The discussion so far indicates that patents work/serve as the signals of the ability of firms and that firms can gain additional profits from patent signals under certain conditions. However, a patent does not work/serve as a signal of the ability of a firm where a relevant patented invention widely moves among firms through license agreements. In order to confirm this point, we examine license agreements in the next Chapter.

VII Effect of License Agreements

In order to make clear the effect of license agreements on patent signals, an extreme case is first assumed in which license agreements are concluded between all firms that possess patented inventions and all firms that do not possess new manufacturing technology.

Firms that have failed to invent technology can manufacture products by the use of manufacturing technology for which a patentee has

obtained a patent by paying license fees to the patentee. If all firms conclude license agreements, the phrase “a patent has been obtained” will be marked on the package of all products distributed in the market.

According to the discussion in Chapter VI, the perceived value of products manufactured by firms that have patented inventions becomes high as consumers correctly guess (based on Bayes’ theorem) that such firms have, on an average, high ability. However, where all firms manufacture products by the use of “patented inventions” through license agreements, patents cannot provide consumers with any information about the ability of firms. That is, patents do not work/serve as the signals of the ability of firms.

Next, we assume the realistic situation where license agreements are concluded among some firms. In this case, there are the following three different types of firms in the market. The first are firms that have failed to invent new manufacturing technology and do not conclude any license agreement. These firms manufacture products without having new manufacturing technology. The second are firms that have failed to invent new manufacturing technology but have obtained new manufacturing technology through license agreements. The third are firms that have succeeded in inventing new manufacturing technology in their own R&D.

With regard to the firms of the first type that do not have new manufacturing technology, consumers probably conclude on the basis of Bayes’ theorem that their ability is low on an average. On the other hand, with regard to firms that have new manufacturing technology, consumers probably conclude that their ability is high on an average. However, the point to be noted here is that consumers cannot distinguish between the firms of the second type and those of the third type. Firms of both types state, on the package of their products, that “a patent has been obtained.” Therefore, **consumers do not evaluate the ability of firms that have new manufacturing technology as highly as in the case where no license agreement is concluded, though they highly evaluate the ability of such firms.** In fact, given firms possessing new manufacturing technology, the conditional probability (based on Bayes’ theorem) of their having high ability is calculated to be lower than the conditional probability thereof in cases where no license agreement is concluded. In other words, it can be said that the function of patent signals as the indicators of the ability of firms becomes weaker.

Whether a license agreement is easily concluded will be decided based on such factors as the characteristics of patents, relationships among firms, and industrial structure. That is, how much profits firms can gain from patent signals also depends on the aforementioned factors.

VIII Conclusion

Trademarks, such as firm names, product names, and brand logos, are indicated on products. Trademarks bear the past history of firms, and communicate information about the ability of firms and the quality of products to consumers. On the other hand, patents can also communicate information about the ability of firms and the quality of products to consumers; however, it is not clear whether firms benefit from patent signal in the situation where trademarks are already carrying out a similar function. This study examined, using the framework of economics, whether utilization of patents as signals brings profits to firms.

Both trademarks and patents communicate the ability of firms and the quality of products to consumers; however, they differ in the source of information. Trademarks are based on past performance while patents are based on new inventions that actually exist. Therefore, even if there have already been trademark signals, patent signals bring profits to firms. However, profits from patent signals are affected by the characteristics of firms and of products and environmental factors surrounding firms as shown in Table 3.

Firm's character-istics	Relationships between ability and the rate of success in creating inventions Relationships between ability and quality Height of trademark-based reputation
Product character-istics	Degree of contribution of technological inventions to quality
Environmental character-istics	Likelihood of license agreements being concluded (threat of catch-up by other competing firms and easiness of technology transfer)

Table 3 Factors that affect the profits brought by patent signals

The stronger the correlation between ability and the rate of success in creating inventions is, the stronger a patent works/serves as an indicator of ability. In this case, a patent signal can increase the profits of the firm. However, for that purpose,

there must be a strong correlation between ability and quality. This conclusion suggests that the more a firm is renowned for "corporate power" (ability) and "product power" (quality), the more effectively it can utilize patent signals. On the other hand, firms that have already established a sufficiently high reputation based on trademarks can gain only low profits from patent signals. Here exists a trade-off.

Next, the higher the degree of contribution of a patented technology to quality is, the more a patent signal increases the profits of the firm. This is a direct effect of a patent signal. The implication of this conclusion is that benefits (merit) of a patent signal are large in the chemical industry, etc. in which technology and quality are strongly correlated with each other while benefits are small in the machinery manufacturing industry, etc. in which one product is manufactured through complicated arrangements of various technologies.

However, even where a patented technology actually makes no contribution to the quality of products, the firm can gain profits from a patent signal if consumers are under the impression that "the probability of products being of high quality increases owing to the patented technology." That is, it can be said that the value of a patent signal can be enhanced strategically by using advertising, such as TV commercials. This is also an effective means for newcomer firms, such as venture firms.

Lastly, we take up the likelihood of license agreements being concluded, as an environmental factor surrounding firms. Where license agreements are highly likely to be concluded among firms, the function of patent signals as indicators of ability of firms becomes weaker. This conclusion suggests that patent signals are likely to be effectively utilized in the chemical industry, etc. in which license agreements are unlikely to be concluded and that the opposite is established in the electric machine industry, etc. in which license agreements are frequently concluded.

The above has revealed that patent signals increase the profits of firms. Moreover, the characteristics of firms that can utilize patent signals more effectively and other factors have been indicated. However, variables taken up in this study are abstract, and they are thus not regarded as specific indicators. Therefore, it is hard to specifically indicate which firms can increase their profits in the case of actually utilizing a patent as a signal. For example, if it is possible to regard the "right of business" on the balance sheet as a proxy variable of "reputation established based on a

trademark” and to deem the number of patents related to one product to be an indicator of the “degree of contribution of the patents to the quality of the product,” it will be possible to provide a strategic suggestion that is beneficial to firms. It is necessary to find a realistic proxy variable for each variable.

Furthermore, it is necessary to verify the obtained results in an empirical manner in the future. For this purpose, it is necessary, when intending to actually verify the proposition obtained in this study, to solve the issue of how to measure profits brought to a firm by a patent signal (value of a patent signal). This issue is similar to the difficulty in measuring the effect of advertising, such as TV commercials. In addition, even if the value of a patent signal is measurable in terms of monetary amounts, it is very difficult to make the profits from and the effect of a patent signal correspond one-to-one with each other as actual firms generally provide multiple products and services. These are very important issues, and will be subject to further study in the future.