6 Research and Study on Influences of the Patent System on Economy

In advanced economies, intangible assets that are referred to as intellectual property or intellectual capital are becoming important more than ever as a source of social wealth. Under the influence of US and Japanese pro-patent policies, patents and other intellectual property are becoming increasingly essential management resources both for the Japanese industry as a whole and for individual companies.

This research and study examines approaches to elucidate the impacts of patents and other intellectual property on individual corporate management and the macro-economy. Part I introduces a patent economy model that was specifically developed for this research and study as an analysis tool. Part II focuses on the valuation of intellectual property rights, and introduces the actual moves in society such as the recent trend in US accounting standards and examples of valuation methods adopted by companies, as well as theoretical discussions on the difficulty of determining the value of intellectual property and on license prices. Part III introduces the applicability of the diffusion indices of intellectual property (IP diffusion indices) that have been developed for this research and study for indicating the activeness of Japanese companies' intellectual property activities, and the results of analysis on venture businesses' intellectual property activities.

I Patent Economy Model

1 Background of the Development of a Patent Economy Model

Recent years have seen rapid and extremely dynamic structural reform (changes) in knowledge society. Advancement of business methods on the Internet including e-commerce and progress in biotechnology centering on genome information have been making great changes to the structure of knowledge society. Such structural reform turns about the fields, in which knowledge is accumulated, and changes the industries and geographical areas concerned (causes "dynamic allocation of resources").

In order to deal with this structural reform appropriately, it is important to follow the process of this dynamic allocation of resources from macro-economic perspectives and to effectively evaluate policies and systems.

The patent economy model enables evaluation of not only fiscal and financial policies as conventional models, but also policies on intellectual property centering around patent, by positioning the patent economy on the axis and linking it with the real economy and the financial economy. No macro-economic model that clearly indicates the macro linkage map of the patent economy has ever been developed so far.

The patent economy model can be used in the following manners.

① As a useful toolbox: A toolbox containing tools for time-series analysis, effect and impact analysis, structure and system analysis, and sensitivity analysis. The structural outline of correlations between the patent eonomiy, and real and financial economies can be simulated by using a quantitative diagram.

② As a tool for processing the results of actual condition surveys and trend surveys: Macro-indices for estimation can be obtained based on data from actual condition surveys on utilizing patents and other intellectual property.

③ As a tool for explaining the macro linkage map: The macro linkage map, such as the factors behind the correlation between the shortening of the period requesting for patent examination and the increase or decrease of patent stock, can be understood.

In addition, the perspectives in policy evaluation will become even more important in the future due to the social demands toward policies particularly in respect to the four items listed below.

① Information disclosure: The responsibility to provide explanation to the people; Accountability

② Organizational management: The optimum path for administration; Manageability

③ Pertinence in a mature civil society: Eligibility

④ Adaptability in a global society coexisting with diversity: Malleability

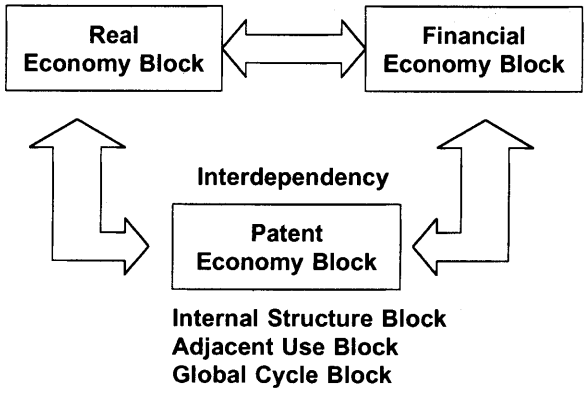
Since comprehensive evaluation from these perspectives is also vital in system planning and policy implementation relating to intellectual property, the patent economy model could possibly play a major role in the future.

2 Structure of the Patent Economy Model

(1) Patent Economic System (PES)

By explicitly indicating a patent economic

system outside the conventional dichotomous framework of the real and financial economies, interrelationships are established between the patent economy and the real and financial economies.



(2) Basic Structural Outline of the PES

① Block for estimating the relational effects between the patent economy and the real and financial economies

② Block for understanding the trends in prices, quantities, performance ratio, valuation values, and employment opportunity in the patent economy (Internal structure)

③ Block for predicting the trends of intellectual property other than patents and the Japan Patent Office's revenues (Adjacent use)

④ Block for understanding the trends of the international patent economy (Global cycle)

In the internal structure block, three subsystems, namely, "Creation/R&D", "Accumulation/Stock", and "Distribution and Exploitation" create the situation of the patent economic flow and stock. The adjacent use block involves the collective effects of patents and other intellectual property, whereas the global cycle block involves the situation of international exchanges between the Japanese economy and the US and European economies. The constitutive variables of the patent economy are the conventionally used variables: "price", "quantity", and "valuation value".

(3) Distinctive Features of the PES

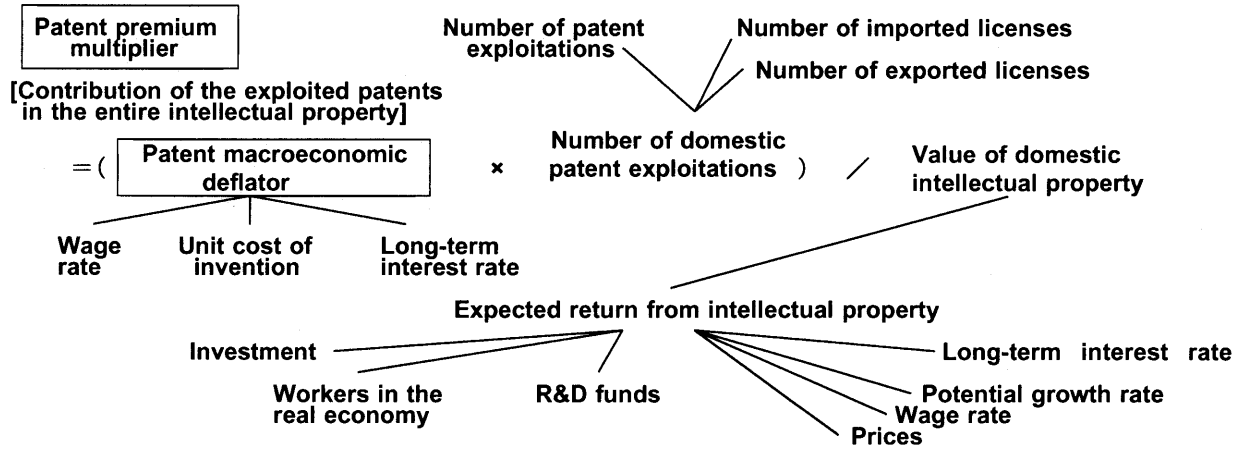
① In addition to the real and financial economies, the patent economy is also depicted.

② With regard to the relation between the patent economy and the real economy, a distinction is made between how the patent economy correlates with the demand-side activities and the supply-side activities. Meanwhile, the relation between the patent economy and the financial economy not only shows the trends in the money flows that are directly concerned with the patent economy, but also the "stock effect of credit creation" that occurs through the macro linkage map. As for the effects of the macro-economic transmission estimated from the price index and employment opportunity index, the direct effects from the real and financial economies are clearly indicated.

③ In this model, the activities of the patent economy are expressed by using four kinds of indices: price index, quantity index, valuation value index, and employment opportunity index. The price index is valuated based on three kinds of prices: option prices, purchase prices, and cash flow prices. The quantity index based on the number of inventions is comprised of flow series: filing; request for examination; exploitation; and distribution: and stock series: registration and maintenance. The valuation value index estimates the expected return from intellectual property, and the aggregate amount of patent stock is broken down into internally exploited patent stock, licensed patent stock, and unexploited patent stock. The employment opportunity index not only estimates trends in the number of workers in the entire patent economy, but also clearly indicates the estimated numbers of patent attorneys, Japan Patent Office officials, patent trade agents and in-house agents.

(4) Macro Linkage Map

The macro linkage map was, for instance, created as below based on the major variables.



(5) Relational Expressions

Relational expressions were estimated based on the macro linkage map. Shown below is an example of a regression model. The figures inside ( ) are coefficients, the figures inside < > are t-statistics, R^2 is the coefficient of determination, and D.W. is the Durbin-Watson statistic.

Patent macro-deflator = f (wage rate, unit cost of invention, long-term interest rate)

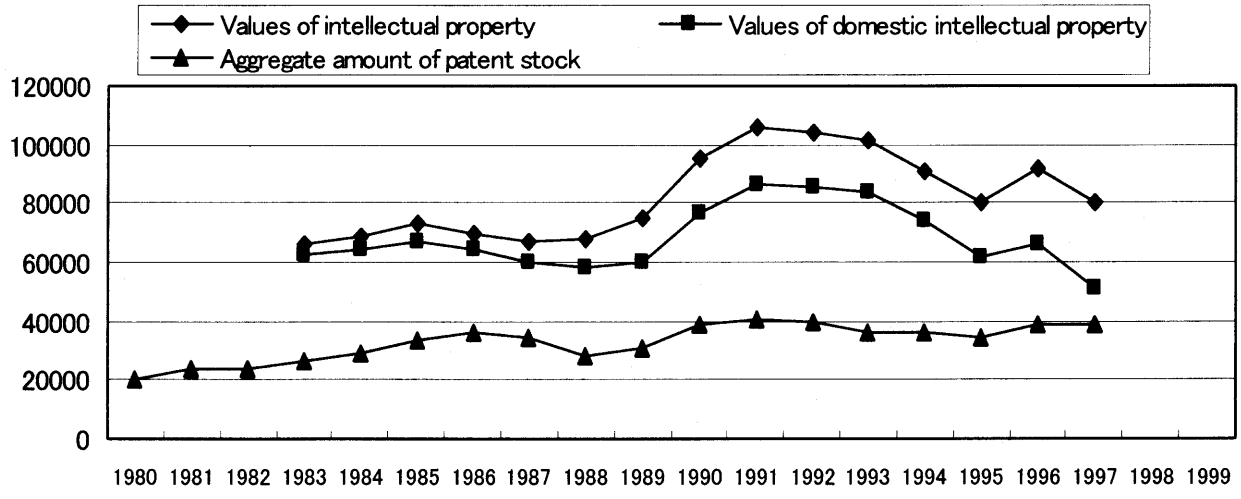
	(+0.00567)	(+2.834)	(+0.0128)
[R^2=0.98 $D.W.$=1.1]	<27.6>	<13.1>	<22.2>

3 Results of Simulation Using the Patent Economy Model

(1) Trial Calculation of Macro Variables

The patent economy model can be used to make trial calculations of various macro variables. In this study, trial calculations were carried out in order to find the transition in intellectual property (IP) values, price indices of the patent economy (patent macro deflator, unit cost of invention, license price, average annual patent fee), quantity indices (number of domestic applications (patents and utility models), number of requests for examination, number of new registrations, etc.), and balance of technology trade. An example of the transition in IP evaluation values is shown below.

Transition in IP evaluation values (¥ billion)



(Transition in IP evaluation values)

IP evaluation values peaked at the beginning of the 1990s at a 100 trillion yen level, and have been on a decreasing trend ever since. The evaluation values of domestic intellectual property have slumped greatly, and the overall level is being pushed up by those of intellectual property transferred from overseas. On the other hand, the aggregate amount of patent stock is steadily growing, though it is slightly affected by business fluctuations. The reason for the sluggish IP evaluation values is that the estimation has been made based on option pricing. The rapid decline of Japanese economic growth and expected yields in the future are considered to be the factors behind the fall of IP evaluation values.

(2) Policy Simulation

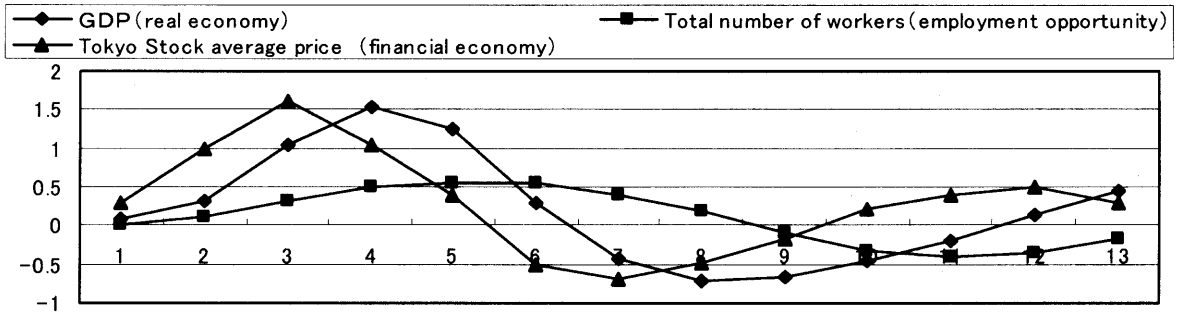
A simulation was made to find the effect of a rise in the average annual patent fee, the effect of large-scale R&D investment, and the effect of an increase in the ratio of exploited patents. The result of the simulation on the effect of large-scale R&D investment is shown below as an example.

(Effect of large-scale R&D investment)

The effect of an additional 100 billion yen scale R&D investment was tracked. The tracking span was 12 years.

First, business fluctuations occurred, and a regular, so-called "business cycle" was formed to follow the same pattern. In short, the result indicated that an R&D policy does not bring about a linear economic growth, but instead creates a business cycle.

Tracking Evaluation of the Effect of Additional 100 Billion Yen Scale R&D Investment



The growth rate or increase rate during the lifespan is naturally positive, with plus values offsetting the minus. In the meantime, the transitions of the financial economy, GDP, and employment opportunity each have peculiar characteristics. In other words, the Tokyo Stock Exchange average price (financial economy) peaks in the third year, and rapidly declines thereafter. The GDP (real economy) peaks in the fourth year and then enters a recession period. The total number of employees (employment opportunity) peaks for a longer span in the fifth year and indicates gradual cyclic variations. The result indicates that the effect of R&D investment shows up in the order of the financial economy, real economy, and employment opportunity, as if to follow each other in sequence.

4 Summary

A patent economy model was developed for this researh and study (a macro-economic model consisting of 113 relational expressions, 150 variables, and 245 parameters). The model is expected to be applicable in various manners as a policy evaluation tool.

The patent economy model needs to be verified further regarding the extent to which it can explain the real circumstances. Also, further improvements should be made along with such verification. The desired improvement areas are: to cover the trends by each industrial field including the information industry and the biotechnology industry; to improve the accuracy of evaluation on intellectual property other than patents and on cross license that does not become easily visible; and to further enhance the parts linking with the US and EU patent economies. Since the availability of statistical data on the patent economy is not sufficient at present, the data should be supplemented and organized urgently.

II Asset Valuation in the Patent Economy

1 Trends Concerning the Valuation of Intellectual Property Rights in Financial Accounting - Focusing on the Trends of the Changes Made to the US Accounting Standards -

As intangible assets that are referred to as intellectual property or intellectual capital are becoming important more than ever as a source of wealth, new moves have emerged to attempt incorporating intellectual property rights into corporate financial statements in the discussions concerning a new and ideal financial accounting method.Such trends in financial accounting will be reviewed below by focusing on the trends in US accounting standards.

(1) Asset Valuation in Accounting

In order to add intangible assets such as intellectual property to the balance sheet, it is first necessary to measure the intangible assets quantitatively on a monetary basis. The Statement of Federal Financial Accounting Concepts of the United States mentions the following five elements as its recognition standards: historical cost, replacement cost, market value, net realizable value, and present value of further cash flows.

(2) "Incorporating Intangible Assets in the Corporate Balance Sheet"

The accounting procedure for intangible assets differs between those for assets purchased from others and internally developed assets. While the purchased intangible assets are included in the financial statements based on their purchase costs, internally developed assets are off the balance sheet in principle.

The acquisition of intangible assets is further divided into independent purchases and obtainment through M&A.

(3) Trends of the Changes Made to the US Accounting Standards for Business Combinations and Intangible Assets

There are two methods of accounting procedure for business combinations in the United States: the purchase method, which adds identifiable intangible assets to the company's assets separately from the goodwill by valuating the acquired assets based on the fair market value; and the pooling-of-interests method, which carry over the book value without revaluating the acquired assets.

Presently, the US Financial Accounting Standards Board (FASB) is fundamentally revising the accounting standards for business combinations and intangible assets. If the new standards are issued according to the current draft, the two major changes would be: ① abolition of the pooling-of-interests method (unified into the purchase method); and ② abolition of goodwill amortization (unified into an accounting system requiring the company to post valuation losses on assets in the financial statement).

These changes will not greatly alter the recognition standards for intangible assets, but they are expected to have a great impact on the actual practices. Specifically, in all future business combinations, intangible assets that satisfy a certain standard will be recognized separately from the goodwill, and this is expected to dramatically increase the chances for intangible assets such as patents to be put on the balance sheet.

Many companies that raise funds in capital markets are already well aware of the "aggregate market value of their listed stock" and their "enterprise value" in doing their business, and recognize the importance of explaining them to the investors and creditors. However, the introduction of the new standards is expected to further raise the need to quantitatively valuate intangible assets or intellectual assets as components of such enterprise value.

(4) Future Challenges

There remains doubt in how much the framework of accounting can deal with a problem that financial statements would no longer be able to sufficiently serve their roles. Even in the US, where accounting standards have the reputation of being the most advanced in the world, the internally developed intangible assets are excluded from items reviewed for the new accounting standards, and there seem to be no specific moves to include them on the balance sheet for the meantime.

Nevertheless, the argument that intangible assets should also be capitalized due to their economic values as long as they are sources of future profits is expected to continue in the future.

In addition, an increasing number of companies have come to valuate their intellectual property rights through their own methods. The changes in the accounting standards may further accelerate such a move.

At least, companies' attempts to utilize intellectual capital will definitely increase in the future, and such move is likely to materialize attempts to create a new accounting framework. Therefore, there is a strong need to continue observing the future trends in accounting standards and to verify the trends of companies that are conducting pioneering practices as well as the specific methods of those practices.

2 Price of Intellectual Assets

The present Japanese economy can be considered a mixture of the real economy that has become more of a knowledge economy, the financial economy, and the knowledge economy itself. One can see that the transition of the Japanese economy has mainly been lead first by the real economy, second the financial economy, and after that, the knowledge economy. When the economic mechanism is classified in this manner, the question would be how assets beiing transacted are priced in the respective economies.

The most typical classifications of valuation methods are: ① the cost approach; ② the market approach (comparison of transaction cases); and ③ the income approach.

The principle of valuation is considered to be basically the same in both the real economy and the financial economy. There may be some differences in where the emphasis is placed and how the valuation method is applied, but the fact that one of these three methods is used is the same in both economies.

(1) Distinctive Features of the Intellectual Assets Market

(i) "Imperfection of information" being a premise for the generation of value

Intellectual assets has an aspect to bear the value as assets as a consequence of the imperfection of information. Also, because of this imperfect information, the price of an asset is more largely influenced by the arbitrary intent of the parties transacting the asset than by when the information has been completed.

(ii) Thin market (market failure)

Only a small number of people participate in the transaction of intellectual assets, particularly intellectual property such as technology. In an extreme case, there may be only one purchaser for one supplier. The fact that there are few participants in the market means that the

principle of supply and demand represented by transacted quantities is not valid.

The prices of intellectual assets would not be determined by the supply and demand relationship in the market as in the case of other assets, but would be dependent on the selling and buying intentions of the parties concerned and their negotiating powers to realize the transaction. This is one of the reasons that the prices of intellectual assets have to be determined case by case.

(iii) Low reproduction cost

The concrete contents of intellectual assets are information. Information assets require little further costs for additional production once they are produced for the first time. It is as if the reproduction cost is almost zero. In other words, after spending a certain fixed cost for development, the company needs to pay little variable cost for additional production.

This fact backs up the reality that it is difficult to simply introduce the development cost of an intellectual asset as the basis for its valuation.

(iv) Determination factors for valuating intellectual assets

The "budget constraints line", which is determined by the amount obtained by the income approach such as "profits", is an important factor for intellectual asset purchasers. The investable amount determined by the "budget constraints line" very likely serves as the basis for determining the purchase intention, that is, determining the price. However, the "profits" that determine the budget constraints line are different in size according to each purchaser. In this sense, the valuation of intellectual assets has to be dependent on the individual party concerned in the transaction.

(2) Diversified Prices of Intellectual Assets

Thus, among the valuation methods for intellectual assets such as technology, the market approach is excluded by the character of thin market, and the cost approach is confirmed as not being useful as the transaction price itself in many cases, although it may be used to indicate the marginal price. Furthermore, the income approach has also been verified to be affected by the individual circumstances specific to the party concerned in the transaction.

Incidentally, Japan's land prices involve multiple value notions including "posted land prices", "land prices based on accessibility (rosenka)", "assessed value for fixed assets tax" and "assessed value for inheritance tax". This means so-called "a piece for multiple prices". Different values of land are used depending on the purpose of policy, such as the taxation or rectification of land transactions. Although the background may be different, the same principle of multiple prices applies to intellectual assets due to the above-mentioned circumstances. In the case of intellectual assets, the conditions of individual transactions directly reflect on the valuation. In short, the valuation is affected by the arbitrariness of the party concerned in the transaction as well as by the profit-earning capacity and budget scale of the party.

It should also be noted that intellectual assets include various kinds of assets. Even within the limited scope of technological assets, the nature of the assets differs according to the technical field. While single technology constitutes one product in the fields of software and pharmaceuticals, multiple technological assets compose one finished product in many cases in the field of electronics. Thus, the means and the result of valuation are also affected by the type of asset.

In this manner, the means of valuation is slightly different by individual economic transactions for the same intellectual asset depending on the different circumstances thereof, and the resulting price is accordingly different. It can be said that there are as many prices for one intellectual asset as the number of transactions made.

In reality, it may be unrealistic to expect a specific third party to objectively and appropriately valuate intellectual assets. The only available way is for the parties concerned in a transaction to make their own efforts to individually valuate the assets. If the parties understand that the diversity of prices is one of the characteristic factors of intellectual assets, they would be able to valuate the assets to suit the real situation rather than being overly prepossessed by the cause of making an "objective valuation".

3 Theory of Technology Value and License Price

This section discusses the microeconomic relationship between technology value and license price by using an approach of economics. The license price can be considered an embodiment of the technology value of the asset. The following part of this section discusses the nature of the licensing on a royalty basis (rate on as-used basis: a method to charge per unit produced) and on a fee basis (fixed rate: a method to charge in a lump sum irrespective of the production volume), and offers insight into technology value from the differences in the nature of the two methods.

(1) Licensing on a Royalty Basis (Rate As-Used)

Supposing that a company could reduce the unit price from C0 to C1 by introducing technology, this new technology generates a value

of (C0-C1) per unit produced. This value (C0-C1) shall be called the "net unit value".

The licensing on a royalty basis only sees the net unit value as the source of value. Therefore, the right holder cannot charge the licensee a royalty that exceeds the net unit value, because, if the right holder charges such the royalty, it would raise the licensee's unit cost of production comprising the royalty.

(2) Licensing on a Fee Basis (Fixed Rate)

A fee is different in nature from a royalty. As mentioned above, a royalty is added to the licensee's unit cost of production, so it diminishes the licensee's advantage in production cost over non-licensees.

On the other hand, a fee, which is a fixed rate paid by the licensee prior to production, does not raise the unit cost of production. Accordingly, the licensee would gain the advantage over non-licensees in terms of production cost. The licensee can expand its market share by utilizing this advantage and increase its profits. In reverse, non-licensees' profits decrease due to the rival's introduction of the new technology. This means that the right holder is able to threaten companies by not licensing out the technology, so as to conclude license agreements under advantageous terms.

This can be explained by using "license-profit tables" (details described in the following part) that are created by considering the market competition. In conclusion, it can be indicated that the fee system provides higher license income to the right holder than the royalty system does.

(3) Market Competition and Technology Introduction

If a competitor introduced a new technology in an oligopoly market, non-licensees' profits would decline. If that new technology was revolutionary, companies who couldn't buy the license might even have to retreat from the market. As a matter of course, the profits of the company that introduced the technology would also decrease if the number of licensees increased. In order to examine this situation, the profits of licensees and those of non-licensees are described below. Since the companies are symmetrical, the profits among licensees and those among non-licensees are equal, respectively.

l: Number of licenses; Valid value is from 0 to 4 because this is a model of four companies

B(l): Profits of the licensee(s) when the number of licenses is l (amount before paying the fee)

N(l): Profits of the non-licensee(s) when the number of licenses is l

F: Amount of fee

B(l) and *N(l)* are both functions of *l*, which is the number of companies that concluded the license agreement. The top three lines (*l*, *B(l)* and *N(l)*) of the tables shown below are the license-profit tables. The figures in these tables were arbitrarily created for convenience. Type 1 assumes technology that has a medium cost-cutting effect, and Type 2 assumes one having an extremely large effect. In Type 2, non-licensees exit from the market. This is indicated by zeros in cells *N(3)* and *N(4)* in Type 2.

Type 1 (medium-scale technology)

Number of licenses *l*	0	1	2	3	4
B(l)		100	90	70	40
N(l)	25	20	15	10	
F (Fee)		75	70	55	30
Profits of the right holder		75	140	165	120

Type 2 (large-scale technology)

Number of licenses *l*	0	1	2	3	4
B(l)		150	130	60	40
N(l)	25	10	0	0	0
F (Fee)		125	120	60	45
Profits of the right holder		125	240	180	160

The figures in the license-profit tables are roughly arranged in the order below.

$$B(1) > B(2) > B(3) > B(4)$$

$$N(0) > N(1) > N(2) > N(3)$$

Such arrangement of B and N is a major premise in this paper. The question of whether the arrangement will actually be like this depends on the contents of the technology and the assets. The pair of the number of licenses and the fee, (*l*, *F*), which is presented by the right holder must at least satisfy the condition below.

$B(l) - N(l-1) \geqq F$ (upper limit formula)

This upper limit formula is the "condition for preventing the l number of companies that have decided to buy the license from buying the license."

(4) Conclusion: Fee and Royalty, Technology Value

The fee is not determined by the differences in the licensee's profits before and after introducing the technology. In other words, when technology is licensed to three companies, the fee is not determined by the difference between *N(0)* and *B(3)*. The theoretical value of the fee is defined by the difference between *N(2)* and *B(3)* as shown in the upper limit formula. Since the profits of non-licensees decrease with an increase in the number of licensees, it is generally $N(2)<N(0)$. This decrease of profits occurs because the fee, unlike a royalty, does not raise the unit cost of production on the part of the licensee. Therefore, it is obviously, $B(3)-N(2)>B(3)-N(0)$. In this

sense, the upper limit formula already incorporates the decrease in non-licensees' profits, and the right holder sets a high fee in anticipation of that decrease.

The fact that not *N(0)* but *N(2)* is used means that, under the fee system, the licensor can consider not only the net technology value, but also the profits of the licensees as the source of income. This is the reason that the fee system brings higher licensing income to the right holder than the royalty system(*1). Naturally, corporate profits after taking away the license fee are smaller than those before licensed. The corporate profits flow to the right holder through the fee.

An infringement of the right can have the same effect as an increase in the number of licenses in the market. When settling an infringement case, the profits that should have been gained by the right holder are calculated in order to determine the amount of damages. In essence, this theory also indicates the possibility that the fee system brings higher profits than does the royalty system.

The argument so far suggests that, if a value that is derived only from the technological effect (i.e. net unit value) were used in an attempt to measure the hypothetical value of technology, the technology value would be underestimated. If the premium that arises from "being competitively advantageous in the market" is taken into consideration, the technology value would surpass that obtained from the net unit value.

4 Method of Evaluating the Economical Efficiency of Patents (Case Example in Komatsu Ltd.)

This method takes into consideration the effect of "improving performance and function" as the economic value of a patent, and aims to calculate this effect.

In many companies, the economic value of a patent is evaluated in the "compensation system for the exploited inventions" where the profits gained by an exploited patent are partly returned to the inventor (employee). However, the coefficients in use are highly subjective, such as the "degree of contribution" to the sales or profits and "importance", causing wide variations in the evaluation results. The variations are so wide that the obtained value can be "plus/minus ten times the correct value, i.e. 100 times difference between the possible minimum and maximum values."

(1) Concepts of This Method

Concepts of this method are as follows.

① It calculates the economic effects (competitiveness) not of "technology", but of the "product" at first.
② The calculation is made based not on "absolute economic effects", but on "relative evaluation against competitors' products".
③ The evaluated result is "rationally divided" into the effects of individual patents.

An idea underlying this method is that "relative comparison between the one's product and competitor's products" can be made to some extent quite objectively at the marketing section that is engaged in sales activities on a daily basis. The aim of this method is to reduce the variations in evaluated results to "plus/minus twice the correct value, i.e. a four or five times difference between the possible minimum and maximum values."

(2) Specific Procedure

① First, the "competitiveness of the performance and function" of a product exploiting a patent is graded in comparison to that of competitors' products into one of the following ranks (S: very high, A: high, B: rather high, C: same level as other products, D: rather low, E: low).

Then, the "relational table of competitiveness ranking and economic effect (%)" that has been prepared in advance is used to determine how much "pricewise superiority (at what % higher the product is sold) = economic effect (%)" is achieved for the product as a result of the "performance and function superiority."
② Next, "multiple selling points relating to the performance and function" of the product is graded into ranks in the order of importance (1st, 2nd, 3rd .....).

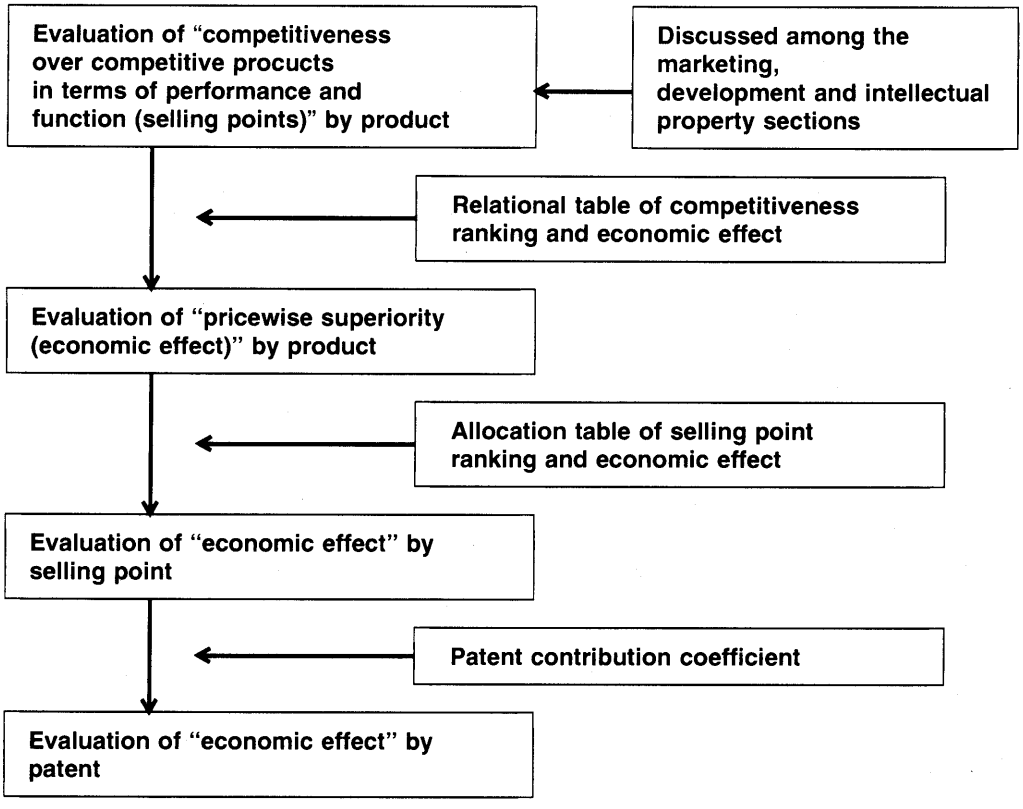
Then, the "allocation table of selling point ranking and economic effect (%)" that has been prepared in advanced is used to obtain the "economic effect (%) of the respective selling points".
③ Evaluation is made on the extent to which each patent (group) covers the respective selling points.

The extent of the contribution of a patent (group) to a selling point is evaluated instinctively, for instance, in three phases of 70%, 30% and 10%. Then the "economic effect of the patent (group)" is obtained based on it.
④ If that patent (group) is composed of "multiple patents", "economic effect of the patent (group)" is divided among these patents by the extent of contribution.

Then, the "economic effects achieved by individual patents" are obtained as a result.

(*1) The values were actually calculated based on the model used in Kamein and Tauman (1986). See the report of this research and study.

Procedure for Evaluating the Economic Effects of the Patents



(3) Utilization of the "Economic Effect" Data of a Patent

① Utilization as business management indices

It can be used to obtain business management indices such as the cost effectiveness of all intelletual property activities of the company.

② Utilization in the regular intellectual property management operations

It can be used as a decision-making index in regular intellectual property management operations to decide whether it should be to file applications for foreign countries, file requests for examination and pay annual fees.

③ Utilization as an incentive for invention

Since economic effects can be calculated by section and by product, it is possible to give an incentive (arouse competitive spirit) for invention to the R&D staffs by internally publicizing the results

④ Utilization in calculating compensation for an exploited patent

No other special calculation would be required for paying the compensation to the inventor employee. At the same time, the calculation will be more rational and consistent.

(4) Summary

This method has a problem deriving from the fact that it starts from evaluating the supremacy of the "product" in order to evaluate "individual patents". Even if the value of a certain patent was actually high, the patent value may be evaluated as "zero" if a competitor's product was using a patent on another technology of equivalent value. However, if used effectively, this method could become one of a useful evaluation method for companies.

III Impact of Intellectual Property on Corporate Management

1 Indices of Intellectual Property (IP Indices)

(1) Diffusion Indices of Intellectual Property (IP Diffusion Indices)(*2)

(*2) While the indices developed in the research and study of fiscal year 1999 focused on the relationship between financial data and intellectual property-related data of companies, these indices focus on how intellectual property-related data changed over the previous fiscal year. Therefore, the last year's indices are referred to as "IP static indices" and this year's indices as "IP diffusion indices" to distinguish them from each other.

(i) Objective of the indices

The intellectual property diffusion indices (hereinafter called IP diffusion idices) were developed with the principal objective to understand the continuing trend of the intellectual property activities of the entire Japanese economy or by each type of industry by investigating and converting to indices the general trend of activities and business strategies for intellectual property.

By regularly publicizing the indices, they could be effectively used by the Japan Patent Office to decide measures and understand the effectiveness of measures or by companies to formulate intellectual property strategies.

(ii) Implementation of a questionnaire survey

A questionnaire survey was conducted from November to December 2000, contacting the member companies of the Japan Intellectual Property Association (JIPA), the Japanese Bankers Association, the Japan Securities Dealers Association (JSDA), the Marine & Fire Insurance Association of Japan, Inc., and the Japan Franchise Association (JFA), as well as venture enterprises.

A total of 444 companies out of the 1,416 contacted companies responded, which accounted for 31.4% of all the companies surveyed. The breakdown was: JIPA member companies (310 companies responding out of 759); venture enterprises (91 companies responding out o 532); and banks, securities, insurances, etc.(*3) (43 companies responding out of 125).

The questions asked were as follows: ① the number of patent applications in Japan; ② the number of patent applications in foreign countries; ③ the number of domestic patents owned; ④ the number of foreign patents owned; ⑤ the contribution of the owned patents to the sales amount; ⑥ the proportion of the owned patents that are exploited in-house; ⑦ the proportion of the owned patents that are licensed out; ⑧ royalty income; ⑨ the share of the royalty income in the sales amount; ⑩ royalty rates; ⑪ the number of conflicts relating to intellectual property (warnings, etc.); ⑫ the number of intellectual property lawsuits; ⑬ intellectual property management cost; ⑭ the number of intellectual property management staff members; ⑮ the number of R&D staff members; ⑯ R&D cost; ⑰ sales amount; and ⑱ the importance of patents as management resources.

In order to survey the "trend", the respondents were asked to choose whether the figure for the current term (accounting term of the current fiscal year) has "increased", "is roughly the same", or has "decreased" over the previous term (accounting term of the previous fiscal year).

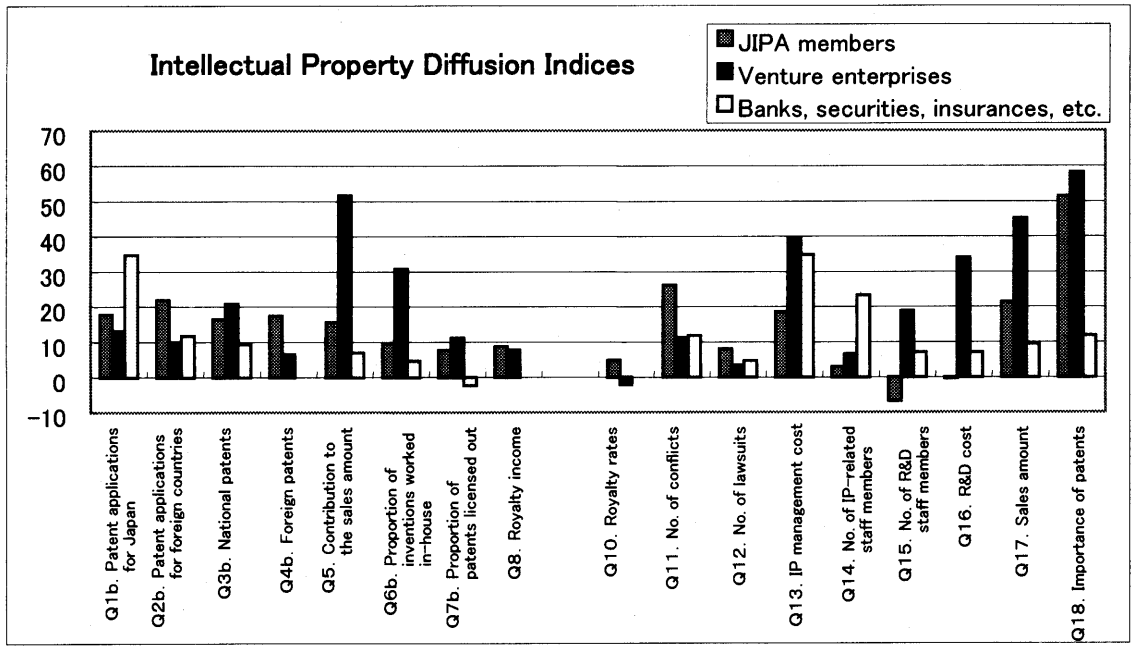
(iii) Intellectual Property DI

Intellectual Property DI (IP-DI) were introduced in order to evaluate from the perspective of whether or not intellectual property activities are vigorous. The IP-DI was calculated by subtracting the number of respondents who answered "decreasing" from the number of respondents who answered "increasing" over the previous tterm for each question and dividing it by the number of all respondents. The obtained figure will be plus if intellectual property activities are vigorous and minus, if not.

$$IP-DI=\frac{No.of\ respondents\ on\ the\ increasing\ trend-No.of\ respondents\ on\ the\ decreasing\ trend}{No.of\ all\ respondents}\times 100$$

The graph below shows the IP-DIs for "JIPA members", "venture enterprises", and "banks, securities, insurances, etc." Overall, intellectual property activities of "venture enterprises" are more vigorous than in the previous fiscal year, compared with the situation of "JIPA members". The IP-DIs for "banks, securities, insurances, etc." are high regarding the "number of patent applications in Japan", "intellectual property management cost", and "number of intellectual property-related staff members", which are assumed to indicate the moves to cope with business method patents. The IP-DI on the "importance of patents as management resources" was high for "JIPA members" and "venture enterprises", but was low for "banks, securities, insurances, etc."

(*3) Member companies of the Japanese Bankers Association, the Japan Securities Dealers' Association, the Marine and Fire Insurance Association of Japan, Inc., and the Japan Franchise Association are collectively referred to here as "banks, securities, insurances, etc."

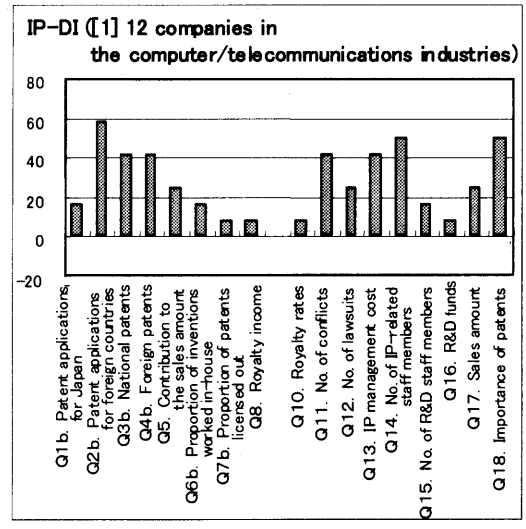


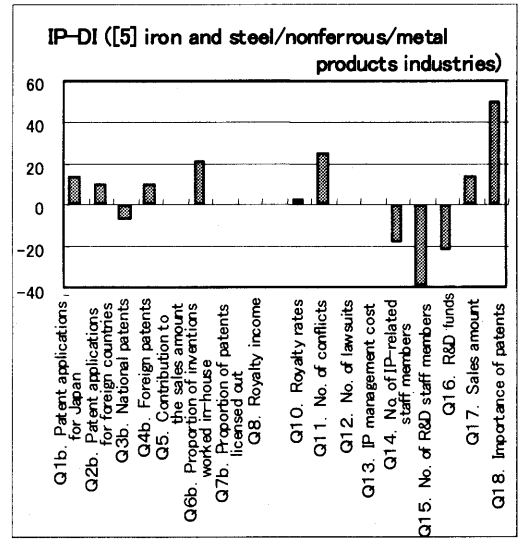
(iv) IP-DI by type of industry

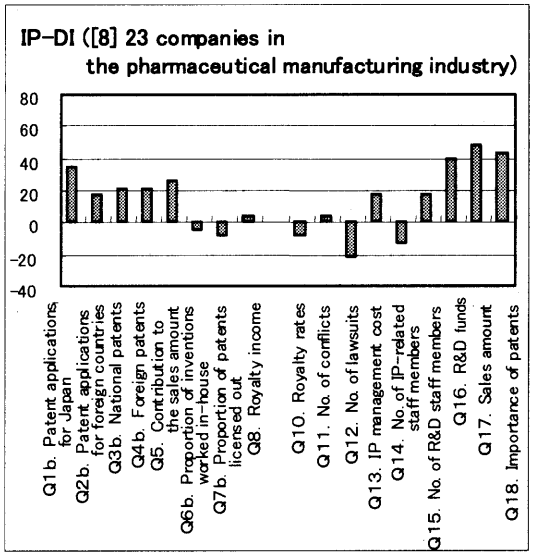
As examples of IP-DI by industry, IP-DI for the following three types of industries are cited below: the computer / telecommunications industries, iron and steel / nonferrous / metal products industries, and pharmaceutical manufacturing industry.

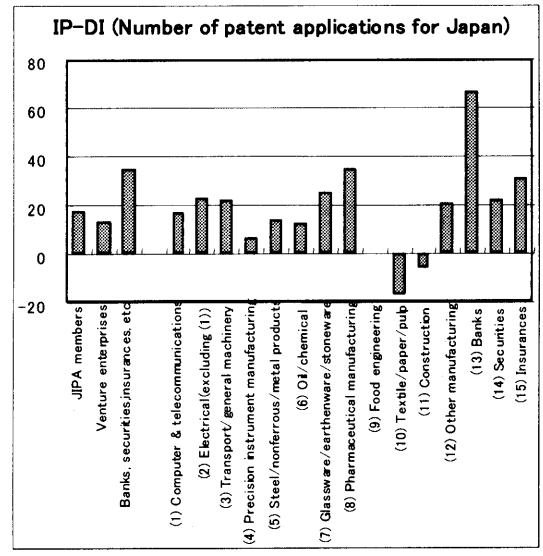
IP-DI for the computer/telecommunications industries show that intellectual property activities are by and large vigorous (plus) compared with the previous term, such as in the areas of "patent applications in foreign countries", the "number of conflicts", the "number of lawsuits", "intellectual property management cost", and the "number of intellectual property-related staff members". The "importance of patents as management resources" has also increased.

As for the iron and steel/nonferrous/metal products industries, the "importance of patents as management resources" has increased, but apart from the "proportion of patents exploited in-house" and the "number of conflicts", intellectual property activities have hardly changed in general over the previous term (slightly to the plus). This is assumed to be the influence of cuts in "R&D cost" and "R&D staff members" due to the economic slump.









With regard to the pharmaceutical manufacturing industry, "patent applications in Japan", "patent applications in foreign countries", "domestic patents", "foreign patents", "contribution to the sales amount," and "intellectual property management cost" became more active (plus), and the "number of lawsuits" decreased (minus). The "importance of patents as management resources" was also high (plus), and intellectual property activities were generally vigorous (plus) compared to the previous term.

(v) IP-DI for each question

As examples of IP-DI for each question, IP-DI for the following three questions are cited below: the number of patent applications in Japan; the number of conflicts; and intellectual property management cost.

① Number of applications in Japan

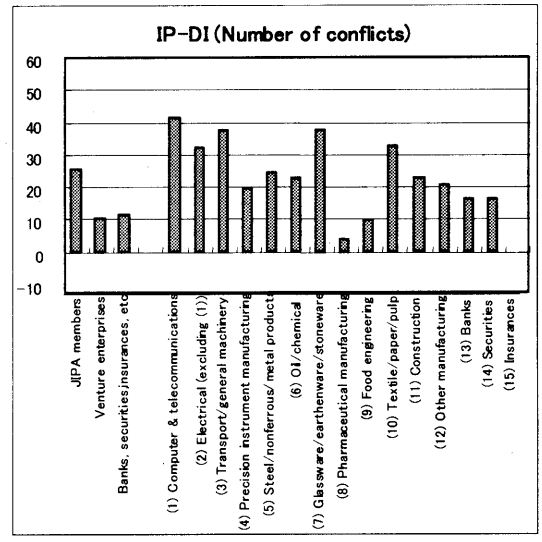
The number of applications in Japan has increased (plus) over the previous term in most of the industries excluding the construction and the textile/paper/pulp industries. The IP-DI for banks was particularly high(*4) .

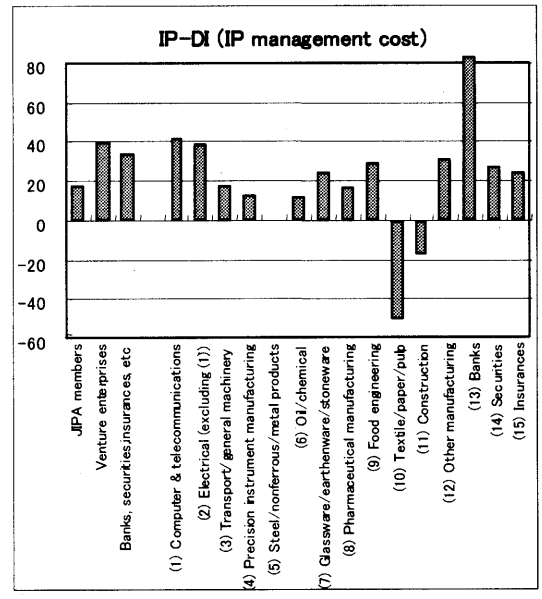
② Number of conflicts

The intellectual property activities were vigorous (plus) over the previous term in most of the industries.

③ Intellectual property management cost

The increase (plus) and decrease (minus) varied among the industries. The increase trend was especially notable for banks, and the decrease was notable for the textile/paper/pulp industries.





(*4) It should be noted that the IP-DI for banks is the figure for the only six banks that responded to the questionnaire.

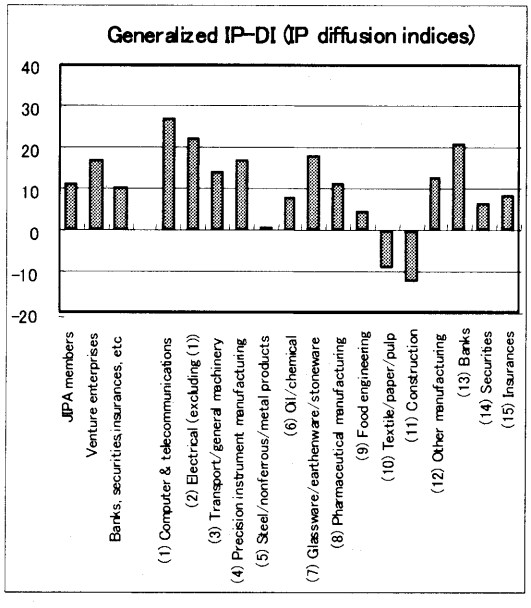
(vi) Generalized Intellectual Property Diffusion Indices (Generalized IP-DI)

The generalized IP-DI was created based on the IP-DI for each question, as indices that provide a comprehensive picture of the vigorousness of intellectual property activities.

Generalized IP-DI:
The average value of the IP-DI for 15 questions that do not include the "importance as management resources" (Q-18) and "contribution to the sales amount" (Q-5).

The result of an analysis using the generalized IP-DI numerically indicated the general trend that the intellectual property activities of venture enterprises are more vigorous than those of JIPA members.

In terms of industry, the value was higher (i.e. intellectual property activities were more vigorous than the previous fiscal year) for computer/telecommunications, electrical (excluding computer/telecommunications), transport/general machinery, precision instrument manufacturing, glassware/earthenware/stoneware, and banks.



(vii) Summary

The IP-DI and generalized IP-DI were developed as indices for the vigorousness of activities relating to intellectual property, particularly patents. They are potential indices that could be used to understand the vigorousness and distinctive features of intellectual property activities of the Japanese industries overall or of each industry individually, as well as their annual transition.

The following items could be additionally considered in the future: ① selection of companies contacted in the questionnaire survey; ② contents of questions; ③ definitions of IP-DI and generalized IP-DI; ④ method of the questionnaire survey (feasibility of an e-mail); and ⑤ frequency and timing of the survey. If these aspects were to improve by conducting continuous surveys over a few years, the applicability of the indices could be enhanced further.

(2) Static Indices of Intellectual Property (IP Static Indices)

Last fiscal year, IP static indices were proposed as indices for quantitatively expressing the relationship between intellectual property rights and corporate management(*5). They were, for instance, the patent index as against sales amount, the patent index as against current profits, the patent index as against royalty income, the intellectual property cost index as against sales amount, the intellectual property cost index as against R&D cost, the intellectual property cost index as against current profits, and the intellectual property cost index as against royalty income.

These indices quantify the value, profitability and cost of intellectual property in a company, and they could be used by companies to formulate their business strategies relating to intellectual property. So, an interview survey was conducted to companies in order to verify the applicability of these indices. Interviews were held with a total of seven companies: two large companies in the electrical industry, two large companies in the chemical industry, one large company in the pharmaceutical industry, one medium-sized company in the machinery industry, and one medium-sized company in the electrical industry.

(Interview results and future challenges)

Many of the interviewed companies commented on the applicability of IP static indices that, although they would refer to the indices if publicized, the indices would hardly affect the management policy of the company. Major comments were as shown below.

(a) The value of a patent has various aspects, such as the licensing value, the value as a technical capability that is influential to the alliance, and the value as an influence to the stock price. Therefore, it is difficult to evaluate patents in a unified manner, and this circumstance makes it difficult to evaluate the obtained indices.

(b) Each company has its own policy concerning intellectual property strategies. So, individual companies may not take an interest in indices that are derived by a simple method such as averaging.

(*5) Institute of Intellectual Property, *Tokkyo Keizai Moderu (Tokkyo Keizaigaku) Ni Kansuru Chousa Kenkyu Houkokusho* (Research and study report on a patent economy model (patent economics)), March 2000.

(c) On the other hand, such data as the number of applications reflects the policy of each company. Therefore, the average value of such data would lack preciseness and steady foundation as an index, so they would not serve as an effective reference unless narrowing the group of companies of the same industry and same scale.
(d) Intellectual property-related indices are regarded merely as the results of corporate activities.
(e) In spite of the pro-patent era, top management are still not so interested in intellectual property, except management in limited fields including the pharmaceutical industry and the electrical industry.

Nevertheless, we heard from the large companies in this interview that the intellectual property cost, intellectual property cost index against R&D cost, balance of licensing income and payment, and other intellectual property-related items are reported to the company management. They said that they also sometimes referred to the indices of the competitors for comparison.

Therefore, examining the above comments, the usefulness should be improved (including the numerical accuracy), and the changes in companies' business environments with time should be followed by a regular publishing of the indices. Then, the indices would become more recognized by companies and their applicability would be enhanced.

2 Management Strategies and Patents of Venture Enterprises

With regard to small and medium-sized enterprises with large market shares, data analyses were conducted on the relationship between patents and financial performance, and an interview survey was carried out concerning intellectual property management.

(1) Business Activities and Patents of Companies with Large Market Shares (Result of Data Analysis)

(i) Distinctive features and an overview of the sample companies

Companies with large market shares whose data was analyzed in this study consisted of the following two groups. Descriptive statistics are shown to give an idea of the general situation of the respective groups.
(a) 548 "small top share companies" capitalized at less than two billion yen and selling less than 50 billion yen (hereinafter "small-scale")
(b) 100 "successful top share companies" capitalized at two billion yen or more and selling 50 billion yen or more (hereinafter "large-scale")

	Share in Japan (Market size)	Years untill IPO(*6)	Sales amount per employee
Large-scale	57% (82.3 billion yen)	28 years	75 million yen
Small-scale	62% (12.5 billion yen)	26 years	34 million yen

	Number of patents owned	Number of patents per employee	Number of utility models owned	Number of utility models per employee
Large-scale	143	0.14	45	0.044
Small-scale	12	0.07	9	0.059

(ii) Business activities and patents

Analyses have been conducted with correlation charts and correlation coefficients as well as regression analyses on the relationships between some of the variables. The analysis results suggested the followings regarding the relationship between business activities and patents.

Firstly, the relationship of the number of owned patents or the like per worker with items such as the sales amount or domestic market share per employee was not so noteworthy overall. This was partly due to few indices available regarding the business results of companies, but there is also a need to review the framework for measuring the economic effect of holding patents or for analyzing the significance of the act of filing applications for patents and holding patents in small-scale companies.

Secondly, it was examined how the act of filing applications and holding patents or the like and the number of owned patents per employee changed in relation to the expansion of the company's size in terms of sales amount. Among the sample companies, the "large-scale" companies, which were already large in size, had an increase in the number of their applications and their owned patents and utility models that occurred at a similar pace as the expansion of their size in terms of sales amount. However, in the case of the relatively "small-scale" companies, the number of their patents and utility

(*6) The years taken untill IPO (initial public offering).

models saw a degressive change in relation to their size expansion. Specifically, while the number of patents increased with their expansion, the rate of the patent increase gradually became smaller in comparison to the rate of the size expansion. A distinctive feature of "small-scale" companies seems to be that, even in the case of those engaged in technological development, they file applications for patents and utility models by carefully selecting the ones for defensive purposes and the basic patents in order to save the intellectual property-related costs and due to their specific purposes for obtaining patents.

(2) Intellectual Property Management in Venture Enterprises Having Large Shares (Interview Results)

The interviews were conducted with four companies engaged in technological development in and around Osaka.

Company A: 130 employees, of which 70 are engineers, and approximately two billion yen in sales. It develops and sells equipment and instruments for vibration tests.

Company B: 39 employees, of which five are engineers, and 1.65 billion yen in sales. It has the top share in some positioning instruments relating to sensors and lasers.

Company C: 128 employees, of which one-third accounts for engineers, and approximately five billion yen in sales. It develops, manufactures, and sells processing chemicals and manufacturing equipment for printed circuit boards.

Company D: 80 employees, of which 70% accounts for engineers, and slightly over three billion yen in sales. It was the first in the world to develop and commercialize a semiconductor gas sensor and has the top share in sensor-related instruments.

All of these companies have the domestic top share in their respective business fields or products. Therefore, they say that they can receive large amounts of useful technological information and product information for development from their business connections. This makes it possible for them to file a broader scope of claims when filing patent applications for newly developed products.

Many of the companies had a policy to file applications for patents after the products have been completed. At the same time, the limited funds and manpower have often prevented them from acquiring peripheral patents and patents relating to the use of the inventions. The actual situation of intellectual property management in these companies seems to be to file patent applications for the results of their daily activities of product/technology development one after another according to the content. For venture enterprises and small-and medium-sized enterprises in general, the first priority seems to be to obtain patents for "defensive" purposes that are directly linked with their daily business. Still, however, there was an attitude of promoting patent obtainment under the leadership or "understanding" of the top management.

From the viewpoint of patent strategy, patents are a "visible" defensive means and contribute to clarifying a company's relationship with its competitors in terms of rights. On the other hand, when companies have overwhelming technological advantages over others, the real sources of their competitive edges seem to be supported rather by reinforcing the technological advantages in the form of "invisible" know-how or trade secrets.

(Senior researcher; Yoshinori Okazaki)