

## 4 Research and Study on Patent Economy Model (Patent Economics)

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*As globalization of the economy proceeds, the influence of intellectual property rights on industry is increasing. In the future, in order to take various measures such as a pro-patent policy, verifying the influence of such measures on industry will therefore become increasingly necessary.*

*In this study, we use economic indicators to analyze how intellectual property such as patents affects both the macro economy and micro economy (especially business management), and investigate socio-economic effects of the recent pro-patent policy from an economic perspective. Finally, we hope that this study will contribute to the development of the intellectual property policy of the government and corporate strategies on intellectual property.*

### I Change in Contents of Pro-patent Policy

#### 1 Verification of Pro-patent Policy

The pro-patent policy of Japan was analyzed by surveying the views of experts and businessmen on the following.

##### (1) Possibility of Bipolarization in the Global Survival Game

- i) As with giant enterprises and small ones, strong companies and weak ones, booming industries and depressed ones, multi-national companies and domestic ones etc., so too there is a progressive bipolarization into strong enterprises and weak enterprises in the patent world, with a clear difference of competitive power between them.
- ii) Small- and medium-sized companies including ventures companies are generally weak in many aspects such as strength of funds, production, personnel, organization, development, and negotiations (including lawsuits, etc.). It is therefore necessary in addition to money funding such as venture capital to establish and strengthen the advisory system for providing advice to small- and medium-sized companies regarding management administration, legal matters and engineering.
- iii) If small- and medium-sized companies have acquired a patent right, but large enterprises have applied for and acquired many patents surrounding the above right, then the former cannot utilize the patent. As a result, large enterprises can purchase a patent developed by a small company at a very low price, which is an advantage for large enterprises.

##### (2) Cost Increase

- i) The cost, time and labor for patent administrative procedures have increased, such as the cost of acquiring patents

(domestic and overseas), cost of administering and maintaining patents, cost of patent searches, etc. The ratio of such costs to R&D expenses is also rising.

- ii) The rising ratio of licensing fee to product price will finally result in a greater burden on consumers. It is recommended that the value of intellectual property rights (market value) be set at a reasonable price for the long-term future. For example, a pooled license system is one approach.
- iii) Since a lawsuit itself is not productive for society, relatively few people can benefit from the lawsuit. The increasing legal cost of a patent lawsuit will eventually place a burden on consumers and taxpayers by way of an increase in social costs. A fair and effective method (know-how) and framework for solving disputes need to be developed and established.
- iv) It is important to maintain the social balance between remuneration paid to inventors and recovery of R&D investment cost, and the costs paid by beneficiaries of patented technology. Excessive costs thereof run counter to the intention of the intellectual property system, which is to improve living standards by developing industrial technology.

##### (3) Questionability of the Content, Quality and Speed of Patents

- i) Lately, the value of patents has been rising, and as a result, the content and nature of patents have been strictly questioned. The content of examination is also questioned, the responsibility of the examination has become strict, and a prudent approach during examination has become more important.
- ii) Regardless of the Patent Office, the intellectual property divisions of enterprises, patent firms and courts of justice, quality is becoming increasingly important, so overall patent activities must be of high quality.

- iii) As the pace of change accelerates, faster patent activities are required, thus inevitably raising the social cost of improving the content, quality and speed of all work.
- iv) Enterprises should reduce their applications for defensive patents in future, and their intellectual property division must strictly assess the content of input and outputs, as well as the cost.
- v) The skills of judges and investigators regarding technology matters in courts of justice need to be improved. Both quantity and quality are required. This applies to attorneys and patent agents. However, there are few professionals who have both legal and technological skills at present.

**(4) Appearance of Patents that Do Not Accompany Business Activities**

- i) Patents are increasingly being purchased as speculation solely for the purpose of making money. This restricts the productive activity of enterprises and raises the production cost of manufacturers due to the payment of unfair royalties, and consumers must then bear such rise in cost.
- ii) Once an unproductive manufacturer has built up a network of patents, a manufacturer that makes products actually cannot utilize its own patents even if it has stand-alone patents. In addition, when intending to use the network, other manufacturers are limited in executing the right because the patents of an individual enterprise are pooled.
- iii) Once the patents are pooled, there is a substantial risk of cartel activity. A patent-holding group such as a guild association may hinder free competition.

**(5) Range of Rights Obligated to Be "Reasonable Scope Corresponding to the Contribution of an Invention"**

- i) The range of patent rights must be "reasonable scope corresponding to the contribution of an invention" and should be adequately considered so as not to destroy the incentive for research and development, which would cause science and technology to stagnate.
- ii) From the viewpoint of public welfare and socio-economic ethics, a social mechanism or system is needed that restricts and corrects an excessive pro-patent policy, and keeps a balance in society.

**(6) Consideration of Social Systems Concerning General-purpose Technology**

- i) To prevent the use of exclusive patent rights from restricting R&D activities and to encourage the development of appropriate industrial technology, a social system needs to be prepared. Just as general-purpose

technology is more useful and widely used, technology exhibits real value and is considered to benefit the development of industry and an improvement of the living standard.

It is thus necessary to prepare a system through which everybody can use patents for reasonable license fees (acquisition of licensing right by public organizations, and release to the public, etc.).

- ii) Article 93 of the Patent Law (arbitrated licensing right for public society) has seldom been invoked, and the interpretation of "public society" that consequently limits the right of patentees is regarded as extremely narrow and somewhat ineffective. The system needs to be reviewed.

**(7) Patent and North/South Problem**

Patents are maldistributed in developed countries, but the relationship of intellectual property rights and developing countries is unidirectional. As industrialization proceeds in the developing countries, royalty payments to patent-holding foreign enterprises will increase, draining those countries of the funds to be used directly for the industrialization.

**(8) Globalization of Business, Expansion of Internet Society and Systems**

The activities of enterprises and internationalization of business continue to develop regardless of whether the economy is in a boom or depression. Personnel and social exchanges via the Internet enable information to cross national boundaries and systems. In today's fast-changing society, firms must act quickly, but no system has yet caught up with both the conditions of change and the speed of change. The three centers of Japan, the U.S. and Europe should establish a common patent system and criteria.

**(9) Miscellaneous**

- i) Innovation is a complex social phenomenon that is affected by various issues, but excellent technology will develop with or without an intellectual property system.
- ii) The intellectual property system accounts for only a small portion of the economy but has a very important relationship with the capital markets. When young people generate ideas and obtain capital, the system is particularly effective.
- iii) Factors that make the U.S. economy innovative are: (a) access to capital, (b) scientific thinking, (c) education, (d) fluidity of labor market, and (e) ease of incorporation and liquidation of companies. These factors have a stronger impact than the intellectual property system.
- iv) Regarding the relationship between America's

pro-patent policy and its prosperous state today, it is a fact that some enterprises profit from patents, but there is no direct relationship between the country's prosperous condition and patents. The information industry itself has been the power behind the present boom.

- v) Strong protection by patent rights encourages technology innovation, but a social system that monitors and prevents the abuse of patents is needed. The excessive development of a compulsory license system in Canada has reduced the motivation to invent.

## **2 Patent Economy in Today's Global Innovation System**

### **(1) The Third Field Called Cyber Economy**

The pro-patent strategy that rapidly developed in the U.S. in the 1980s has, after some twenty years, become an essential dynamic element in the 21st century. Intellectual property as an economic resource goes beyond the boundary of accessories of human resources closed within one organization; indeed, it provides financial credibility in the network society. Moreover, sometimes it produces excessive profits (added value).

The origin of this trend can be traced back to 160 years ago, as the "new source of growth" pointed out by Friedrich List in his book published in 1841 (Chapter 19, "The National System of Political Economy"). Namely, "... in developed countries in the past, physical capital has been overly used as the source of productive power. Limitations ought naturally to be produced in a free economy in which mental capital has been neglected. It is incorrect to focus on only the productive power resulting from the use of mechanical tools. It is necessary to develop industry so as to maximize the synergistic effects of mental and physical capital." Recognition of the importance of this mental capital led to the patent system. However, as the later historical process shows, the emphasis has been on physical capital while treating mental capital like a promissory note to prevent exclusion in the zero-sum economy (in which there is no economic growth). It is necessary to return to harmonious development as indicated by List.

There is one more trend that must be monitored in assessing how the knowledge-based society will develop, namely, the rapidly-growing third field called cyber economy. It has past a half century since one paid attention to a possibility of advanced information society or innovativity of networked society. The initial

stage of "information technology (IT) revolution" was born from the need to effectively use scarce resources, but only attempted to improve the efficiency of using physical energy. This promoted mainly the growth of the "object economy". But the act of settlement in the object economy brought about the second stage of the IT revolution in the "financial economy". That is, the revolution extends beyond a credit settlement system and changes various functions of conventional organizations and systems. Indeed, it has gained so much strength that it has changed the value system in the object economy and the financial economy. The "creative destruction" phenomenon cited by Schumpeter is proceeding. The IT revolution brought one kind of accumulation. Extensive knowledge that underpins society is being accumulated. In the networked society that extends beyond national boundaries, fields and organizations, economic activity depends on knowledge. This is the so-called "cyber economy". This cyber economy will promote the growth of the object economy and the financial economy. A new market (such as e-commerce) is forming between the object economy and the financial economy.

"Intellectual property premium goods" based on a package of intellectual property will generate surplus profits. But on the contrary, there is a risk that the cyber economy may have adverse impacts. For example, friction resulting from the transfer of productivity increases the gap between the supply and demand for human resource, and so unemployment may rise. In addition, boundless transactions expand the black economy, which heighten the social risk. A balance needs to be struck between the benefits and disadvantages of the cyber economy.

### **(2) Global Innovation System**

As the cyber economy grows, society will no longer be based on the object economy and financial economy, and the nature of intellectual property will vary largely.

Intellectual property has suffered from being closed and weak. It needs to change to an open, robust system. With open intellectual property in which information is disclosed and distributed, intellectual property will have a global nature beyond national boundaries, fields and organizations. A pro-patent policy based on wide protection (expansion of range) and strong protection (expansion of validity) will correct the conventional weaknesses and make the system more robust.

However, it is not easy to shift from a closed, weak intellectual property to an open, robust intellectual property. The risk of instability due to the strong influence of environmental conditions and the absence of market principles

due to diversity of evaluation criteria, stemming from the conventional weak nature, are barriers to such a shift. A means of overcoming these barriers is necessary. Of course, the environment in which free usage prevails must be eliminated. In addition, expanding the range and validity will introduce new weaknesses such as the ambiguity problem of doctrine of equivalence and the trap of validity. The pro-patent policy will inevitably become increasingly multi-layer in nature.

The trend of society moving to an open knowledge-based society cannot be stopped. But there are differences between enterprises, differences between industries, and international differences in intellectual property dynamics. A stable model case cannot be established, and this is another barrier. It is necessary to establish a new "gemeinschaft" to enable an open, robust intellectual property society to develop.

The framework of the new "gemeinschaft" is still immature and is still being formed. For example, a TLO, patent consortium, venture group, world-common patent system, etc. are included in the scope. The objective of many of these is to create an open, robust intellectual property system as the basis. They differentiate from the so-called "gesellschaft" whose main purpose was to boost individual profits, and are shifting to a "gemeinschaft" that uses individual characteristics and knowledge. However, suitable experts for senior management are generally scarce, and a pro-patent orientation in research and development is currently impossible.

Those who insist on the "gesellschaft" of technology push-type cannot recognize the possibility of the "gemeinschaft" of needs-pull-type generated by non-experts. They keep the "gesellschaft" called "international" with difficulty while firmly maintaining a "national innovation system" that aims at maximizing the efficiency of distributing resources in the strong framework of enterprises, nations and professional fields. It is an old society based on a closed, weak intellectual property.

It is necessary to create a system that discloses more information such as patents, promotes the distribution of knowledge and extends the global technical innovation of needs-pull-type across national boundaries, professional fields and enterprises. This is called a global innovation system.

### **(3) Center of Excellence as the Foundation of the Knowledge-based Society**

An open knowledge-based society is only just beginning to be formed. To enhance the weak intellectual property market, a reliable and stable market must be built while reducing the

cost of information. A social needs-pull-type system must be created for making intellectual property available, as well as a method for overcoming the weaknesses of intellectual property. However, to secure such centers of excellence (for distributing and promoting IP) domestically in enterprises and universities, sophisticated strategies are necessary. Skilled personnel must be trained to promote an open knowledge-based society rapidly and widely.

Also, centers of excellence must not be uniform. In today's era of diversification and cooperation, centers of excellence must be multi-faceted. It would be a good idea that local governments establish "angel fund" which is available for investing in key areas. Centers of excellence should promote the market for unused patents, led by the government. Consortiums based on patents, opening up of grading information on patent prices from third parties, and establishing a test market for an open knowledge-based society mainly by universities are basic measures. Businesses derived from patents should be encouraged through linking to funding.

These various model cases are considered, but it is also important to conduct research on centers of excellence in the social non-core (non-central axis of ongoing social needs) field when promoting the open knowledge-based society. It is important to utilize the old core technology possessed by large enterprises and that of non-core fields held by enterprises which have moved away from the manufacturing industry. In addition, universities and public research facilities must actively bring the subject in the social non-core fields. The needs of developing countries possibly correspond to the non-core fields in Japan. It is important to establish a global innovation system dealing with the social non-core fields.

## **II Patent Economy Analysis and Enterprise Management**

### **1 Analysis of Present Condition of Enterprise Management, Using Index of Intellectual Property**

#### **(1) Characteristics by Enterprise Scale**

As the number of employees increases, R&D investment rises and so the ratio of R&D (the degree of concentration of research and development) increases. However, the unit cost of a patent application remains the same or a little lower. This is because the number of patent applications rises at least in line with the amount of R&D investment.

In addition, the cost of intellectual property seems to be declining slightly. That is, there are some economies of scale regarding research & development and intellectual property administration. Furthermore, as mentioned above, the

larger the enterprise, the higher the rate of return on patent rights. This pushes up the unit price of intellectual value, as the cost of intellectual property decreases.

<Actual numbers>

Number of employees	Less than 1,000	More than 1,000	More than 3,000	More than 5,000	More than 10,000	Total
R&D ratio (%)	3.0	4.3	3.4	4.2	5.0	4.6
Unit cost of an application (ten thousand yen)	7,102	6,823	6,930	5,301	6,666	6,650
Return on sales (%)	7.8	9.9	10.2	8.4	11.1	9.4
Cost ratio of intellectual property (%)	0.27	0.29	0.26	0.24	0.20	0.27
Unit price of intellectual value (thousand million yen)	1.7	2.0	4.7	3.2	4.6	3.1

<Index values, Total=1>

Number of employees	Less than 1,000	More than 1,000	More than 3,000	More than 5,000	More than 10,000	Total
R&D ratio (%)	0.65	0.93	0.74	0.91	1.09	1.00
Unit cost of an application	1.07	1.02	1.04	0.80	1.00	1.00
Return on sales	0.83	1.05	1.09	0.89	1.18	1.00
Cost ratio of intellectual property	1.00	1.08	0.97	0.89	0.74	1.00
Unit price of intellectual value	0.56	0.64	1.52	1.04	1.50	1.00

## (2) Characteristics by Type of Industry

The table below compares the index across industry types and assesses it relatively. The results of the assessment consequently affect the ranking, concerning research & development in each industry, return rate, the efficiency of intellectual property administration, and also the "high or low" of intellectual value and others. Note that such ranking does not evaluate absolutely the productivity of intellectual property rights in each type of industry. Rather, it indicates only the relative positions derived from the characteristic of each type of industry.

The characteristics of each industry are as follows.

### i) Pharmaceuticals

Research & development investment in this field is active and patent applications are made only for strictly-selected inventions, from the results of research and development, so the value of each patent is higher. Intellectual property rights thus acquired have high earning power. The administrative cost of intellectual property is highly efficient, and the unit price of intellectual value remains high in this field.

### ii) Chemicals, materials and machinery

In these industries, research & development is relatively weak and the return on intellectual property rights is low. The administration of intellectual property is relatively inefficient and overall intellectual value is low. As a whole, intellectual assets show relatively low productivity in these industries.

### iii) Steel

In this field, the economic indicator of research & development activity is low and the

stock of knowledge is relatively small. The return on intellectual property is low. However, the burden of administrative cost of intellectual property is small and compared with the cost of intellectual property, therefore the intellectual value is high. Intellectual property rights show relatively low productivity in this industry.

### iv) Electronics/Consumer Electronics

The R&D ratio in this field is high and investment is active to secure the stock of knowledge. However, the number of patent applications is large, and the earning power to sales and ordinary income per patent are low. On the contrary, the proceeds from royalties are large and so this industry is highly productive in terms of royalties.

### v) Automobiles

This industry enjoys a high earnings rate and efficiently administrates intellectual property as well, so the high intellectual value is maintained.

### vi) Precision machinery

This field constitutes knowledge stock at high R&D ratio. However, the large number of patent applications means a low unit cost for an application, and so a low earning rate per patent right. However, the unit price of intellectual value is high. The creation of intellectual value is thought to depend upon know-how other than patents.

### vii) Construction

In this field, R&D investment is relatively low and hence the unit cost of an application is low. However, the small number of patents held means that the earning rate per patent is high. However, the low intellectual value means that actual earnings of intellectual property rights

are poor.

Assessment of various economic indicators by industry

	Average index	Pharmaceuticals	Chemicals	Materials	Steel	Electronic/ Consumer electronics	Automobiles	Precision machinery	Machinery	Construction
R&D ratio	4.6%	⊙	△	×	×	○	△	○	×	×
Unit cost of an application	67 million yen	⊙	×	×	×	×	△	×	×	×
Total research & development		⊙	×	×	×	△	△	△	×	×
Return on sales	900 million yen	○	×	△	△	△	○	×	×	○
Ratio of return to ordinary income	30 million yen	⊙	×	×	×	×	○	△	×	○
Return ratio of royalties	1.2 million yen	⊙	×	×	×	○	○	×	×	×
Total rate of return		⊙	×	×	×	△	○	△	×	×
Cost ratio of intellectual property (to sales)	0.27%	△	×	○	○	×	○	×	×	○
Cost ratio of intellectual property (to R&D)	10.8%	⊙	×	△	○	△	○	×	×	△
Cost of intellectual property (to ordinary income)	40 times	○	×	△	×	×	△	△	×	○
Cost of intellectual property (to royalties)	1.4 times	○	×	△	△	○	△	×	△	×
Total cost of intellectual property		○	×	△	○	△	○	×	×	○
Unit price of intellectual value	300 million yen	⊙	×	×	×	△	○	○	×	△
IP cost magnification of intellectual value	540 times	○	×	×	○	△	△	△	×	×
Total intellectual value		○	×	×	△	△	○	○	×	×

○:The index is relatively high or the economic indicator is at an efficient level.

⊙:The economic indicator is at a high level

△:The degree of the economic indicator cannot be determined or is in the middle level.

×:The index is relatively low or the economic indicator is low in efficiency.

<Actual values>

	R&D ratio(%)	Unit cost of an application (ten thousand yen)	Return on sales (%)	Cost ratio of intellectual property (%)	Unit price of intellectual value (thousand million yen)
Pharmaceuticals	10.2	32,208	9.4	0.26	14.1
Chemicals	4.5	3,570	12.7	0.31	0.8
Materials	2.3	3,391	3.3	0.14	1.8
Steel	2.4	2,347	5.4	0.14	1.2
Electronic/ Consumer electronics	8.5	4,624	6.3	0.38	2.7
Automobiles	5.2	6,071	5.6	0.09	3.3
Precision machinery	6.6	1,617	14.0	0.60	3.6
Machinery	4.4	2,912	3.5	0.32	1.3
Construction	0.9	4,091	2.7	0.06	2.7
Others	2.5	9,059	27.5	0.07	4.1
Total	4.6	6,659	20.1	0.27	3.1

<Index values, Total=1>

R&D ratio	Unit cost of an application	Return on sales	Cost ratio of intellectual property	Unit price of intellectual value
2.22	4.84	0.47	0.96	4.59
0.98	0.54	0.63	1.15	0.25
0.50	0.51	0.17	0.52	0.59
0.52	0.35	0.27	0.52	0.38
1.85	0.69	0.32	1.41	0.87
1.13	0.91	0.28	0.33	1.09
1.43	0.24	0.7	2.22	1.18
0.96	0.44	0.17	1.19	0.42
0.20	0.61	0.13	0.22	0.88
0.54	1.36	1.37	0.26	1.32
1.00	1.00	1.00	1.00	1.00

viii) Conclusions

- The pharmaceutical industry typically enjoys a relatively high earning power of patents by creating a stock of knowledge.
- In the chemicals, materials, steel and

machinery industries, the index indicates a low earning power because an insufficient stock of knowledge is created.

- In the construction industry, little knowledge stock is created but this makes the number of

patents smaller and hence the earning power per patent higher.

- In the electronics/Consumer Electronics and precision machinery industries, knowledge stock is created but the qualitative earning power is lower than that of pharmaceuticals etc. compared with the stock.

### (3) Characteristics by R&D Ratio

In enterprises having a high R&D ratio, the unit cost of an applications is high and applications are strictly selected, so high-quality

rights are secured. As the cost of intellectual property increases, more rights are acquired as a whole. However, the rise in the cost of intellectual property is not so high as that in the good results of research & development. Namely, high-quality rights in terms of absolute value are largely acquired.

This trend is apparent in enterprises where the R&D ratio is more than 10%. Enterprises in this group have a very high unit price of intellectual value.

Various economic indicators classified by R&D ratio

R&D ratio	Cost ratio of intellectual property	Unit cost of an application	Unit price of intellectual value
0- 3%	0.15%	37.68 million yen	260 million yen
3- 5%	0.31%	50.84 million yen	110 million yen
5-10%	0.39%	60.96 million yen	230 million yen
More than 10%	0.40%	280.48 million yen	1,430 million yen

### (4) Comparison with the U.S. and Japan

In general, Japanese enterprises have tried to create intellectual stock in the form of intellectual property rights by investing more heavily in intellectual property than in the U.S. As the unit cost of an application shows, the invention value per patent of Japan, however, is only one-fourth of that in the U.S. This is because the number of applications in Japan is

large, which makes the ratio of intellectual property cost to sales and research & development costs twice as high as those in the U.S.

The earning power of one patent in Japan is thus smaller than one in the U.S. This is because Japan has acquired a relatively large number of rights, but focused on the quantity rather than the quality of those rights.

Comparison of economy indicators between the U.S. and Japan

	Japan (large enterprises)	the U.S.
R&D ratio	5.0%	3.9%
Unit cost of an application	66.66 million yen	297.64 million yen
Cost ratio of intellectual property	0.20%	0.09%

## 2 Influence of Information Accompanying Patent on Stock Price

A study of the relationship between patent information and stock prices shows that when investors have sold stocks after losing a patent lawsuit, the stock price of the enterprise tends to fall.

On the contrary, if a patent lawsuit is won, the stock price is not so sensitive and investors do not immediately invest. Concerning the relationship between winning and losing patent lawsuits, stock prices at least seem to move asymmetrically.

## 3 Strong Connection between Growth of Venture Enterprises and Intellectual Property ?

With respect to patent indicators, a method for analyzing the restricted data was developed by focusing on only the relationship between the basic financial indicators of enterprises and patents/utility models. It was found that:

- (1) The correlation coefficients of indicators associated with patents, etc. and scale ones do not coincide largely in parts between venture enterprises and listed ones;
- (2) Utility models have an inherent role different from that of patents and so provide a method for acquiring rights helpful for not only classification by type of industry and the timing of application but also small-scale enterprises;
- (3) With respect to venture enterprises, as the directivity of acquiring intellectual property ("hit ratio") increases, the growth before a public offering over the counter is high and the growth after such offering and profits are rising;
- (4) As regards venture enterprises, only those enterprises that direct to acquiring patents/utility models enjoy improved ordinary profits and sales; etc.

However, as the analysis results here were obtained only from limited data, they strongly reflect the characteristics of tentative assumption. It is necessary to carefully check

again the statistical accuracy and stability using other samples. Also with respect to venture enterprises, the meaning of patent strategies, etc. must be defined through a case study on a particular enterprise. Further, as businesses become increasingly global, the strategic meanings of applying and registering patents in foreign countries must be recognized. These are subjects for future studies.

### III Establishment of Patent Economy Model

The ultimate objective is to develop and propose a patent economy model, but this cannot be achieved at present. However, the proposed viewpoints of theoretical analysis clarify the macro characteristics and provide a framework of the patent economy model.

The viewpoints of the analysis are as follows:

#### 1 Factors Changing the Disposition of Patents:

Factors changing the disposition of patents were considered as indicators showing how many patents enterprises have applied for and acquired to the given quantity of both the power of enterprises applying for patents and input elements to inventions.

#### 2 Contribution of Patents to Economic Growth:

The analysis of contribution of technological knowledge to growth was outlined according to the framework of traditional economy model, while clarifying the problems of the framework to be used for economic analysis of patent. Furthermore the meaning of patent data for developing the analysis was mentioned.

#### 3 Estimation of Investment Multiplier of Intellectual Property:

As a technique for abstracting the "net effect" of intellectual property, two techniques are considered: one is a technique for setting a suitable productive function to measure the limited productive power of intellectual property stock, and the other is a technique for assessing the return of intellectual property stock on the total amount of stock prices to, measure the so-called "partial q of intellectual property stock" (the "q of Tobin", also referred to as "Multiple q").

#### 4 Conditions of Rationalizing Research & development Competition in an Open System:

A mathematical approach was adopted concerning factors for determining research & development investment by enterprises, and the characteristics of an enterprise's strategy on the licensing of patents.

The above four items were analyzed but are only summarized here. For the details including the mathematical explanation and the approach

technique, see the report "Research and Study on patent economy model (patent economics)".

### IV Future Issues in Patent Economy Analysis

Analysis of the patent economy in today's knowledge-based society has just started. Future study issues are outlined below:

- 1 To reflect the trend of an open knowledge-based society
- 2 To be able to analyze the characteristics of the global innovation system
- 3 To be able to grasp the portfolio of intellectual property (the selection of assets) based on patents
- 4 To be able to clarify the managerial positioning of intellectual property and to conduct an analysis for providing a benchmark for strategic management
- 5 To analyze the trends of venture enterprises and individual inventors
- 6 To analyze factors of disturbing information in order to grasp the fundamentals of the economy
- 7 To prepare price, quantity and quality indicators about intellectual property; for example, to investigate the working ratio based on the rate of exploited patents to total number, to develop productivity analysis based on the number of inventions and to grasp the administrative cost and the number of patents owned in order to estimate the return on investment in intellectual property
- 8 To analyze human resources associated with the patent economy and employment trends

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