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TECHNOLOGICAL INNOVATIONS AND THE PATENT SYSTEM IN PREWAR JAPAN*

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Abstract

The purpose of this paper is to analyze the relationship between the technological innovations and the patent systems in prewar Japan. In the Japanese patent system, there has been a specific law for protecting small inventions. The law is called the "New Utility Model Law", and had greatly contributed to technological and industrial development in prewar Japan. In prewar Japan, the conventional industries had large market share, and their technological innovations were mainly improvements of old technologies. However, the law strongly supported the development of conventional industries. Technologies protected by the aforementioned law significantly contributed to the economic development of Japan, which had been a backward country.

Keywords: Patent System; New Utility Model Law; Large and Small Inventions
JEL classification: N65; O31.

I. *Introduction*

Present Japan is known not only as a big economic power but also a major patent's country.[1] Actually, before World War II, Japanese inventions still had not reached to European and American standards, however a huge number and variety of patents and new utility models had been invented and they contributed to prewar industrial and economic development.[2]

Quantitative analysis concerning technological innovation is an attractive theme. Furthermore, it is also important to analyze the technological policies of the governments, which regulated the character of technological innovation. However, as it is difficult to estimate the actual effect of technological policy, the studies concerned with this theme have not always been successful.[3] In particular studies of the patent system or prior studies in connection with

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[1] Since World War II, the number of patent applications from Japan has been consistently at the top in the world. In 2000, number of applications was 436.9 thousand and the registered numbers was 125.9 thousand.

[2] The number of prewar inventions is less than postwar. However, for patents, 160,000applications were approved (1885 to 1945), for new utility models, 340,000 applications were approved (1905 to 1945).

[3] For studies concerning prewar technological policies, Hiroshige [1973], Uchida [1986], Hashimoto [1994] are listed.

economic development had not really existed.[4] Therefore, this paper examines the relationship between the patent system and technological innovation in Japan. Jumping to conclusions, the new utility model law is a unique law concerning industrial properties in Japan and it has played a more important part than patent law. Because it protected a great volume of merely small inventions, these technologies could be utilized to the maximum and they greatly promoted the development of the conventional industries.

Section II indicates the characteristics of the Japanese patent system considering its formation process. Section III examines economic theory concerning large and small inventions according to my original viewpoint. Thereafter I'll set up a hypothesis, and the hypothesis is demonstrated quantitatively and generalized. Section IV evaluates the effect of several technological policies, which are deeply related to the patent system.

II. *Formation Process of the Patent System and Its Characteristics*

In 1885, the Japanese patent system was formally established and it greatly contributed to technological and industrial development. Also it had special characteristics. In other words, because the Japanese patent system had special distinctive features, it brought subsequent rapid technological and industrial development. One of the typical laws, which directly expresses the Japanese patent system's intent, was the new utility model law enacted in1905. This law was the very factor, which institutionalized and widely promoted Japanese modern technological and industrial development.

1. Establishment of the patent system

The Japanese patent system first was attempted in 1871, immediately after the establishment of Meiji Government. It was temporarily operated as the "Provisional Regulations for Monopoly". This regulation was abrogated the next year over the disapproval of monopoly rights. However, it had a historical significance as the first legal system introduced from Western Europe. That is to say, it is very interesting that the Japanese modern law system was started with an introduced patent law.[5]

There were many uncertain matters existing in this establishment and abrogation of the "Provisional Regulations for Monopoly". The following situation probably existed. First, for its establishment, the introduction of the Western patent system by the pioneers, Yukichi Fukuzawa and Kohei Kanda exerted a great impact on the Meiji Government, which had little knowledge of the patent system.[6] It can be conjectured that expertise of civilians contributed

[4] There are some commentaries on the Japanese patent system. For example, Japan Patent Office [1955], The Ministry of International Trade and Industry [1964], Ichikawa [1965], Japan Patent Office [1985], etc.

[5] "The Family Registration Law" was promulgated by proclamation of Minister of the Interior at the same time as the "Provisional Regulations for Monopoly".

[6] Yukichi Fukuzawa introduced the Western patent system in his "Western Affairs (third volume)" (1867), which was popular and was written based on his second travel abroad to visit Western countries (1861-62). Kohei Kanda strongly insisted the necessity of the patent system in his article "Hokoshisetsu", in volume four of "Western Journal" (1867). Furthermore, Ichiro Watanabe and Fumio Murata introduced and explained the Western patent system. For the detail, refer to The Ministry of International Trade and Industry [1964] and Ichikawa [1965].

to the enactment of the "Provisional Regulations for Monopoly". In fact, the then government enthusiastically accepted the new Western systems and the expertise of civilians. For the abrogation of this regulation, Korekiyo Takahashi, the first chief of the patent bureau, explained two reasons.[7] One was that it was difficult to expect excellent inventions due to the low technological standards then and the other was the absence of qualified examiners. At that time, the social and technological conditions to effectively manage a patent system did not exist. However, it goes without saying that this trial and error approach positively influenced the later establishment of the standard patent system, awakening popular awareness among the private citizenry and promoting of inventiveness.

In reference to the present legislative standards, the "Provisional Regulations for Monopoly", however, not quite satisfactory but was furnished with the essential requirements of patent law. It included the "principle of examination", which required submission of specifications and drawings. The monopoly effective term was determined including three ranks of: seven, ten and fifteen years, depending on the quality of the invention. Upon paying the patent fee, the monopoly right was granted to the applicant. It furthermore approved of the transfer, succession and enforcement of monopoly rights, and regulated the official patent notice, extensions of rights and penal regulations. The expression of the contents of this regulation was somewhat overbearing and had an authoritative tone. However, its contents deserve high respect. Many portions of the "Provisional Regulations for Monopoly" were cited in the "Patent Monopoly Act", enacted in 1885. Furthermore, for example, the approval of patent rights with specified term depending on the rank of the invention was cited in the later patent law and the new utility model law.

After the repeal of the prematurely delivered the "Provisional Regulations for Monopoly", the incentive to invent gradually increased within the private sector. Between the repeal of the "Provisional Regulations for Monopoly" in 1872 and establishment of the "Patent Monopoly Act" in 1885, 326 applications for monopoly licenses and inventions were submitted to the relevant local governments.[8] Notifications to the Ministry of Industries and the Ministry of Agriculture and Commerce totaled 56 applications,[9] which were for example, rice cleaning, brewery, textile, and chemistry, farming tools, stationery, surveying instruments, etc. Furthermore, news stories publicizing the inventions in newspapers exceeded 100 articles,[10] on inventions which including water-powered machines, silk technology, alloys, weapons, vehicles, telegraphy, furniture, paper technology, brewing technology, farming tools, etc.

Discussion on the establishment of the patent system arose spontaneously but gradually within the private sector.[11] For example, in the readers' column on July 9, 1873 of the Postal and Information Newspaper, the views of Shigesuke Kobayashi, drawing attention to the Tokyo Commerce and Law Conference, which was reported. It was insisted that the rickshaw's inventors should have been granted monopoly rights. Furthermore, Katsuro Nishimura petitioned the Lower House twice in 1874 to request the immediate establishment of the monopoly system. The Lower House accepted the petition, but the House of Representatives withheld it. However, the petitions by Nishimura and others might have been accepted or

[7] Refer to Takahashi [1936] pp218-219.

[8] Refer to Tamura [1988-89].

[9] Refer to the Ministry of International Trade and Industry [1964] pp90-91.

[10] Refer to Nakamura [1944] p24, Ichikawa [1965] pp31-34.

[11] Refer to the Ministry of International Trade and Industry [1964] pp82-86, Ichikawa [1965] pp35-47.

considered because the Ministry of the Interior started the planning of the trademark law in 1875.

After abrogation of the "Provisional Regulations for Monopoly", the government took a negative stand on the formation of the patent system. However, along with the aforementioned social and technological conditions gradually maturing, the interest in the system of the industrial property rights had increased within government. First, although the government guidelines were not yet clearly determined, enactment for trademark and design started. As this enactment section transferred first from the Ministry of the Interior to the Ministry of Finance (1878), and then to the Ministry of Agriculture and Commerce (1881), the enactment of the industrial property rights could not progress smoothly. Meanwhile, the draft from the Ministry of Agriculture and Commerce was examined from 1884 through the Ministry of Interior, the Systems Investigation Office, Councilor's Office and the Upper House, and was promulgated as the "Patent Monopoly Act", April 18, 1885.

The patent law had been amended four times by end of the World War II. With these revisions, the Japanese patent system gradually matured step by step. Incidentally, the trademark law (1884), the design law (1888) and the new utility model law (1905), which were parts of the industrial property rights, were revised in accordance with the revision of the patent law.

2. Enactment of the New Utility Model Law

As previously mentioned, the most distinctive example of the Japanese patent system was the "New Utility Model Law", which was enacted in 1905.[12] It was copied from the German new utility model law (1891). However, it had further effective provisions under the law. There were three major differences between the German and the Japanese laws. First, the protected items were restricted to "working tools or tools in use" in German law. However, they extended to general industrial matters in Japanese law. Secondly, the German law followed the principle of no inspection. In contrast, Japanese law was based on the principle of inspection similar to that of the patent law. And thirdly, the effectiveness of the rights of the German law was comparatively weaker than those of their patent law. However, the effectiveness of the Japanese new utility model law was almost the same as those of their patent law. For example, the duration period of the new utility model rights was originally three years with a possibility to extend for a further three years, however that was extended to ten years under the revision of 1921.[13]

The direct effect to the enactment of the new utility model law was the active invention boom after the Sino-Japanese War. However, a similar idea had existed before. Article 1 of the "Provisional Regulations for Monopoly" (1871) expressed that "...though it is a conventional technology, if it shows a useful and newly-devised function, the monopoly right will be approved within a certain period of time." The concrete expression of this right was evident in Article 2 of the same regulation. It provided that "the duration time of the monopoly right (for the patent acquisition) would be fifteen years for the first rank, ten years for the second rank

[12] Only Japan and Germany enacted the new utility model law before World War II. After the war, this law was introduced to many countries: Italy, Australia, Brazil, Mexico, Philippines, Korea, China, etc.

[13] Before this revision, a four-year extension was permitted through the partial revision of 1916.

and seven years for the third rank depending on the quality of the invention."[14] The "Patent Monopoly Act" (1885) regulated the duration time of the patent right. In principle the effective patent period was a maximum of fifteen years (Article 3) but there were also provisions for five and ten years in Article 17. The maximum period of the patent right was clearly regulated by the revision of 1888. In 1899, the revision provided just one period of fifteen years. However, after another six years, upon enactment of the new utility model law, the short periods patent rights were virtually restored.

Generally, in the patent law, there is comparative latitude in the alteration of patent duration time, which reflects political initiative. Government authorities regulate activity in invention through revisions of the laws in reference to social and economic circumstances.[15] This is obvious from the aforementioned series of revisions of the law in the Meiji era. The enactment of the new utility model law was actually an expedient in giving patent rights to minor inventions and devices. It was abundantly clear that this policy was reasonable considering the technological level of Japan in those days.[16]

III. *Economic Significance of the Patent Systems*

Various studies on the economic significance of the patent system had proceeded.[17] Because outcome of the research and development (R&D) is usually information for the economic value, that should tend to have the nature of the public goods, For example, non-excludability of consumption or inappropriability of return. The result of the R&D should be readily spilled to some other individual or organization as a kind of information. Therefore, not all of the profits were obtained from the application of the R&D should be returnable to the inventor/researcher. Consequently, the individual inventor's or the company researcher's incentive is diminished, but the total social benefit is magnified through utilization of the result. In this way, with regard to the activities of R&D, a contradiction exists between the private benefit and the social benefit. In order to resolve this conflict, some political intervention is required to raise the low level of invention to a socially optimal level. The patent system is commonly applied in many nations as one of the effective and important measures to solve in this problem.[18]

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[14] Refer to Ichikawa [1965] p23.

[15] The patent existing period is different from country to country. For the developed countries: 15 years for Japan, 16 years for Britain, 17 years for the U.S.A., 18 years for former West Germany, 20 years for France. The Japanese period is the shortest among them.

[16] Ichikawa said that the new utility model law was enacted as a defense from an invasion of the foreign high standard patents. (Ichikawa, [1965] p123)

[17] The traditional argument concerning the economic significance of the patent system was represented by Machlup [1858]. Arrow [1962] and Nordhaus [1969] tried to explain the patent system within the framework of modern economics. Kaufer [1989] investigated the patent system through economical analysis.

[18] There are many problems in the patent system. (1) Fundamental problems even if the patent system functioning as planned. (2) Problems that fundamentals of the patent system do not function or that the system itself is a negative factor. (3) Operational problems of the patent system. For detailed argument, refer to Kami [1984] pp 105-116.

1. Economic theory of large and small inventions

The patent system has the legal force to give a certain period of exclusive possessive right to the inventor or the owner of the new intellectual property and, on the other hand, to demand that the inventor or the possessor open the new invention to the public. Namely the patent system has two functions; one is that the inventor recovers the investment costs and will use the profit for further R&D, the other is that the unveiled new technology forces other inventors/researchers to join in competitive R&D. These are the general functions of the patent system, however, the degree of appropriability differ depending on the actual investment level. Arrow [1962] pointed out that the profit belongs to the inventor but its magnitude depends on the degree of the cost reduction after the invention. The argument regarding the question of large and/or small inventions is discussed.[19] The following is the outline of the discussion.

Fig. 1 (a, b) shows the social benefit, the inventor's personal benefit, and the consumer's surplus when the marginal cost of the produced goods through application of a new invention decreases from C_0 to C_1. Case 1 shows a comparatively large invention. Point A shows the price and quantity before the invention. Provided that the marginal cost decreases from C_0 to C_1, the resulting social benefit in the competitive market becomes P_1ACP_3. However, if the inventor requests exclusive benefit using such patent rights, it is possible to project the price and quantity to point B. The inventor obtains personal benefit corresponding to P_2BDP_3 with the royalty set at γ. On the other hand, by decreasing the market price from P_1 to P_2, the consumer's surplus increases to P_1ABP_2.

Case 2 shows a comparatively small invention. Like Case 1, quantity and the price before the invention are determined at point A and the marginal cost decreases from C_0 to C_1 due to the new invention. The latent social benefit obtained from the invention is P_1ACP_2. When the value of C_0-C_1 is small and when the inventor requests exclusive rights, the expected price is P_m. However, as this value exceeds the market price, the market price after the invention is left as P_1 as it was before the invention. In this case, when the royalty γ is set, the personal benefit of the inventor is P_1ADP_2. Hence the consumer's surplus will not increase.

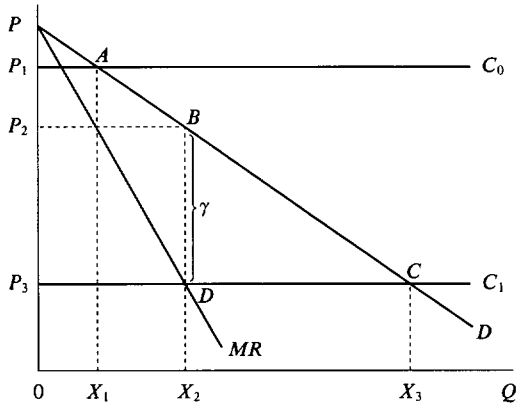
2. Hypothesis of the present paper

By considering the aforementioned theoretical examination, personal benefit from the small invention, which is protected by the patent system, is relatively higher than that of the large invention. Therefore, when considering the Japanese patent system before Wold War II, as R&D standards were far behind those of the advanced countries, the protection of the patent system was more significant to the small inventions than to the large ones. The distinction of the patent duration time depending on the invention level and the protection of the small invention by the new utility model law was mentioned in the previous section. Such Japanese patent policies obviously considered the limited technological development potential of the Japanese industries in those days. Actually, the quantity of the small inventions was greatly higher than that of large inventions before World War II. Furthermore, the technologi-

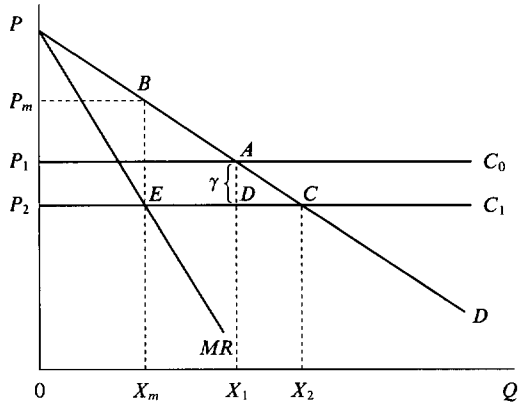
[19] The following argument is based on the argument of Arrow [1962], Nordhaus [1969], Imai, Uzawa, Komiya, Negishi, Murakami [1972] and Kami [1984].

FIG. 1. ECONOMIC SIGNIFICANCE OF LARGE AND SMALL INVENTIONS

CASE 1: LARGE INVENTIONS



CASE 2: SMALL INVENTIONS



cal backgrounds of many of the small inventions were based on the conventional industries. By considering the theoretical and actual situations, we would like to present the hypothesis that the prewar patent system was more effective in the development of the conventional industries than in the development of modern industries. And its effect was much higher with the beginning of economic development. Indeed the development of the conventional industries had been supported by technological innovation, and the technological innovation had been promoted by the unique patent system.[20] By unique patent system it is meant the new utility

[20] Guan [1997] discussed it with the relation between the development of the conventional and modern industries and technological innovation.

TABLE 1. MAJOR POINTS OF DIFFERENCE BETWEEN THE PATENTS LAW AND NEW UTILITY MODEL LAW

Items		Patents Law	New Utility Model Law
Subject to be protected		Invention	Design
Advancement		not easy	not extremely easy
Application procedure	①Application fee, examination fee	Expensive	Moderate
	②Examination period	Long	Short
	③Unveiling procedure	Complicated	Simple
	④Application Alteration period	Long	Short
	⑤Merged application system	Yes	No
	⑥Additional application system	Yes	No
Effective period		15 years	10 years

Note: this data is based on the patent law and the new utility model law as of 1959.
Source: The Patents Office [1955], The Ministry of International Trade and Industry [1964], Yoshifuji [1982].

model law and this law aimed to protect the small inventions. As many new utility models had emerged in the conventional industries, they contributed to the technological innovation of those industries. Paradoxically, if the new utility model law had not been enacted, almost all technological innovations in the conventional industries might have been an illusion.

The new utility model law followed exactly the same policy as the patent law with regard to the protection of the creation of the technological ideas. Therefore, almost all of the principles of the new utility model law were derived from those of the patent law. For example, its principle regarding order of application receipts, its publication unveiling system, its principle of examination, its system of the public notice of application, its judgment system, etc. There was difference in no way whatever from those of the patent law. However, when observed in detail, there was disparity between these laws. Table 1 shows the main difference between these laws. For the object of protection, the patent law regulates its invention, and the new utility model law regulates its design. A design was defined under natural law as having a technological idea whereas an invention was defined as having a highly technological idea. The "invention" requires a high level of creation but the "design" requires a merely ordinary level of creation. However, the term "design" does not infer a poor quality idea. In order to grant the invention for a patent, freshness, advanced technology, industrial applicability, etc. are required. Similarly for registration under the new utility model law, these conditions are the same. The "advancement" of the invention is defined as not "easy", but that of the design is defined as not "extremely easy". There were some other differences in the application and examination procedures of the new utility model law, but all were simpler than the regulations of the patent law.[21]

3. Demonstration of the hypothesis

In order to quantitatively prove the hypothesis, we set three indexes to define invention levels from actual data. The first index is the new utility model ratio (the ratio of new utility models to the sum of patents and new utility model). It is possible to consider the following

[21] For details, refer to Yoshifuji [1982] pp484-497.

two types of understanding. The first is, because the new utility model is a small invention, a high value of these index points to comparatively lower technological standards in the concerned industrial field. On the contrary, a low value means a comparatively high technological standard. The other understanding regards the patent as the core of the technological innovation and the new utility model as a peripheral technological improvement. As there were a relatively limited number of core technologies in the conventional industries, the new utility model had continuously played an important role. On the other hand, in the modern industries, the core technologies act as a determinant in the beginning, but then in making the product fit for practical use, the role of the peripheral technologies increases. The second index is the Japanese patent ratio (the ratio of Japanese patents to the sum of Japanese and foreign patents). It is also possible to consider these following two interpretations. First, as Japanese technological knowledge was somewhat lower than that of foreign countries, when this index is high, it points to a lower technological standard in the concerned industry. Second, in the conventional industries, there were many Japanese inventions connected to Japanese culture. However, in the modern industries, this index reflects the level of assimilation of imported technologies. That is, the increase in the Japanese patents in the modern industries means not low technological standards but rather an assimilation of foreign technologies. The third index is the individual patents ratio (the ratio of the individual patents to the sum of the individuals and companies). Excepting a small element of genius, the technological level of the individual inventions is comparatively lower than that of organizational inventions because high technology requires stupendous funds, varied technological information and many talents.

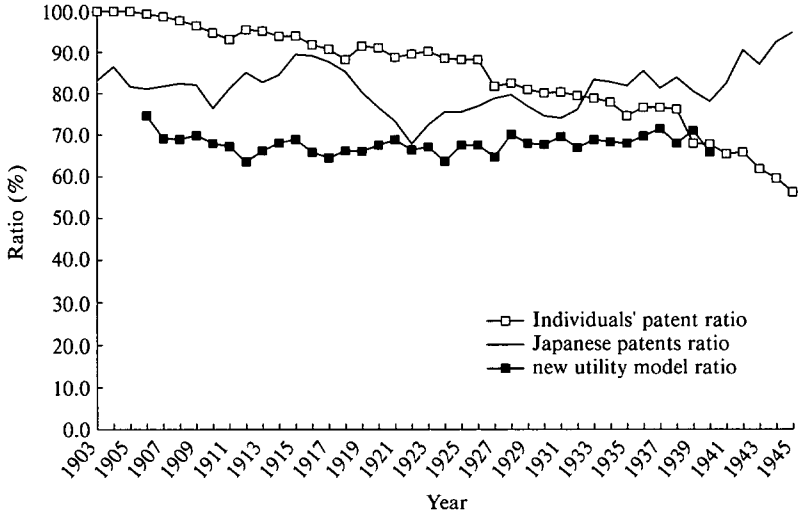
By applying the aforementioned three indexes, we compare the actual conditions of conventional and modern industries. Fig 2 (a, b) shows the big difference between the two groups in terms of each value and their curves.[22] The new utility model ratio consistently maintained a high level for conventional industries. However, it was clearly low but increasing in level for modern industries. The same trend is observed in the Japanese patent ratio. The individual patent ratio gradually decreases from a high level in the beginning both in the conventional and in the modern industries, however, their rate of decrease are different. Ratio of decrease in the modern industries is higher than that of the conventional industries. From these observations, it is possible to infer the following. First, through the prewar era a technological gap had existed between the conventional and modern industries. The modern industries had higher technological standards than the conventional industries. Second, the technological gap between conventional and modern industries was large at first, but later this gap was reduced to a certain extent. Third, reduction of the technology gap between the modern and conventional industries is characterized by the practical use (the increased new utility model ratio) and Japanese autonomy (the increased Japanese patent ratio) of the technologies in the modern industries.

This argument is well supported by correlation analysis. For example, when observing the new utility model ratio and the Japanese patent ratio in the selected industries,[23] the earliest data (the mean value for the three years from 1906 to 1908) shows a comparatively strong correlation ($r=0.745$). For the next stage (the mean value for the three years from 1922 to

[22] There were some studies concerning the classification of conventional and modern industries. For details, refer to Guan [1997].

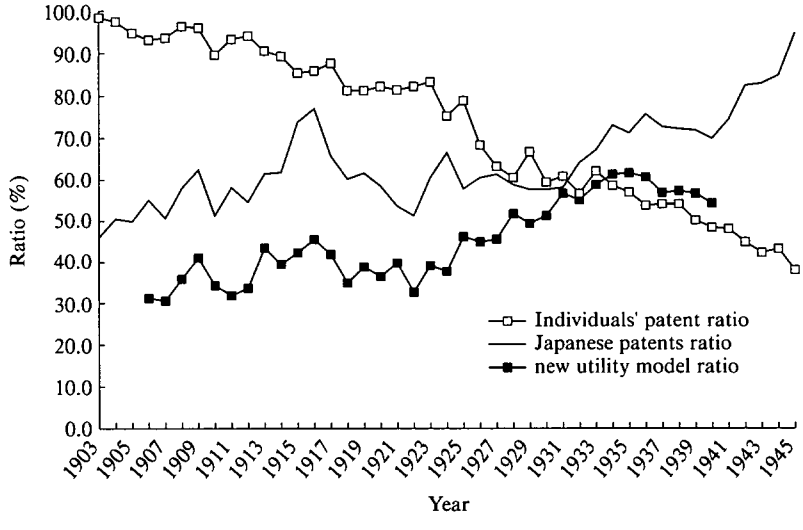
[23] The selected industries are 30 conventional industries and 23 modern industries. These contents are the same as in footnote 20 of Guan [1997]. Due to data limitation, the industry is eliminated.

FIG. 2. (a) CHARACTERISTICS OF TECHNOLOGICAL INOVATION IN THE CONVENTIONAL INDUSTRIES



Note: for each indexes, refer to the text.
Source: The Patents Office

FIG. 2. (b) CHARACTERISTICS OF TECHNOLOGICAL INOVATION IN THE MODERN INDUSTRIES



Note: for each indexes, refer to the text.
Source: The Patents Office

1924), this correlation is weaker ($r=0.440$). Later data (the mean value for the three years from 1938 to 1940) shows no correlation ($r=0.154$). Therefore, at the beginning (for example, the latter half in the 1900s), the new utility model and Japanese patent ratios were both high in the conventional industries, but they were both low in the modern industries. However, in a later term (for example, the latter half of the 1930s), with the increase of new utility models and Japanese patents in the modern industries, the differential between the modern and the conventional industries decreased. It shows to a certain extent a decreasing of the technological gap between the modern and the conventional industries, and means that the technological innovation in the modern industries followed through to the stage of practical use of those technologies and there was a level of capacity for them to independently develop high technology.

Restating the point, if the new utility model law, which protected the small inventions, had not been enacted, many new utility models existed in the conventional industries could not have been protected and they might have disappeared as phantom technologies. This condition would have affected the incentive to develop new technologies in the conventional industries and would have inhibited the sound development of the conventional industries. Then, this bad influence would have continually affected the modern industries, in the latter period, because the new utility model ratio was to increase, its R&D also would not have been protected.

4. Significance and effect of the patent system

From the aforementioned discussion, it is possible to summarize the significance and effect of the Japanese patent system. First, the patent system is established at an early stage, supported the sound development of the conventional industries. The enactment of the "Provisional Regulations for Monopoly" and the "Patent Monopoly Act" was comparatively early considering the stage of economic development in those days in Japan. The technological stage in which it appeared was almost equal to that of the developed countries when it appeared there.[24] The enactment of the Japanese patent system had a great significance in the protection of the minor inventions under technological standards were backward compared to those of the European countries. It is popularly known that the inventors of the rickshaw, the spinning machine and the straw matting machine suffered large losses in a time of no patent system. Upon establishment of the patent system, inventions that were even smaller than those above came to be protected.

Second, another function of the patent system in an under developed country is to facilitate the acquisition of technological information from more developed countries. As the Japanese government joined the Paris Treaty in 1899, the foreigner's industrial property rights

[24] Enactment of the patent system in Japan was slightly behind that in the developed countries. However, considering the of stage economical development, the establishment of the Japanese patent system was rather fast. For example, British enactment in 1624 was the earliest enactment. The Beginning of their modern economic growth was 1765-1785. French enactment was 1791 and the beginning of their modern economic growth was 1831-1840. American enactment was 1790 and the beginning of their modern economic growth was 1834-1843. German enactment was 1877 and the beginning of their modern economical growth was 1850-1859. Elsewhere than Germany, the patent system was prepared before the beginning of modern economic growth. It may be a proof that the industrial revolution originated in Europe. It is an interesting point that Japanese enactment was faster than Germans with regard to the beginning of their economic growth. The initiating time of modern economic growth was based on the data of S. Kuznets. Minami [1981] also explained it clearly.

also became protected equally to those of the Japanese. The initial purpose of Japan joining the Paris Treaty was to revise the unfair treaty. As a result, Japan was put on an equal footing with the developed countries, and the technological information from the developed countries came to be introduced to Japan. As new inventions of the developed countries were registered and new technological information was also unveiled in Japan, Japanese inventors received some hints from this information and developed new inventions with imitated technologies.[25]

Third was the application of the patent system, especially the new utility model law. After and even before the enactment of the new utility model law, the prewar patent system gave more favorable treatment to the basic invention than to more advanced inventions. That was an extremely realistic policy considering the low technological standards in those days. The conventional industries' share in the initial period of economic development was high, but the quality of their technological innovation was not so high. By protecting those inventions of technological innovation, the patent system promoted the development of the conventional industries.

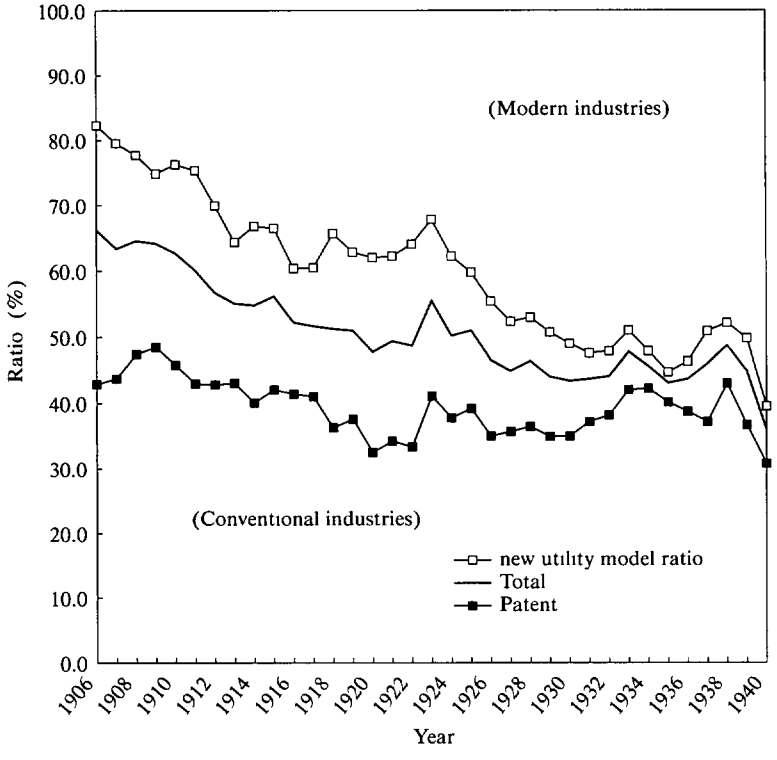
Finally, we would like to generalize our argument. Generally, at the initial stage of economic development, as both technological standards and development ability was low, applicable technological knowledge is biased toward conventional industries. At this stage, the significance and effect of the patent system's protection is extremely high in terms of technological innovation in the conventional industries, whose technologies are many but of low technological rank. Then, along with increasing technology and developing abilities, the amount of technological knowledge, between conventional and modern industries is reversed. At that time, the significance and effect of the patent system is reversed. This trend is well substantiated by patent data in Fig. 3. The total patent and new utility model decreased greatly from 66.63% (1906) to 35.98% (1940). The patent decreased from 42.89% to 30.74%. The new utility model drastically dropped from 82.35% to 39.58%, less than half of that of 1906. In only 35 years, from 1906 to 1940, the amount of technologies held by conventional as to modern industries was completely reversed. In other words, the modern industries had acquired the dominant position in terms of their technological innovation over the conventional industries through the first half of 20th Century.

IV. *Evaluation of the related policies*

Some political intervention with regard to research and development (R&D) of technologies exists, in addition to the patent system. For example, (1) government-controlled independent R&D through the national universities and national institutes, (2) subsidy aid programs and tax reductions for R&D and (3) the establishment of organizations, which link the private sector with government institutes, and offer financial assistance. Unfortunately, these policies had not effectively performed their important roles. Rather the following politics were more effective.

[25] There are some opposite points of view. That is if Japan had not ratified the Paris Treaty, Japanese industries could have illegally imitated high technologies in the developed countries without retribution. However, imitation of high technologies was not so easy, and once some technology was imitated, it became difficult for Japan to import high technologies because the developed countries tighten their guard against technological leaking.

FIG. 3. SIGNIFICANCE OF INVENTION BETWEEN THE CONVENTIONAL AND THE MODERN INDUSTRIES



Note: Figure = Number of the inventions of the conventional industries ÷ total number of invention × 100.
Source: The Patents Office

1. Invention expositions

As is generally known, many expositions and conventions as part of industrial development policies of the Meiji era, which were frequently opened all over the country, greatly contributed to the development of the industries of those days. Kiyokawa found that the evaluation functions and the publicizing effect of these expositions and conventions greatly promoted the diffusion of new technologies.[26] Technological knowledge and information was promoted and spread through this function of expositions and conventions. On the other hand, as well as the patent system legally protecting the results of technological innovation, provision of accessibility of the new technology to the entire society is an obligation of the patent system. Protection as well as accessibility of the invention may seem a contradiction. Nevertheless,

[26] Refer to Kiyokawa [1995], Section 7.

policies, which did both, existed in Japan before World War II. One of these policies was opening of the invention exhibitions.[27]

The number of expositions and meetings, which started at the beginning of Meiji era, peaked at the end of Meiji era, since then slowly declined. Despite their decline, the role of the patent system grew. At that turning point between 1909 and 1932, four invention expositions were held.[28] While the scales of these expositions were not so large, however, all exhibits represented patents and/or new utility models, including a number of designs and trademarks. The evaluation functions and the publicizing effects of these invention expositions were extremely effective.

The Imperial Invention Association sponsored all four of these invention expositions. But in the 1930's, the government also independently sponsored invention exhibitions. The Patents Office opened eleven invention exhibitions between 1933 and 1943. The "50-year retrospective exhibition" commemorated the 50-year history of the patent system (1934), and many other chemical electric and other special invention expositions/exhibitions. Similarly to other expositions, these invention expositions/exhibitions promoted examination and evaluation of the exhibits, and lecture meetings and discussions were held. These activities publicized the new technological knowledge and triggered inventiveness among the public. It seems that the political motives of opening invention expositions had two aims, promoting technological innovation and new technological diffusion.

2. Invention encouragement policy

The invention encouragement policies included the commendation and subsidiary systems and the extension of patent rights. The commendation system had two forms in prewar days: medal and official commendation.

The medal system allowed government commendation of meritorious contributor's achievements. The inventor received the Medal with a Blue Ribbon. Nearly 2,000 people in all

[27] These Japanese expositions were not the first such projects in the world. A similar type of first exposition was held in London in 1756. For the detail, refer to Yamamoto [1973].

[28] An outline of four invention expositions is as follows:

Name of expositions	No.1 Invention Exposition	No.2 Invention Exposition	No.3 Invention Exposition	No.4 Invention Exposition
Year	1909	1914	1923	1932
Number of exhibits	1,175	2,634	4,128	6,137
Number of exhibitors	502	953	1,012	1,352
Number of awarded	474	632	550	523

Source: Wakabayashi [1909], Seigawa [1914], Shichiji [1924], Gondo [1932].

For reference, the major expositions held at the same period are shown below.

Name of exposition	Tokyo Kangyo Exposition	Tokyo Taisho Exposition	Peace Memorial Tokyo Exposition	Imperial Memorial Domestic Product Exposition
Year	1907	1914	1922	1928
Number of exhibits	93,854	160,293	141,016	82,433
Number of exhibitors	14,876	65,102	75,074	9,127
Number of awarded	8,012	21,965	26,472	4,134

Source: Yamamoto [1973] p72.

fields were decorated. However, these included only 28 invention-related people. This fact reflects that prewar understanding in invention and invention level were both not enough. Furthermore, this means that it was difficult to evaluate the value of inventions, and government insufficiently recognized invention. The encouragement recipients and the subjects include: Tachi Gaun "Spinning machine" 1882, Sakichi Toyota "Automatic textile machine" 1911, Keijiro Kishi "Transformer's radiator" 1918, Jikisabro Gohogawa "Multi line silk-reeling machine" 1928, Tadatake Yamamoto "Induction synchronized motor" 1944, Toshiichi Satake "Vertical grain cleaning mill" 1944. They were all famous inventors. It is interesting that one third of the 28 inventor were in the conventional industries. Furthermore, the recipients from just after World War II include: Toshihiko Satake "Mortar type grain cleaning machine" 1950, Tsugekiyo Iwata "Threshing machine" 1950, Kiichiro Toyota "Automatic shuttle weaving machine" 1950, Shinjiro Takakita "improvement of spade" 1950, Shuji Yagi "Directional antenna" 1951, Shoji Kobayashi "Telephotograph machine" 1951. These inventions were all created before World War II.[29]

Another related policy is the extension of patent rights system. This system is derived from the British law system and was introduced under the revised patent law of 1909. The aim of the British law was a protection for personal profit and/or compensating for war losses. However, in Japan the extension was decided upon by considering national interest not personal profit. For example, unconditional extension was permitted to secret military patents. This concept was far from the original purpose of the patent system but it functioned to a certain extent. A total of 112 inventions were granted before prewar days, and many of them were lodged in the latter half of Taisho period. Some famous inventions were included under extended patents: Sakichi Toyota "Automatic shuttle weaving machine", Jiro Itsumi "Slide rule", Teruyoshi Masaki "Noodle winding machine", Tsunekichi Takuma "Steam Generator", Kotaro Honda "Special alloy steel", etc.[30]

The last concerned policy is subsidy. It did not effectively function due to restrictions of budget. This system originated in the "Invention bounty grant regulation" enacted in 1917. However, the amount of subsidy was not enough. For example, the invention subsidy in the Taisho latter period (1918-1924) was around 60 to 70 thousand yen as opposed to about 200 to 250 thousand yen for the Japan Physics and Chemistry Institute. That was three to four times more than the invention bounty grant subsidy.[31]

3. The Imperial Invention Association

The Imperial Invention Association played an active part in various fields before World War II.[32] The major activity was commendation of the inventor and/or designer. Upon the revision of 1920' Invention Commendation Regulation, invention commendation was divided into the imperial and the local commendations. The Imperial Commendation was held five times, the local one was held 20 times. The commendation system of the Imperial Invention

[29] Refer to the Patent Office Journal [1955] pp532-535.

[30] Refer to the Patent Office Journal [1955] pp528-531.

[31] Refer to Uchida [1986] pp246-247.

[32] The former organization was the Industrial Property Preservation Association, established in 1904. The name of the organization was altered to the Imperial Invention Association in 1910. After the war, this organization was succeeded (1947) and continues as the Corporation of Invention Associations.

Association took effect through various expositions, exhibitions, prize contests and patent conventions. The first recipients were Uichi Torigata, Eitaro Yokoyama and Seijiro Kitamura for the TYK wireless telephone in 1911. The regulations were organized and codified in the Taisho period. Based on the "Invention commendation regulation" of 1919, the first imperial exposition was held with funding from the aforementioned subsidy. The commendation was constituted of progress and contribution awards. Nineteen inventors of twenty-two inventions were commended. The famous inventions included: Kyota Sugimoto "Japanese typewriter", Senzo Yai "Dry battery", Genzo Shimazu "Anode ribbon for the battery".

A summary of the Imperial commendations from awards No.2 to No.5 is as follows: for No.2 (1926), 106 awards, for No.3 (1933), 345 awards, for No.4 (1938), 293 awards, for No. 5 (1944), 162 awards. A total of about 1,000 inventions were awarded the grand prize, progress prize, or contribution prize, etc. On the other hand, for the local commendations, a total of 1,278 inventors were awarded.[33] Additional activities of the Imperial Invention Association were the sponsorship of expositions and exhibitions, editing and publication of "Hatsumei (Invention)", establishment of the Invention Hall and institutes, prize contests for invention, etc.

V. *Conclusion*

The conclusion of the aforementioned analysis arrives at the following four points. First, the Japanese patent system had some distinguishable characteristics. A typical example was the ranking of patent rights, which was effective until 1899, and the new utility model law, enacted in 1905. This influenced not only Japan but also many other countries after World War II.[34]

Second, the patent system, which protected the small inventions, achieved great success. This system greatly advantaged technological innovation in conventional industries, which occupied a large market share. Therefore, the technological innovation in this field greatly improved. The small technological innovations supported the development of the conventional industries. However, this effect also contributed to the modern industries. Because not all of the technologies of the modern industries were high technologies, they needed only small technological innovations, which contributed to the modern industries to no small extent.

Third, the significance and the effects of the patent system greatly altered along with economic development. We can indicate two points. One is the reversal of the significance of conventional as opposed to modern industries. For the conventional industries, the patent system is relatively more effective in the earlier period of Japanese economic development. On the other hand, for the modern industries, the patent system is relatively more effective in the later period of Japanese economic development. The reason for this is the change of the ownership ratio of each industry for all technological knowledge. Another is that as technological standards increased, the significance of protecting the small technological innovations gradually decreased. Actually, the significance of the new utility model law diminished greatly in comparison to that of the prewar situation. The emergence of discussion on the abrogation

[33] Refer to Invention Association [1974] pp190-192.

[34] After the war, many countries followed the Japanese new utility model law as an example of their patent systems.

of the new utility model law has clearly shown this significance.[35]

Fourth, the contribution of the additional policies including invention expositions, the commendation systems, etc. cannot be neglected. The role of these policies altered along with the changing of the times. However, they functioned well to back up the patent system. For executing these policies, the role of the Imperial Invention Association deserves mention.

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[35] For this argument, refer to Yoshifuji [1982] pp501-502. Recently the number of applications and registrations in new utility model has drastically decreased. In 1980, there were more than 200 thousand applications, however, in 2000, less than 10 thousand applications. Registrations showed the same tendency.

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