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## Stock Market Reaction to Patent Value in Japan: an Event Study Analysis<sup>1</sup>

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*The patent is regarded as an indicator of a firm's innovativeness and many studies have tried to use it as a proxy for the same. However, little research focuses on the impact of the substantial value of patents on stock prices.*

*This study employs event study analysis to explore the stock market reaction to the announcement of the "Patent Value Brand" by the Tokyo Stock Exchange and the "YK Value," which is used to measure the economic value of a patent during the selection process. Our finding reveals little evidence for positive and significant stock price reactions to the brand announcement around the event day.*

*In addition, the result is not altered in terms of cumulative abnormal returns over a longer term.*

*We conclude that the stock market did not respond to the announcement of the Patent Value Brand and the substantial value of patents which is represented by the YK Value.*

**Keywords:** Patent, event study; Japan's stock market; innovation; Tokyo Stock Exchange

**JEL classification codes;** G14; O34

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<sup>1</sup> The views expressed in this paper are personal and do not represent those of any of the institutions with which I am affiliated or to which I refer. The author is solely responsible for any possible errors.

## Introduction

This study employs patent value to explore stock market reactions to the innovation of firms in Japan.

Innovation is considered by academics and practitioners to be one of the important sources of firm growth, and great efforts have been made to measure it appropriately. In the literature, R&D spending is commonly used to gauge the innovativeness of firms<sup>2</sup>. The number of patents is also often employed as a proxy for innovation<sup>3</sup>. Patent can be both an input and an output of innovation; investors can measure past innovative activities by taking a patent as an output and anticipate future products by taking it as an input.

There are, however, some issues in treating the patent as a proxy for innovativeness. First, not all innovations necessarily take the form of patents. Second, technological and economic values differ between patents, and the number of patents with substantial value can be limited. Some patents can hinder the imitations of competitors and even can be a source of patent fee revenue, while others can be a cost for the owner, if they do not generate enough revenue to cover registration fees. This means that the mere number of patents a firm owns may be appropriate as an indicator. In order to render the patent a more sophisticated proxy, the numbers of forward citations (Nagaoka et al. (2010)), patent renewals or the duration of patent rights (Klette & Griliches (2000) for example), and patent family size (Harhoff et al. 2003 for example) have been proposed as alternatives to the mere number of patents.

The innovativeness of a firm is also a key in realistically valuing companies<sup>4</sup>. With regard to patents, they are evaluated by investors and financial institutions as the important intangible assets of a firm, since registering them prevents innovative technologies from being illegitimately imitated at lower cost by other firms and enables patent owners to receive stable revenue rewarding invention, which contributes to business

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<sup>2</sup> In the literature of corporate governance for instance, Hill & Snell (1988), Baysinger et al. (1991), Cho (1998), and Lacetera (2001) adopt R&D spending to measure the innovativeness of firms.

<sup>3</sup> Hall & Harnhoff (2012) provide an excellent survey on recent development of research on economics of patents both theoretically and empirically.

<sup>4</sup> For example, Koller et al. (2010) points out that innovative goods and services can be a source of competitive advantage if they are protected by patents and/or difficult to copy

stabilization and future growth (Tokyo Stock Exchange (2012)). In this context, the Tokyo Stock Exchange (TSE) on 10 August 2012 selected 10 companies with valuable patents and named them “Patent Value Brand” (hereafter Brand), which are listed in the Second Section or Mothers Section. The Brand was designated to attract investors to firms with high value patents by more easily distinguishing them from others. What makes the selection unique is that an original indicator, which was developed as a measure of the substantial value of a firm’s patents, is applied in scoring each company.

Even though innovativeness is broadly regarded as important in evaluating a firm and the patent as a proxy for innovation, it is fair to say that the reaction of the stock market to patent-related events have attracted little academic attention. This study contributes to the literature by exploring the effect of the substantial value of patents that a firm owns on its stock prices through an examination of the Patent Value Brand announcement by the TSE. In doing so, we try to capture the attractiveness of patent value from the perspective of investors.

This research has three advantages. First, the value of the patents of a firm that is employed in this analysis is calculated through the published score of a patent attorney’s office; investors can judge the extent of the innovative advantage of a company quite easily with those scores. Second, the scores, named the “YK Value,” are available exclusively to the clients of the patent attorney’s office, except for those of the top companies listed to the First Section of TSE; the scores of patent value of the remainder of firms in the First Section and all companies listed in other sections are new information for an investor, unless he or she has already purchased them. Third, the Patent Value Brand, whose announcement we examine, was selected from firms listed to the Second and Mothers Sections of the TSE by taking the YK Value into consideration. This means that the brand announcement can push up the stock prices of selected firms, if investors perceive the substantial value of patents and thus of innovativeness in the future growth of a company.

This paper is organized as follows. Section 2 reviews the literature and Section 3 surveys the background and process of the selection of the Patent Value Brand. Section 4 explains the empirical approach which is employed in this research. Section 5 performs a formal event study and

analysis with a longer horizon by examining cumulative abnormal returns and discusses the results. The final section concludes the paper.

## The Literature

Event study analysis, which is often adopted to examine the impact of an event on stock prices, has a well-established analytical methodology. With this approach, we can capture the initial phase of the attractiveness of the Brand companies as evaluated by investors in the capital market.

Though the event study methodology is employed in quite a number of analyses, few of them focus on patent-related events. Austin (1993) examines the impact of patent grants on the stock prices of a company with such grants and those of its rivals among the 20 biggest biotechnology firms in the United States and finds the effect of its own grants is greater than the latter. Wang et al. (2010) point out that patent infringement litigation from 1998 to 2008 in the information technology industry in Taiwan had negative impacts on stock prices. Hong and Chung (2012) look at voluntary patent disclosure by a patent owner company in Korea and find a significant positive effect only in companies who voluntarily disclosed their patent.

Kawaura and Croix (2007) focus on patent-related events from a different viewpoint than the above studies. They investigate the change in the rates of return of 16 Japanese pharmaceutical firms by taking the amendment of the Japanese Patent Law in 1975 as an event; in doing so, they reveal that a half of the companies experienced significant excess returns.

As no previous research has to my knowledge undertaken event study analysis of the substantial value of patents, this paper contributes to the literature by offering empirical results on the response of the capital market to information on the quality of patents. The YK Value, on which we focus, was developed by Kudo & Associates (a patent attorney's office in Tokyo), and quantitatively indicates the extent of exclusiveness stemming from patent holding in order to measure the economic value of a patent<sup>5</sup>.

The basic idea of the YK Value is described as follows. Rival companies are threatened if a patentee monopolizes invention, since the former are no longer able to use freely the technology. Thus, a competitor

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<sup>5</sup> Further information is available at [http://www.kudopatent.com/english/areas\\_of\\_practice\\_2.htm#YKS\\_Method](http://www.kudopatent.com/english/areas_of_practice_2.htm#YKS_Method)

tries to block a patent grant that it judges a menace to its business or to repeal it, once granted. The greater the risk of a technology, the more a competitor is motivated to attack it.

The YK Value of a patent is computed by the number of legal actions taken by a third party against it from the conception of an innovation to its expiration. Attacks can take various forms, such as requests for inspection after the publication of a patent application, requests for information at the examination stage, and invalidation trials after the registration. Attacks against a patent are summed up to compute the YK Value of the patent once they are weighted by the cost that a third-party pays for the attack and the obsolescence of the technology concerned is deducted. Then, the YK Value of a company is calculated as an aggregate of the YK Values of its patents.

The number and gravity of attacks by competitors represents the seriousness of patent threat to competitors. A firm with a higher YK Value is considered to have a “good” patent and is empowered with business potential.

## The patent value brand

The TSE has tried since 2012 to attract potential investors by releasing a “Brand” under which selected stocks are classified into groups according to a specific theme. The first of this kind is the “ESG Brand,” which was announced on 11 July 2012; it focuses on companies with ESG-oriented management, and four different kinds of Brand including ESG Brand were announced by November 2013<sup>6</sup>. The Patent Value Brand was released on the 10 August 2012 as a second attempt. The motivation of the Brand selection is that advanced technologies are an important source of competitiveness for Japanese companies in the global market; the share of patent applications by Japanese firms in terms of number exceeds 20 percent of the world total, indicating that Japanese firms produce innovative and high-quality products armed with patented technology (Tokyo Stock Exchange (2012)). Thus, the disclosure of the quantitative “value of patents” held by Japanese companies

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<sup>6</sup> Mitsuyama & Shimizutani (2013) analyzes the impact of “Nadeshiko Brand” (the third attempt) on the stock prices of selected companies.

is thought to be indispensable to attract potential investors from capital market.

In the screening process of the Patent Value Brand, YK value was adopted as an indicator to measure the substantial value of that patents that a firm owns. Among the companies listed in the Second Section or Mothers Section of TSE, two firms with a higher YK value and lower price earnings ratio (less than industry average) were selected as Patent Value Brands from each of five industrial sectors: chemicals, machinery, information and communication, food, and electronic equipment. Ten companies, which are listed in the first column of Table 1, thus qualified for the Brand. The screening process and the result were announced only in Japanese at around 16:00 on 10 August 2012 on the website of TSE.

## Methodology and data

The main methodology in this study is an event study analysis, which is quite standardized in financial economics (Corrado (2011), Campbell et al. (1997)).

The essence of event study analysis is to estimate the abnormal return on an event day with daily stock data, compute any deviation from the normal return which is calculated with stock data of the pre-event period, and test statistically the difference between the normal return and the actual return on an event day. The normal return of stock  $i$  in day  $t$  is estimated using the market model as follows (Corrado (2011)).

$$R_{it} = \alpha_i + \beta_i R_{mt} + e_{it}$$

where  $R_{it}$  is the return on stock  $i$  on day  $t$ ,  $R_{mt}$  is the return on the overall market on the same day. In the equation,  $\alpha$  and  $\beta$  are the parameters to be estimated, and  $e_{it}$  is a firm-specific return that is unrelated to the overall market and has the expected value of zero.

The abnormal return of stock  $i$  on the event day ( $t=0$ ; 10 August 2012 in this case),  $AR_{i0}$ , is defined as follows:

$$AR_{i0} = R_{i0} - E(R_{i0}|R_{m0}) = R_{i0} - \alpha - \beta R_{m0}$$

where  $E( )$  is an expectation operator.

The Tokyo Stock Exchange Second Section Price Index is used to calculate  $R_{mt}$  as market indices, since the majority of Patent Value Brand companies are listed in the Second Section in TSE<sup>7</sup>. The stock prices of 10 companies in the Brand are obtained from the “Kabuka CR-DOM,” issued by Toyo-Keizai Inc<sup>8</sup>. We set the pre-event window (control period) to 250 days prior to 10 days before the event day, a time period which corresponds to the number of trading days in a calendar year<sup>9</sup>.

The parameters are estimated by an ordinary least-squares (OLS) regression of a firm returns  $R_{it}$  on market returns  $R_{mt}$  over the control period. We then statistically test the null hypothesis that the difference between the normal return and the return on the event day of focus (excess return) is zero. The Patent Value Brand was officially announced at 16:00 after the market was closed on the event day; thus, we examine the abnormal return on Friday 10 August 2012 and the post-event day (Monday the 13th) as well as the prior day (Thursday the 9th) to capture any responses around the event day.

In order to evaluate the influence of the Patent Value Brand announcement on the stock price of selected company  $i$  on day  $t$ , we compute test statistics by standardizing abnormal return on a day as follows.

$$SAR_{it} = \frac{AR_{it}}{\sigma_i^2}$$

We use a standard deviation of  $e_i$  during the pre-event period as the denominator. The distribution of  $SAR_{it}$  is approximated by the standard normal, since the pre-event period is sufficiently long. Under the null hypothesis,  $SAR_{it}$  would be zero if the event does not affect the price of stock  $i$ , while significantly large  $SAR_{it}$  would be observed if the event is

<sup>7</sup> Nine companies out of 10 are listed in the Second Section at the time of the event. Ekitan & Co. Ltd. is listed in Mothers Section in TSE.

<sup>8</sup> Stock splits are adjusted accordingly in the case of Ekitan, which split during the pre-event period. As Nitta Gelatin Inc. was listed to the Second Section of the TSE on 20 December 2011, 159 days prior to the event day, its pre-event window is inevitably shorter than 250 days. Even though the other nine firms had been listed earlier than 260 days prior to the event, some have a pre-event window shorter than 250 days because of the existence of days without transaction records.

<sup>9</sup> Patent Value Brand had been announced more than four months before the Liberal Democratic Party regained the administration and stock prices started to rapidly increase. The economic situation had stagnated during the year prior to the brand announcement, and the event window with 250 operating days is thought to be reasonable for linear regression, while securing a sufficient number of observations.

influential. The standardized cumulative abnormal return (SCARit) is used to test the longer event window of two or three days, which is calculated with a standard deviation of  $e_i$  during the pre-event period as  $\sigma_i^2$ .

## Empirical results

If investors positively evaluate the innovativeness of a company, the stock price of that firm is assumed to respond favorably to the Patent Value Brand announcement, if the market is able to efficiently process new information.

First, in order to examine the immediate response of the stock market to the brand announcement, we perform an event study analysis. Table 1 reports the abnormal returns on the three days, including the event day, and test statistics for the null hypothesis that the abnormal returns are zero at the time of announcement. First, we look at the first three columns to see abnormal returns on the prior day (-1), on the announcement day (0), and the post-event day (+1), respectively. While only one company (Nitta Gelatin) has a positive and significant excess return on the announcement day, all the other excess returns are not significantly different from zero. Those observations show that the returns on each of the three days are not statistically different from the normal returns, except those of Nitta Gelatin, implying that the stock prices of other companies did not significantly react to the Patent Value Brand announcement.

Moreover, the remaining three columns report the abnormal returns over multiple days; thus, we expand the scope to cumulative abnormal returns; the day before and the day of the announcement (-1, 0); the day of and the day after the announcement (0, +1); the day before, the day of, and the day after the announcement (-1, +1). Again, we do not observe any positive cumulative abnormal returns that are significantly different from zero, except for two companies. We see the positive and significant coefficient for the (-1, 0) period again for Nitta Gelatin and the significant negative effect for KURODA PRECISION for the (-1, +1) period.

If investors evaluate the substantial value of patents as a resource for the future growth of a company, its stock price is expected to stay high after it experiences a jump around the day of the brand announcement. In order to examine if the effect is transitory or permanent, an analysis with a long horizon should be conducted. This is particularly the case for Nitta Gelatin, which shows positive and significant abnormal returns around the

event day. The possible gradual influence can also be identified in an analysis with a long horizon. For this purpose, we examine CARs (cumulative abnormal returns) of each firm over 96 days subsequent to the announcement day, until the last operation day of 2012 (the post-event window)<sup>10</sup>.

Figure 1 (1) depicts the CARs of Nitta Gelatin. The graph shows a long decreasing trend, starting from 66 days prior to the announcement day. This means that the positive effect of brand announcement for the company was only momentary if any.

Figure 1 (2) displays the CARs of three companies with increasing trends during the post-event window. Turmoil is observed in CARs in all cases, but the long increasing trends start before the announcement day for all three firms: around 90 days for KURODA PRECISION, around 200 days for JFE Systems, and around 60 days for Ekitan. The brand announcement, therefore, can hardly be a trigger for the long-term increasing trends of the three companies. The CARs of remaining six firms show decreasing or mixed trends during the post-event window, as depicted in Figure 1 (3).

From the results of analyses with both short and long horizons, it is fair enough to conclude that the stock prices of Brand companies were not affected by the announcement of the Patent Value Brand announcement and thus the substantial value of patents which is represented by the YK Value.

## Conclusions

We examined the stock market reaction to the Patent Value Brand announcement in August 2012. The unique measurement was employed in the selection process in order to evaluate the substantial value of the patents that a company owns. Two sets of analyses were conducted in the research. First, in order to examine the immediate effect of the brand announcement, an event study analysis was employed to identify any abnormal return on the announcement day as well as the prior and post-event days. Nitta Gelatin shows significant and positive abnormal returns during and around the event day. Second, in order to examine the effect to the Brand companies in a longer-run, the CARs during the post-event window were

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<sup>10</sup> The post-event window of Nitta Gelatin is set to end on 19<sup>th</sup> December 2012, the 90<sup>th</sup> day from the event day, since the company was moved to the First Section on the 20<sup>th</sup>.

investigated. The long-term influence of the brand announcement on the CARs is not observed for any company.

Based on the findings above, we conclude that the stock market did not respond to the announcement of the Patent Value Brand and thus the YK Value which represents the substantial value of the patents the Brand companies own. The inactive response of stock prices to the brand announcement may be explained in two ways. First, investors did not put higher value on patents and did not expect that the companies with valuable patents would attain sustainable corporate growth and improve investment performance. Second, investors had obtained information that the selected companies hold valuable patents prior to the event by certain means other than the YK Value, and thus the Patent Value Brand announcement was supposed to be nothing new for them.

While we cannot examine the two possibilities without more information on investors, future studies should address why stock market prices did not respond, as such an examination that would shed a light on the market capitalization of innovative companies.

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## Appendix

**Table 1:** Cumulative Abnormal Returns around the Event Day of the Announcement of the “Patent Value Brand” Selection

Company name	(-1)	(0)	(+1)	(-1, 0)	(0, +1)	(-1, +1)
Nitta Gelatin Inc. (Chemicals)	-0.0093 (-0.2618)	0.0735 (2.0809)**	-0.0255 (-0.7221)	0.0643 (1.8190)**	0.0480 (1.3587)	0.0388 (1.0969)
SOFT99 corporation (Chemicals)	-0.0029 (-0.3555)	0.0079 (0.9876)	-0.004 (-0.4999)	0.0051 (0.6322)	0.0039 (0.4877)	0.0011 (0.1322)
KURODA PRECISION INDUSTRIES LTD. (Machinery)	-0.0071 (-0.3901)	-0.0200 (-1.0936)	-0.0033 (-0.1817)	-0.0271 (-1.4837)	-0.0233 (-1.2753)	-0.0305 (-1.6654)**
MAMIYA-OP CO.LTD (Machinery)	0.0379 (1.3991)	-0.0301 (-1.1097)	0.0050 (0.1851)	0.0078 (0.2894)	-0.0250 (-0.9246)	0.0129 (0.4744)
JFE Systems Inc. (Information & Communication)	-0.0032 (-0.2063)	0.0060 (0.3817)	- -	0.0027 (0.1755)	0.0060 (0.3817)	0.0027 (0.1755)
Ekitan & Co.Ltd. (Information & Communication)	-0.0033 (-0.1038)	0.0146 (0.4642)	0.0112 (0.3570)	0.0113 (0.3604)	0.0258 (0.8212)	0.0225 (0.7174)
NIHON SHOKUHIN KAKO CO.LTD. (Foods)	- -	-0.0031 (-0.1534)	- -	-0.0031 (-0.1534)	-0.0031 (-0.1534)	-0.0031 (-0.1534)
S&B FOODS INC. (Foods)	0.0083 (0.9701)	-0.0070 (-0.8203)	-0.0009 (-0.1112)	0.0013 (0.1498)	-0.0080 (-0.9315)	0.0003 (0.0385)
Togami Electric Mfg.Co.Ltd. (Electric Appliances)	-0.0005 (-0.0253)	-0.0199 (-0.9198)	-0.0028 (-0.1312)	-0.0204 (-0.9451)	-0.0227 (-1.0510)	-0.0233 (-1.0763)
SHIZUKI ELECTRIC COMPANY INC. (Electric Appliances)	-0.0018 (-0.1173)	0.0048 (0.3062)	-0.0044 (-0.2852)	0.0029 (0.1889)	0.0003 (0.0210)	-0.0015 (-0.0963)

**Note:** The figures in the upper rows are cumulative abnormal returns (CAR) and those in the lower rows are standardized CAR (SCAR) as test statistics. \*\* and \*\*\* refer to 5 percent and 1 percent significance in the cells in gray. The timing to measure the abnormal return is as follows; (-1) The day before the announcement; (0) The announcement day; (+1) The day after the announcement.

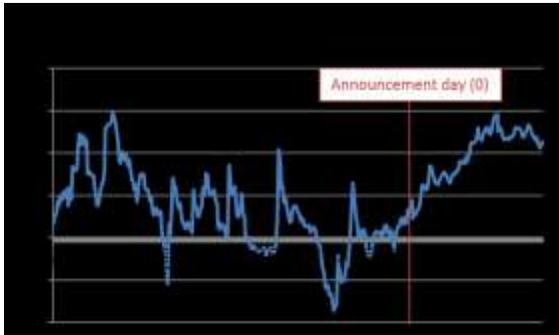
(-1, 0) The day before and the day of the announcement; (0, +1) The day of and the day after the announcement; (-1, +1) The day before, the day of, and the day after the announcement.

“-“ means that CAR cannot be calculated as no transaction is recorded on the starting day and/or ending day of the period.



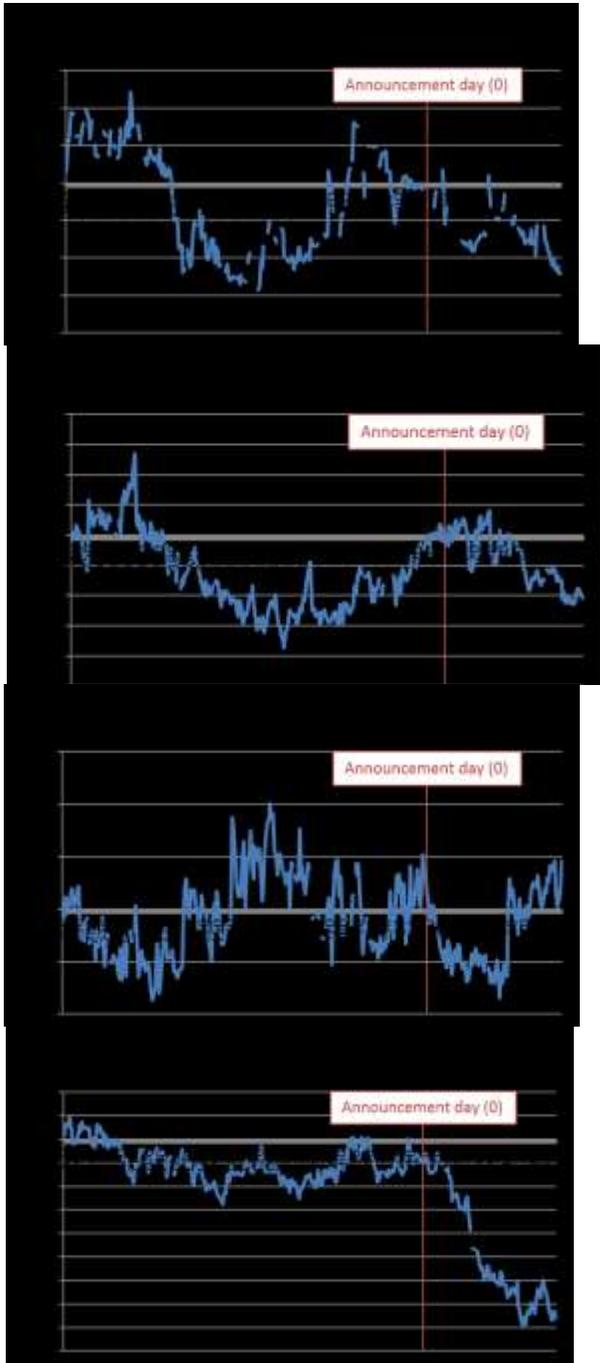
(i) Nitta Gelatin





- (2) Three companies with an increase trend during the post-event window





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- (3) Six companies with a decrease or a mixed trend during the post-event window

**Figure 1:** Cumulative Abnormal Returns over a Longer Term