

# **CPRC Discussion Paper Series**

## **Competition Policy Research Center Japan Fair Trade Commission**

### **The Impact of Mergers on Profits, Share Value, Innovation, and Product Prices in Japan in the 2000s**

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CPDP-51-E July 2011

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# **The Impact of Mergers on Profits, Share Value, Innovation, and Product Prices in Japan in the 2000s**

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July 2011

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## Acknowledgement:

This paper is an outcome of a joint research project at Competition Policy Research Center (CPRC) of Japan Fair Trade Commission (JFTC). We wish to thank other members of CPRC for their assistance and comments, to Takuji Saito for his valuable advice on the use of propensity score method, and to Kuninobu Takeda for his comments on legal aspects. The views expressed in this paper are the authors' alone and do not represent that of CPRC or JFTC.

## **Abstract**

This paper investigates the extent of performance changes after mergers (including all forms of business combination) in Japan since 2000. The performance measure used is four-fold: profit rates, share prices (event study), innovation measures (R&D intensity and the number of patents), and product prices. To study the effects from diverse viewpoints, we adopt methodology and sample that would fit each performance measure best. The result produced little evidence to suggest that mergers improved the firms' performance. There are more cases of the performance worsening than improving after mergers, though hardly any results are statistically significant, because of the presence of large variance across cases.

## 1. Introduction

This paper purports to investigate the extent of performance changes after mergers (meaning all forms of business combination including not just mergers but also asset acquisitions, share acquisitions, and business integrations using holding companies) in Japan since 2000. The performance measure used is four-fold: profit rates, share prices, innovation measures (R&D intensity and the number of patents), and product prices. Our aim is to study the effects of mergers from diverse viewpoints. Thus, we adopt methodology and sample that would fit each measure of performance best, not always insisting uniformity across them. For instance, we focus on banks to study the effects on profitability, because several comparable mergers took place in this industry, while we focus on manufacturing to study the effects on innovation, because the R&D measure is most useful in this industry. More details will be discussed in the following sections.

Roughly speaking, we find little evidence to suggest that mergers improved the firms' performance. There are more cases of the performance actually worsening rather than improving after mergers, though hardly any results are statistically significant. The evidence, simply, is not strong enough to support the argument that mergers improve efficiency. Still, variance is large across cases, implying that some of the mergers might have been successful.

In the next section, we survey theoretical and empirical studies on mergers and discuss their relations to competition policy, taking the Japanese Anti-Monopoly Law as an example. In Sections 3 to 6, we discuss our studies on the above-mentioned four performance measures in turn, explaining the sample, methodology, and the results. In Section 7, we summarize and discuss implications.

## 2. Mergers and Efficiency

Japan, like many other countries, prohibits mergers, acquisitions, and other means of business combinations "when the effect of the merger may be substantially to restrain competition in a particular field of trade" (Anti-Monopoly Act, Section 15). Japan Fair Trade Commission (JFTC) has published "Guidelines to Application of the Anti-Monopoly Act Concerning Review of Business Combination" (*Merger Guidelines* hereafter) to clarify what they will investigate in their review of whether a particular merger is "substantially to restrain competition."<sup>1</sup>

The question that has often arisen in this context is whether and to what extent the prospect of efficiency improvements should justify mergers that otherwise may harm competition. The Williamson trade-off argument is commonly used to argue that a merger that may raise the market price can nevertheless improve social welfare (i.e., the sum of consumers' and producers' surpluses) provided the merger-related efficiency improvements cause the marginal cost to be reduced sufficiently (Williamson, 1968). Business people and the advocates of industrial policy often try to justify mergers in

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<sup>1</sup> The Guideline was revised recently and a new version took effect on 1 July 2011. See <http://www.jftc.go.jp/en/pressreleases/archives/individual-000432.html> (accessed July 2011). In Japan, firms use mergers, acquisitions of shares, acquisition of businesses, the establishment of holding companies, and other means to combine previously separate businesses. "Business combination" is the word used to refer to any of these. However, for simplicity, we will use the word "merger" as synonymously to business combination throughout this paper, regardless of whether two or more firms actually merged or not.

concentrated markets on this ground. For instance, Japan's Ministry of Economy, Trade, and Industry (METI) published "The Industrial Structure Vision 2010" and called for "conversion to corporate merger review that considers the medium- to long-term and the global market"<sup>2</sup>. Implicitly, they called for a merger review with more emphasis put on "the medium- to long-term" effects of mergers that presumably arise from efficiency improvements and intensification of competition in the innovation market than the supposedly short-term effect of reduced competition in the product market.

Williamson's analysis is flawed in that all the firms, both merging firms and their rivals, are assumed to decrease the marginal cost. Of course, it is usually merging firms only that can achieve efficiency gains (if any) through mergers and, even if there is some spillover to other firms, it is far from perfect. The other flaw of Williamson's is its lack of explicit analysis of oligopoly market equilibrium.

Analyzing mergers in a Cournot oligopoly of homogeneous goods, Salant, et al. (1983) showed that, with unchanged cost conditions, a merger causes the decline of combined profits of merging firms while increasing the profits of other firms -- a proposition often called 'merger paradox'. Farrell and Shapiro (1990) showed that, even if the marginal cost decreases sufficiently so that the profits of merging firms increase, the equilibrium price increases, thereby hurting consumers' surplus, unless the cost reduction is even more significant.

The Merger Guidelines in Japan, as in the US, requires that, for the efficiency improvements to be considered, "improvements in efficiency contribute to the interests of users" suggesting that the price needs to be reduced. These discussions together imply that, if a merger fails to raise the merging firms' profits, the efficiency improvements must be limited and the price must increase, hence failing to satisfy the Guidelines' condition.

This consideration explains why, in Section 3, we will compare the post-merger profitability of firms to that of control firms. And the result that, in the majority of cases, the merging firms' profits failed to show significant improvement, suggests that the efficiency gain must have been insufficient to improve consumer welfare.

But, how about the so-called long-term consequences? We will analyze these in two ways. First, in Section 4, we will analyze the behavior of share prices using the event-study methodology. The Modigliani-Miller Theorem indicates that a firm's share price is determined in the stock market so that its market value (total share value plus debts) equals the present value of its future profit stream. Therefore, even if the profits decline in the short-term, the share price should rise with the announcement of the merger if the investors anticipate the profits to increase in the long run. We will find that, even though the shareholders' cumulative abnormal returns (CAR) tend to be positive on the very day of merger announcement, they become insignificant in a few days in the majority of cases, hinting that the investors are by no means optimistic about the merging firms' future profitability.

Second, in Section 5, we will investigate post-merger changes in R&D intensity (i.e., R&D expenditures as a ratio to sales) and the number of patent applications, because it is often argued that the merger contributes to more active and efficient R&D activities, leading to long-term growth. Again we will find very limited evidence to support this

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<sup>2</sup> [http://www.meti.go.jp/english/policy/economy/pdf/Vision\\_Outline.pdf](http://www.meti.go.jp/english/policy/economy/pdf/Vision_Outline.pdf) (accessed May 2011).

argument.

Finally, in Section 6, we will investigate the effects of mergers on product prices, using the POS (point-of-sales) retail price data. Although we could analyze only three markets due to data limitations, the results suggest post-merger price increases. Again, the result is not favorable to efficiency arguments and gives a grave concern from the competition policy viewpoint.

In this paper, we will discuss these results briefly, leaving the details to a companion paper (in Japanese only; to be published in 2011 as a *CPRC Report*). The mergers investigated in this paper are those that took place mainly after 2000. We confine our analysis to the mergers in the 2000s, because there are studies on the effects to profit rates of mergers in Japan in the 1980s (Odagiri and Hase, 1989; reproduced with slight modifications in Odagiri, 1992), and on the effects to profit rates, share value, and product price of mergers in the 1990s (CPRC, 2003; Fukamachi and Makino, 2004a and 2004b)<sup>3</sup>. The results in these studies gave similar pictures, that is, the lack of evidences suggesting efficiency improvements and the presence of an upward pressure in product prices<sup>4</sup>. Therefore, the popular argument in business press that the increased global competition and stagnant domestic market of Japan in the last decade or two intensified the need for industrial re-organization (meaning, usually, mergers and acquisitions) to improve efficiency seems unwarranted.

We have no intention to claim that our study is definite. It in fact has several limitations. For instance, the sample varies across studies. For the studies on profits and innovation, we needed to have financial statements both before and after the mergers and, for the share price event study, we needed share price data. Therefore, our sample is mostly confined to mergers between public firms (i.e., those listed in one or more of the stock markets in Japan). For the price study, we needed to have POS (point-of-sales) data at retailers and could secure such data for only three categories of products. The differences on samples and methodology are summarized in Table 1. Although we believe these differences can be justified in view of the suitability for each analysis and of limited data availability, comparability across studies is admittedly imperfect.

In addition, we are aware that a few other criticisms may apply to our studies. First, some of the measures of performance are hardly ideal; for instance, the number of patents may be affected not only by the R&D performance of firms but also by patentability of technological fields and the patent strategy of firms. Second, it may take a few years until a merger produces its full effect on company performance and, as a result, the three-year lag we usually used may be too short. However, one business consultant we interviewed observed that if a merger cannot achieve its target performance by the end of the third year, it is likely bound to failure, suggesting that the use of three-year lag may not be out of mark. Third, the characteristics of the sample mergers are diverse and quite a few of them are in declining industries, including those made to rescue failing companies; therefore, the lack of improvement in many cases may be the reflection of industry problems than management failure. We will discuss these issues again in the conclusion.

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<sup>3</sup> There are a few other empirical studies on mergers in Japan in the 1990s and 2000s; see the survey in Odagiri (2008).

<sup>4</sup> An exception is the market of petroleum products studied in Fukamachi and Makino (2004a) in which the price decreased owing to substantial increases in imports during the period.

### 3. Effects on Profit Rates

#### 3.1. The Sample and the Choice of Control Group

The six merger cases to be studied are all between regional banks<sup>5</sup>.

According to the data compiled by a private consulting firm Recof, there were 1,000 to 2,000 mergers and acquisitions (including minority acquisitions) between domestic firms every year during 2000-2010<sup>6</sup>. However, in order to make an accurate pre-merger and post-merger comparison, we need financial data for both of merging firms (i.e., both acquirer and acquired). We thus confined our analysis to mergers between public (i.e., listed) domestic firms, which occurred only in a handful of cases a year. And we wanted the merger to take place before 2006 so that we can have at least three-year post-merger financial statements. Furthermore, we decided to concentrate on a single industry (at basically the two-digit level) in order to eliminate industrial effects. We found that the banking industry had the largest number, albeit only six, of such cases. These are the merger cases we are going to analyze.

We intend to compare the changes in profit rate around the time of merger, relatively to that of a comparable firm (control firm). Most of the past studies selected control firms on the basis of similarity to merger firms in terms of business composition and size. Such a selection method is unsatisfactory, however, because banks of similar size may differ significantly in terms of their tendency to undertake mergers. As a result, one cannot say whether the observed difference between a merger firm and a control firm occurred as a consequence of the merger itself or that of the factors that prompted the merger firm to undertake that merger. To make this separation, we want to make a comparison between a merger firm and a firm with a similar likelihood of undertaking a merger but with no merger actually undertaken. The selection of such control firms can be made with the application of the propensity score matching method<sup>7</sup>.

Thus, as a first step, we used an unbalanced panel (pooled data) of all the regional banks during 1999-2005 (sample size = 773) to make a logit estimation of the probability of undertaking a merger. The independent variables are of two types. The first is the company financial data, such as ROE (the rate of return on equity, calculated as a ratio of current profits to net worth), its square, operating cost ratio (operating costs divided by net worth), capital asset ratio (net worth divided by total assets), bad loans ratio (the amount of insolvent debts divided by net worth), total assets in logarithm, and its square. The second is the variable for regional economic condition, measured by the rate of growth of products of the prefecture the bank is headquartered. To avoid reverse causality, all the independent variables were measured with one-year lag.

The estimated result is shown in Table 2. The result suggests that a bank with a higher

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<sup>5</sup> Retail banks in Japan consist of two types -- city banks and regional banks. The former includes three mega banks (Mizuho, Sumitomo-Mitsui, and Tokyo-Mitsubishi UFJ) and a few smaller ones. There are about 100 regional banks whose activities are more or less concentrated in the prefectures they are headquartered.

<sup>6</sup> <http://www.recofdata.co.jp/mainfo/graph/> (accessed, June 2011)

<sup>7</sup> The propensity score matching method has been used in various fields from policy evaluation, labor economics, corporate governance, and business strategy to the evaluation of drug clinical test results. See Rosenbaum and Rubin (1983). For a different use of propensity score in a merger analysis, see Danzon, et al. (2007).

operating cost ratio, a lower capital asset ratio, a higher bad loans ratio, and bigger assets was more likely to undertake mergers during this period. That is, roughly speaking, a bigger and less healthy bank seems to have chosen to merge.

The probability of merger predicted from this estimated equation is the propensity score. We calculated the propensity score of each of the merger bank at the year of merger. Then, we chose as the control bank a bank that has the nearest propensity score in the same year. The result is in Table 3. Since Yachiyo Bank showed the nearest score to two of the merger banks, it appears twice in the list of control banks.

### 3.2. Results

We employ ROE as a measure of corporate performance, and look at its changes as defined below.

$$(1) \quad \Delta ROE_{i,t} = ROE_{i,t} - ROE_{i,t-1}$$

where  $ROE_{i,t}$  is ROE of  $i$ -th firm in  $t$  years after the merger ( $t = 1, 2, 3$ ) and  $ROE_{i,t-1}$  is ROE of  $i$ -th firm one year before the merger. For merged banks, we calculated  $ROE_{i,t-1}$  as that of a hypothetical combined bank by adding the two pre-merger firms' data and then making the ratio. Also, to control the effects of business fluctuation, we used year-adjusted ROE by subtracting from ROE the annual average across all the sample banks used in the logit analysis above.

The results are summarized in Table 4. For instance, one year before the merger, Shinwa Bank had its ROE 9.696 percent point higher than the average of the year, whereas the control bank, Chukyo Bank, 11.928 percent point higher. That is, both banks had above-average ROE but the control bank had a higher one. Kiyoo Bank, on the other hand, had the ROE 14 percent point lower than the average whereas the control bank, Hokuto Bank, had an above-average ROE. Among the six cases, merged banks had higher ROEs in three cases and the control banks had higher ROEs in three cases.

The table also shows that ROE declined after the merger in four of the six cases. In comparison to control banks, ROE worsened in three of four cases one year after the merger, four of six cases two years after the merger, and three of six cases three years after the merger. On average, merger banks did worse than control banks; however, the difference is statistically insignificant because the variance across banks is large<sup>8</sup>. Therefore, we cannot conclude whether the mergers improved or worsened the ROE relatively to control firms. In other words, there is no evidence to support the argument that mergers generally improve the firms' profitability. However, the results vary significantly across cases.

## 4. Effects on Share Prices

### 4.1. An Event Study Methodology

A frequent criticism to the pre- and post-merger comparison of profit rates is that it fails to capture the long-term consequence. It may take several years before the necessary re-organization is completed, the employees get used to new practices and corporate

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<sup>8</sup> We conducted a  $t$  test and a Wilcoxon's signed rank test (resp.) to find that null hypotheses cannot be rejected that the mean and median (resp.) of the effects of merger on company performance are equal to zero.

culture and learn the better technologies and management method of the partners, and synergy effects take place. Until then, the financial indicators, such as profit rates, may not produce noticeable effects. Still, the shareholders would try hard to predict such long-run consequences to make buy-or-sell decisions. Of course, the information is imperfect and the prediction is bound to error. Still, investors, particularly institutional investors, tend to have substantial information on the internal and external conditions of the firm and the industry, as well as the history of mergers in the same industry, with which they will endeavor to predict the long-run profit stream of the merger firms. Such prediction will affect their buying/selling decisions and thus the share prices. It is for this reason that an event study methodology is commonly applied to study the changes in share prices around the time of merger announcement.

Let  $R_{i,t}$  be the rate of return to the share of  $i$ -th firm in day  $t$ . It is calculated as the rate of change in share price because there was neither dividend payment nor share split during the sample period<sup>9</sup>. Similarly  $R_{m,t}$  is the rate of return to market portfolio. Using the pre-merger time-series data, we first estimate the following equation:

$$(2) \quad R_{i,t} = a_i + b_i R_{m,t} + u_{i,t}$$

where  $u_{i,t}$  is the error term. Using the estimated parameters,  $\hat{a}_{i,t}$  and  $\hat{b}_{i,t}$ , we calculate abnormal returns (AR) as the difference between the actual value and the predicted value, and the cumulative abnormal returns (CAR) as its cumulative value from day  $T_1$  to day  $T_2$ ; that is,

$$(3) \quad CAR_i(T_1, T_2) = \sum_{t=T_1}^{T_2} [R_{i,t} - (\hat{a}_i + \hat{b}_i R_{m,t})]$$

If  $CAR$  thus calculated for the post-merger period is positive, then we can infer that the investors predicted that the merger would produce a higher stream of long-run profit, which resulted in the market share price being higher than that predicted by general market price movement alone.

#### 4.2. Sample and Period

The day of the event is the day when the merging firm(s) made their press release. As the actual merger always takes place several months after the press release, the share prices of both partners are available for both pre-merger and post-merger days. These share prices, of course, are available only for listed firms; thus the sample is confined to mergers between listed firms that occurred between 2000 and 2007. With this criterion, we selected 15 merger cases, of which 11 were between financial institutions (banks or insurance companies) and 4 were between manufacturing firms. With two mergers involving three banks each, we have the sample of 32 firms in total.

We estimated equation (2) using the daily share price data from one month before the announcement to two working days before. We then calculated  $CAR$  according to equation (3), where  $T_1$  is one working day before the announcement and  $T_2$  varies from 0

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<sup>9</sup> To be more precise, it was calculated as the difference in logarithm of prices between days  $t$  and  $t-1$ .

(the day of announcement) to one month after the announcement.

### **4.3. An Example: Merger of Two Pharmaceutical Firms, Sankyo and Daiichi**

On 21 February 2005, Sankyo and Daiichi, both among the largest ten pharmaceutical manufacturers in Japan, announced their plan to merge to create Daiichi Sankyo. Figure 1 shows the movement of CAR of these two firms and of two rival pharmaceutical firms of similar sizes, Eisai and Chugai.

On the day of merger announcement, both Sankyo and Daiichi yielded CAR of about 0.04, implying that their share price increase was 4 percent point higher than the one that would have occurred were it not for the announcement. It is often the case that the news of a merger (or other reorganization plans) produces excitement and certain optimism in the stock market, raising the share prices of the merger partners. Such optimism, however, tends to fade soon and be replaced with cool-headed calculation. Indeed, as shown in Figure 1, CARs of the two companies soon decline and turn to negative in Day 3 (Daiichi) or Day 5 (Sankyo). Daiichi's CAR then bounced back and stay positive for a few days but eventually turns negative again. Sankyo's CAR stays negative. By contrast, even though on the announcement day the CARs of the two rival companies, Eisai and Chugai, were smaller than those of Daiichi and Sankyo, they got to overwhelm the latter after several days and then stayed positive.

The result suggests that, except for the excited reaction on the day of announcement, the stock market tends not to expect positive long-run gains to merging firms from the merger but do expect such gains to the competitors. This result agrees with the theoretical conclusion of "merger paradox" discussed in Section 2 and implies that the stock market was expecting that the merging firms would not be able to produce efficiency gains large enough to offset the paradox.

### **4.4. Summary of the Results from 15 Cases**

We show the number of cases with positive and negative CAR in Table 5, with the estimated CAR of individual merger firms given in Appendix Table. As in the case of Daiichi Sankyo, CAR is positive on the day of announcement (Day 0) in 25 (78%) of the 32 firms in 16 merger cases; however, this proportion gradually declines. More importantly, the table shows that whereas 16 of the 25 positive CARs on Day 0 were statistically significant, they all become insignificant by Day 7. More CARs are still positive than negative on Day 7; however, only two CARs are statistically significant and both of these are actually negative.

In that there were more cases of positive CAR than negative CAR throughout the seven days, this event-study result on share prices is somewhat more favorable to the expected performance of mergers than that with the profit rate discussed in Section 3, in which the proportion of positive results was roughly on a par with that of negative results. Still, the lack of significance in the majority of cases (except the day of announcement) gives only a limited support, if any, to the hypothesis of investors' anticipating long-run efficiency gains from the merger.

## **5. Effects on Innovation**

### **5.1. The Motivation**

In announcing the merger plan to the press and the investors, the firms almost always proclaim that the merger will improve efficiency, including efficiency in R&D activities.

They argue that with the two together, they can exploit economies of scale and scope, taking advantages of larger and complementary resources and capabilities for innovation.

The existing literature is ambiguous on such effects. The so-called Schumpeterian hypothesis emphasizes the advantage of size in R&D and would predict an increase in R&D activity and/or R&D output after the merger. By contrast, the so-called quiet life hypothesis would argue that the management of a bigger and more monopolistic firm would indulge in a quiet and safe life, avoiding risky activity such as R&D. Also, the more monopolistic the firm is, it is more likely that its new product attracts customers only by having them switch from the existing products of the same firm. Because of this 'replacement effect', a bigger firm or a firm with more variety of products will have a smaller incentive to engage in R&D. These arguments suggest that the merger may result in lower innovation activity.

Empirical results are also mixed; however, there appear more cases suggesting a negative effect of merger<sup>10</sup>. For instance, Cassiman, et al. (2005) and Colombo and Garrone (2006) found that mergers, particularly horizontal ones, tend to reduce R&D intensity and this tendency is stronger when the merger partners' technologies are substitutable. All these results therefore suggest that the effects of mergers on innovation are neither straightforward nor universal, which is why we need to make an investigation in the Japanese cases.

## 5.2. Sample and Variables

Our sample consists of 39 mergers of manufacturing firms. As in Section 3, we basically added the figures of merger partners for the pre-merger period. Two mergers, however, were the acquisitions by listed firms of smaller non-listed firms and, for these, we compared the pre-merger figure of the acquiring firm only to the post-merger figure, because the acquired firm was much smaller and adding its pre-merger figure was assumed to affect little. If anything, its neglect will overestimate the effect of a merger as regards the number of patents and, unless the smaller firm is more R&D intensive than the larger one, R&D intensity<sup>11</sup>.

We use both R&D input variable -- R&D intensity, measured by the ratio of R&D expenditures to sales -- and output variable -- the number of published patent applications. In the Japanese patent regime, all applications are published after 18 months of application<sup>12</sup>. We counted the number of these published applications.

There is one important difference between the two variables because of data source. R&D intensity was calculated from consolidated financial statements; that is, both the numerator and the denominator include the figures of consolidated subsidiaries. By comparison, we counted the number of patents from the JPO (Japan Patent Office) database, based on the name of parent company only, because tracing all the subsidiaries and counting the patents filed under these names is very difficult and time-consuming. We trust that this difference between the two variables does not cause a serious bias as the

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<sup>10</sup> Colombo and Garrone (2006) gives an excellent survey of empirical studies.

<sup>11</sup> In addition, two cases were the acquisitions between a Japanese firm and a foreign firm. For these, we used the figures of only the Japanese partner for both pre-merger and post-merger periods.

<sup>12</sup> An application is not published if, by the end of 18 months, it has been withdrawn or it has been subject to examination and rejected.

subsidiaries tend to be less active in patenting. There are a few subsidiaries that are R&D centers of the parent firm (e.g., Honda R&D is a 100%-owned R&D subsidiary of Honda Motor) in which case their inventions are usually assigned to the parent firm.

The purpose of this study is to compare the pre-merger level to the post-merger level. The pre-merger level is calculated as the average in the three years preceding the merger of R&D intensity (or the number of patents), to smooth away yearly fluctuations that can be large particularly as regards the number of patents. The post-merger level is the average of three years ( $T$ ,  $T+1$ ,  $T+2$ ) following the merger (in accounting year  $T$ ), of five years ( $T$ ,  $T+1$ ,  $T+2$ ,  $T+3$ ,  $T+4$ ), or of the three years beginning with the second year ( $T+2$ ,  $T+3$ ,  $T+4$ ) to take account of the lag in the effect of integration.

### 5.3. Results

The results are summarized in Table 6. When we took post-merger five years, the number of firms that increased R&D intensity after the merger was on a par with the one that decreased R&D intensity. However, when we took post-merger three years or three-to-five years, decreasing cases occupied the majority. Decreasing cases were even more dominant concerning the R&D output measure, that is, the number of patents. In short, there is no evidence suggesting that mergers increased R&D intensity or R&D efficiency as measured by the productivity of R&D to produce patents.

To inquire if this conclusion is robust, we made a few further analyses. First, we restricted the sample to R&D-intensive firms, which were defined as the firms with the R&D intensity being 3 percent or more, or 4 percent or more. The table suggests that, among these firms, the merger may have had an effect of intensifying R&D efforts, because the number of firms that increased R&D intensity is greater than that of firms decreasing R&D intensity. However, in terms of the number of patents, there were, again, more firms with decreases following the mergers. Therefore, the mergers do not appear to have increased R&D efficiency and in fact are more likely to have decreased it.

Second, we restricted the sample to those merger cases for which Japan Fair Trade Commission gave close scrutiny before giving approvals with or without remedies<sup>13</sup>. The number of cases is only 5 or 6 and, therefore, the result is difficult to be generalized. Among these, the table indicates that, like R&D-intensive firms, there are more firms with increases in R&D expenditure and yet there are more firms with decreases in the number of patents. That is, even if the mergers helped the firms to increase their efforts, there is no evidence suggesting that they increased R&D efficiency.

Third, as discussed in the previous subsection, it takes 18 months from patent application to its publication. Also, there may be a lag between R&D efforts and patent applications. To investigate if such a lag changes our result, we made similar comparisons incorporating a 2-year or 3-year lag. The table shows that, even with such lags taken into account, the number of firms whose patent applications decreased after the mergers outweighs that of firms with increasing patent applications.

These results together suggest that there is no evidence to support the argument that mergers intensify R&D efforts. To be true, among R&D-intensive firms and among big

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<sup>13</sup> To be precise, these were the cases that appeared in JFTC's annual reports titled "Shuyo na Kigyo Ketsugo Jirei" [Major Business Combination Cases], which is available only in Japanese at the JFTC website. The number of cases taken up in these reports varies year by year but is usually around ten.

merger cases that attracted JFTC's concern, there may have been more cases of increased R&D intensity, that is, R&D expenditures per sales. However, in all cases including these, we found that more firms decreased patent applications after the mergers. We are aware that the number of patents is a poor measure of R&D output and the firms may have changed their patenting strategy after the mergers. For instance, if a firm merges with its main rival, it may find it less necessary to apply patents for defensive purposes. Also, with fewer rivals, it may find it easier to exploit monopoly profits from the invention regardless of whether they obtain patent protection or not. Therefore, we have to be cautious in interpreting our results as the evidence of decreasing R&D output or R&D efficiency. Still, the result is not in conflict with this interpretation. Besides, if the merger decreased the firms' propensity to patent for the reasons just discussed, it can be a manifest of reduced competition, which, of course, should cause a great concern to JFTC or any other competition policy authority.

## 6. Effects on Product Prices

### 6.1. Model

In this section, we investigate if the retail prices of the products increased after the merger<sup>14</sup>. The products to be considered are differentiated consumer goods. Therefore, the prices can vary across firms (i.e., manufacturers) and even across different items (different brands, different package sizes, different types of package, etc.) of a firm. When two firms in such a market merge while other firms remain as the rivals, the merger can affect not only the prices of the items of the merging firms but also the prices of the rival firms' items, as suggested by differentiated oligopoly models. We will therefore investigate both the effect of the merger on the general market price, calculated as the weighted average over all the items in the market with their sales shares as the weights, and the effect on the price of the merged firm, calculated again as a weighted average over the items offered by the firm.

The model follows that of Ashenfelter and Hosken (2008): for  $i$ -th item,  $j$ -th region, and  $t$ -th month,

$$(4) \quad p_{i,j,t} = \alpha_{i,j} + \sum_{m=1}^{11} \delta_m M_t + \beta_1 POST_t + \beta_2 POST_t \times MPP_i + \varepsilon_{i,j,t}$$

where  $p_{i,j,t}$  is the price (in logarithm),  $POST_t$  is a dummy variable that equals 1 for and only for the post-merger months,  $MPP_i$  (short for merging party product) is a dummy variable that equals 1 for and only for the items of the merging firms,  $\alpha_{i,j}$  is a product- and region-specific factors,  $M_t$  is a month of the year indicator,  $\delta_m$  is the month effect, and  $\varepsilon_{i,j,t}$  is the error term.

Therefore, the estimate  $\hat{\beta}_1$  indicates how the market price in general increased after the merger whereas the estimate  $\hat{\beta}_2$  indicates how the prices of the merger firms' items increased after the merger in addition to the general market price increase.

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<sup>14</sup> The detail of this study is available as a separate discussion paper: see Arai (2011). For a survey of related studies in the US, see Ashenfelter and Hosken (2008).

## 6.2. Sample Markets

We make separate analyses for three markets. The first is household flavor seasonings (hereafter, seasonings), which includes about 3,000 items. The largest producer, Ajinomoto, acquired 33.4 percent of the share of the third largest, Yamaki, in 2007.

The second is sugar, with about 850 items. Three sugar refineries, Shin Mitsui Seito (the largest in the market), Taito, and KS, merged in 2005 to become Mitsui Seito (Mitsui Sugar).

The third is instant noodles including cup noodles (hereafter, noodles). Nisshin, No. 2 in pack noodles and No. 1 in cup noodles, acquired Myojo in 2006. Myojo became a wholly owned subsidiary of Nisshin and, two years later, a joint holding company, Nisshin Foods Holdings, was established with both Nisshin and Myojo as its wholly owned subsidiaries.

## 6.3. Data

The data, purchased from private data companies, were gathered at more than 600 stores at point of sales (POS). It is aggregated into nine regions (e.g., Hokkaido, Tohoku, and Tokyo Metropolitan). The data is monthly basically from two years before the merger to two years after the merger. It includes the data on both the value and quantity of sales for each item. By dividing the value by quantity, we obtained the price data.

## 6.4. Results

The results are shown in Table 7. To save space, we suppressed the estimated results of brand, region, and month effects ( $\hat{\alpha}_{i,j}$  and  $\hat{D}_m$ ) and only show the estimated coefficients,  $\hat{\beta}_1$  and  $\hat{\beta}_2$ . For more details, see Arai (2011).

$\hat{\beta}_1$  is the estimated effect of the merger (or acquisition) on the market price on average. It is positive and significant for seasonings and sugar. For noodles, it is negative but small; that is, it decreased the price only by 0.23 percent. By contrast, the merger increased the price by more than 5 percent in the sugar market – a substantial increase. The price increase was smaller but still significant in the seasonings market, at 0.16 percent.

$\hat{\beta}_2$  shows how much the prices of merging firms' items increased relatively to the average market price. It is positive and significant for all the three products. Again, the effect is strongest in the sugar market: here, after the merger, the average price increased by 5.28 percent and, in addition, the prices of the merging firms increased by 3.84 percent; therefore, the latter increased by 9.12 percent in total after the merger. By contrast, the effect is again small in the noodles market. Here, the merging firms increased their prices relative to the market average by 0.23 percent. Together with the effect the average market price went down by 0.23 percent, this implies that the merging firms did not change their prices despite the general decline in the market prices.

In view of the theoretical prediction from oligopoly models discussed in Section 2, these results suggest that the marginal cost of the merged firm never decreased sufficiently to have the firm lower its product price. Particularly in the case of sugar and, to a lesser extent, seasonings, the consumers' surplus must have been hurt as a result.

## 6.5. Case Study: Seasonings

In the seasonings case, the two partners, Ajinomoto and Yamaki, remained as separate

companies after the merger despite the former acquiring the 33.4 percent share of the latter in March 2007. Therefore, we can inquire into the post-merger price movement of these two firms separately. For this purpose, we estimated the following equation:

$$(5) \quad p_{i,j,t} = \alpha_{i,j} + \sum_{m=1}^{11} \delta_m M_t + \beta_1 POST_t + \beta_2 POST_t \times AII_i + \beta_3 POST_t \times YAMA_i + \varepsilon_{i,j,t}$$

where  $AII_i = 1$  if and only if the item belongs to Ajinomoto and  $YAMA_i = 1$  if and only if the item belongs to Yamaki.

The result is shown in Table 8. Interestingly, the cross term with Ajinomoto ( $\hat{\beta}_2$ ) has a positive coefficient while that with Yamaki ( $\hat{\beta}_3$ ) has a negative coefficient. This contrast in the estimates agrees with the actual movement of the prices (weighted averages of all the items of Ajinomoto's or Yamaki's) as shown by the lines in Figure 2. That is, relatively to the market price, Ajinomoto raised its prices after the merger whereas Yamaki lowered them.

A likely interpretation of this contrasting result is that the combined firm reorganized its product positioning strategy so as to sell its Ajinomoto-related brands as high-end ones and the Yamaki-related brands as low-end ones. In fact, even before the merger, the average price of Ajinomoto-related brands was higher than that of Yamaki, implying that the consumers evaluated Ajinomoto brands more highly than Yamaki brands. After the merger, the firm apparently decided to exploit this consumer evaluation to its advantage, by widening the price differential.

This finding suggests that, in a market with differentiated products, a merger affects not only the price in general. It also affects the positioning of the firm's various products<sup>15</sup>. This repositioning may affect consumers in different manners. In the seasoning case, those consumers who continued to buy Ajinomoto brands suffered from the price increase whereas Yamaki's buyers benefitted from the price decrease. In that the cheaper brands became even cheaper, the merger may have had a favorable effect from the income distribution viewpoint.

More generally speaking, this example suggests that a competition policy authority may have to evaluate not just the expected movement of the average price, but also possible change in the structure of prices across different brands. Of course, this is no easy task: nevertheless, it is a necessary step towards understanding probable social effects of a merger.

## 7. Summary and Conclusion

To summarize, our studies indicate the following:

- A. No evidence was found that merged firms improved their profitability relatively to that of control firms selected on the basis of similarity in propensity to merge. Actually, even though statistically insignificant, there were more cases of declining profit rates than increasing profit rates.
- B. The share prices rose in many cases on the day of announcement but tended to decline within a few days, making the cumulative abnormal returns not

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<sup>15</sup> For other studies on the effect of merger on product positioning, see Gandhi, et al. (2008) and Sweetening (2010).

- significantly different from zero in the majority of cases.
- C. Both R&D intensity and the number of patents decreased in the majority of cases. Among R&D-intensive firms, more firms experienced an increase in the intensity but decrease in the number of patents.
  - D. As regards the effect on product prices, our study on three markets showed that the average market prices increased (except noodles, for which the market price slightly decreased) and the average prices of the merged firms' items increased even more.

These results suggest that efficiency increase associated with merger was limited, if any at all. Oligopoly models teach us that efficiency increase must be sufficiently large for the merger firms' profit rate to increase and, for the price to decrease, the efficiency increase must be even larger. Both findings A and D imply that the efficiency increase was either nonexistent or not large enough. Consumers' surplus was likely damaged and so was social surplus, that is, the sum of consumers' surplus and producers' surplus. The long-run effect of mergers was similar, in two senses. First, as finding B implies, there was no statistically significant evidence suggesting that investors were expecting the merger to improve long-run profits of the firms. Second, as finding C implies, the merger unlikely resulted in greater innovation efforts or more efficient R&D activity.

The results should be taken with caution, however, because of data limitations and other reasons mentioned earlier. In particular, we emphasize that looking only at the average can be misleading because variance across merger cases is large. There were cases, albeit in a minority, in which profitability increased, share prices increased, or R&D intensity increased. There may have been also cases in which consumers' surplus and social surplus increased. All this suggests is that the impact of merger has to be investigated case by case. To be true it is very difficult for a competition office to estimate accurately the merger's impact on efficiency and on prices; still, it has to be done and the merging firms have to cooperate by providing necessary data and information. With such an estimate in hand, one had better be skeptic about efficiency claims made by merging firms.

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**Table 1. Variables, Samples, and Methodology of the Four Studies**

	Section 3	Section 4	Section 5	Section 6
Effects on	Profits	Share prices	Innovation	Product prices
Variables	Rate of return on equity (ROE)	Cumulative abnormal stock rate of return (CAR)	(1) R&D intensity (R&D expenditure/sales) (2) the number of patents	Retail prices
Comparison between	Pre-merger and post-merger, in comparison to firms with a similar propensity to merger (selected with the propensity score matching methodology)	The actual value and the value predicted with pre-merger data (event-study methodology)	Pre-merger and post-merger	Pre-merger and post-merger, in comparison to market average
Mergers used as samples	6 mergers of local banks	15 mergers (11 financial and 4 manufacturing)	39 mergers of manufacturing firms	Mergers in 3 product markets (seasonings, sugar, and instant noodles)

**Table 2. Logit Estimation Result of the Propensity to Merger**

Explanatory Variable	Estimated Coefficient	Estimated Standard Error	Statistical Significance
Constant	-407.693	194.857	***
ROE	0.188	0.205	
Square of ROE	-0.020	0.005	***
Operating Cost Ratio	4.769	2.622	*
Capital Asset Ratio	-1.899	0.605	***
Bad Loans Ratio	0.535	0.156	***
Log of Assets	52.613	27.370	**
Square of Log of Assets	-1.723	0.956	*
Growth Rate of Regional Production	0.541	0.236	***
Sample Size	773		
Pseudo-R <sup>2</sup>	0.410		
Log of Pseudo-Likelihood	-20.739		

Notes:

1. All explanatory variables except the constant term are measured with one-year lag.
2. Standard errors are adjusted for heteroskedasticity over banks.
3. \*\*\*, \*\*, and \*, respectively, indicate statistical significance at 1%, 5%, and 10%.

**Table 3. The List of Merged Banks and the Control Banks**

Month/Year of Merger	Merged Bank (Surviving Bank + Absorbed Bank)	PS	Control Bank	PS
April/2000	The Kinki Osaka Bank (Osaka Bank + Kinki Bank)	0.447	The Towa Bank	0.200
April/2003	The Shinwa Bank (The Shinwa Bank + The Kyushu Bank)	0.013	The Chukyo Bank	0.013
April/2003	Tsukuba Bank (Kanto Bank + Tsukuba Bank)	0.157	Suruga Bank	0.145
May/2003	Momiji Bank (Hiroshima Sogo Bank + Setouchi Bank)	0.040	The Yachiyo Bank	0.029
October/2004	The Nishi-Nippon City Bank (Nishi-Nippon Bank + Fukuoka City Bank)	0.060	The Yachiyo Bank	0.029
October/2006	The Kiyō Bank (Kiyō Bank + Wakayama Bank)	0.124	The Hokuto Bank	0.043

Note: PS stands for “Propensity Score.” The third column shows estimated propensity scores of merged banks and the fifth column, those of control banks.

**Table 4. Year-Adjusted ROE and Its Changes: Merged Banks and Control Banks Compared**

Merged Banks	ROE	Change in ROE from one year before merger to			Control Banks	ROE	Change in ROE from one year before merger to		
	One year before merger	One year after merger	Two years after merger	Three years after merger		One year before merger	One year after merger	Two years after merger	Three years after merger
	$ROE_{i,-1}$	$\Delta ROE_{i,1}$	$\Delta ROE_{i,2}$	$\Delta ROE_{i,3}$		$ROE_{i,-1}$	$\Delta ROE_{i,1}$	$\Delta ROE_{i,2}$	$\Delta ROE_{i,3}$
The Kinki Osaka Bank	34.664	-59.175	-50.313	-111.371	The Towa Bank	25.079	-15.021	-59.492	-40.053
The Shinwa Bank	9.696	-44.989	-36.705	-3.916	The Chukyo Bank	11.928	-8.357	-7.495	-8.519
Tsukuba Bank	4.784	-2.714	-33.387	-22.345	Suruga Bank	16.084	-4.692	-8.490	-7.381
Momiji Bank	11.682	-11.253	-7.769	-54.274	The Yachiyo Bank	2.017	-2.127	4.948	4.723
The Nishi-Nippon City Bank	3.334		1.415	7.341	The Yachiyo Bank	2.017		4.948	4.723
The Kiyō Bank	-14.035		20.960	18.492	The Hokuto Bank	3.282		-3.656	-108.485
Mean	8.354	-29.533 (0.14)	-17.633 (0.50)	-27.679 (0.95)	Mean	10.068	-7.549	-11.540	-25.832
Median	7.240	-28.121 (0.25)	-20.578 (0.44)	-13.131 (0.84)	Median	7.605	-6.525	-5.575	-7.950

Note: In three cases, the merger took place on the first day of a new accounting year. In another, the merger took place just one month after the first day of a new accounting year. In these four cases, this new accounting year is defined as  $t = 1$ , and the previous accounting year is defined as  $t = -1$ . In two cases, the merger took place in the midst of an accounting year, in which case this accounting year was defined as  $t = 1$  but eliminated from the comparison of  $\Delta ROE_{i,t}$ . In parentheses are the  $p$ -values of a  $t$  test and a Wilcoxon's signed rank test with null hypotheses that means and medians, respectively, of the effects of merger on company performance are equal to zero.



**Table 5. Number of Cases with Positive and Negative Cumulative Abnormal Returns from the Day of Merger Announcement:**

	Positive		Negative	
	All	Significant	All	Significant
Day 0 (event day)	25	16	7	3
Day 1	25	7	7	1
Day 2	23	2	9	1
Day 3	22	2	10	2
Day 4	21	2	11	1
Day 5	21	3	11	3
Day 6	21	1	11	2
Day 7	20	0	12	2

Notes:

1. In the column “Significant” is the number of cases that are statistically significant at the 5 % level.
2. For individual CAR estimates, see the Appendix Table.

**Table 6. The Number of Cases in which R&D Intensity and Patent Applications Increased or Decreased after the Merger**

	R&D intensity		Number of Patent Applications Published	
	<u>Increased</u>	<u>Decreased</u>	<u>Increased</u>	<u>Decreased</u>
All sample				
Pre-merger 3 years vs. Post-merger 3 years	17	22	11	28
Pre-merger 3 years vs. Post-merger 5 years	17	17	9	25
Pre-merger 3 years vs. Post-merger 3-5 years	16	19	11	23
R&D-intensive firms only (R&D intensity $\geq 3\%$ )				
Pre-merger 3 years vs. Post-merger 3 years	9	6	5	9
R&D-intensive firms only (R&D intensity $\geq 4\%$ )				
Pre-merger 3 years vs. Post-merger 3 years	7	3	4	6
Cases with JFTC examinations				
Pre-merger 3 years vs. Post-merger 3 years	5	1	2	3
With 2-year lag				
Pre-merger 3 years vs. Post-merger 3 years			12	22
With 3-year lag				
Pre-merger 3 years vs. Post-merger 2 years			12	22

Notes: “Pre-merger 3 years” is the average over the years ( $T-3$ ,  $T-2$ ,  $T-1$ ) where  $T$  is the year the merger took place. “Post-merger 3 years” is the average over ( $T$ ,  $T+1$ ,  $T+2$ ); “Post-merger 5 years”, over ( $T$ ,  $T+1$ ,  $T+2$ ,  $T+3$ ,  $T+4$ ); and “Post-merger 3-5 years”, over ( $T+2$ ,  $T+3$ ,  $T+4$ ). With 2-year lag, “pre-merger 3 years” is the average over ( $T-1$ ,  $T$ ,  $T+1$ ) and “post-merger 3 years”, over ( $T+2$ ,  $T+3$ ,  $T+4$ ). With 3-year lag, “pre-merger 3 years” is the average over ( $T$ ,  $T+1$ ,  $T+2$ ) and “post-merger 2 years”, over ( $T+3$ ,  $T+4$ ).

**Table 7. Estimated Effects of Mergers on Prices**

	Seasonings	Sugar	Noodles
$\beta_1$	0.0016	0.0528	-0.0023
t-value	2.76***	40.31***	-2.91***
$\beta_2$	0.0039	0.0384	0.0023
t-value	3.33***	14.37***	1.82***
Sigma_u	0.0904	0.0818	0.3264
Sigma_e	0.0741	0.1094	0.0558
rho	0.5980	0.3586	0.9716

Notes:

Estimated coefficients of  $\alpha_{i,j}$  and  $D_m$  are suppressed.

\*\*\*, \*\*, and \* indicate statistical significance at 1% , 5%, and 10%, respectively.

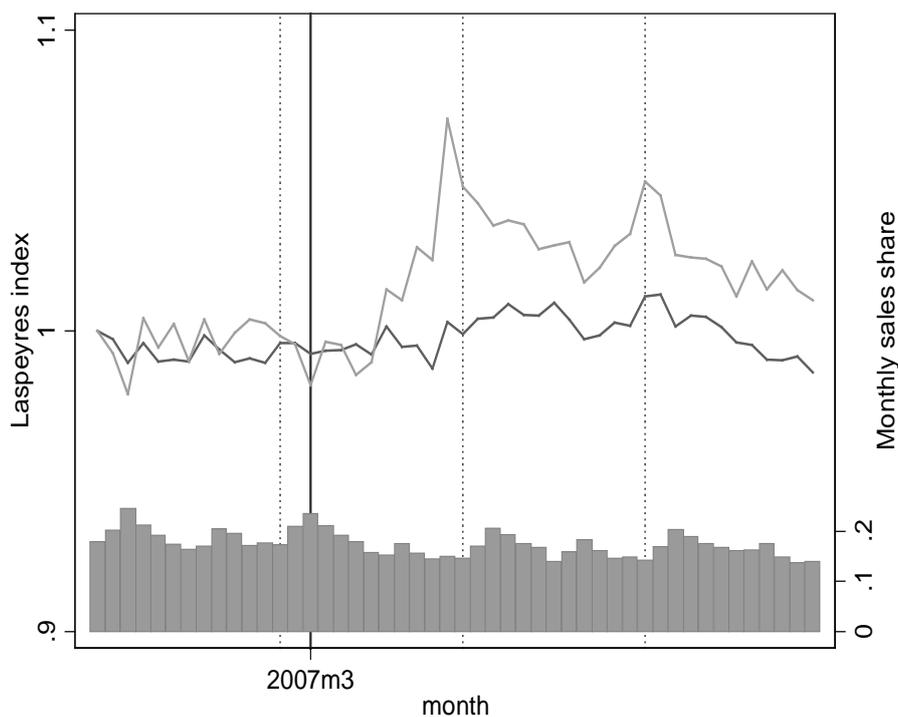
**Table 8. Estimated Separate Effects on Prices of the Merger Firms**

	Seasonings
$\beta_1$	0.00795
t-value	6.71***
$\beta_2$	0.00255
t-value	0.76
$\beta_3$	-0.0285
t-value	-5.91***
Sigma_u	0.1133
Sigma_e	0.1725
rho	0.3013

Notes: See Notes to Table 7.

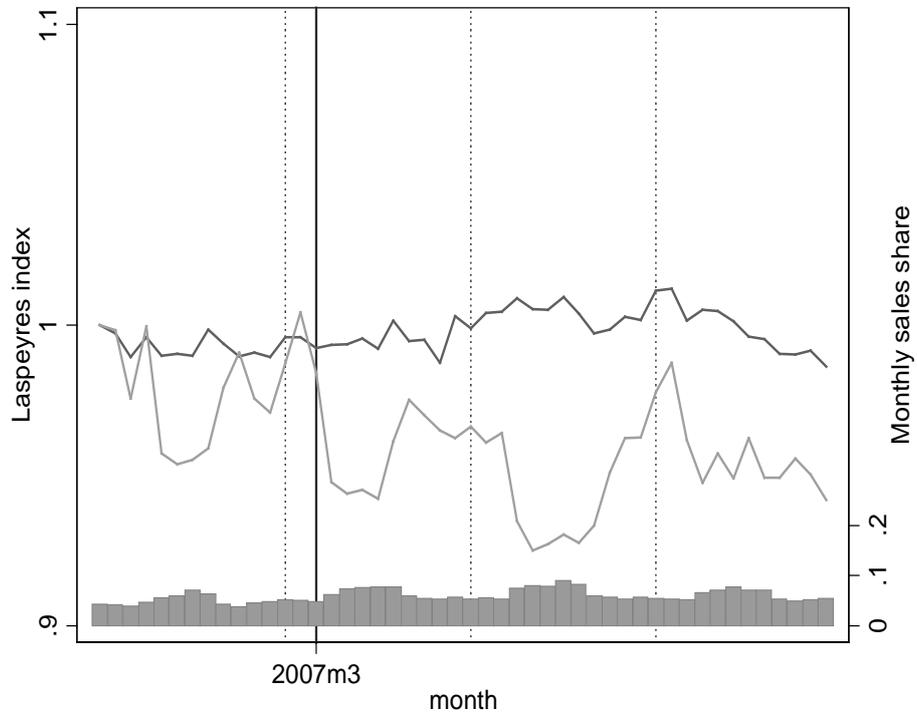
**Figure 2. The Movement of Market Price and the Prices of Ajinomoto and Yamaki Products**

**Panel A: Market price (black line) and the price of Ajinomoto products (gray line)**



Note: Bars show the monthly market share (the right-hand side axis).

**Panel B: Market price (black line) and the price of Yamaki products (gray line)**



Note: Bars show the monthly market share (the right-hand side axis).

**Appendix Table. Estimated Cumulative Abnormal Returns**

	Merger firms	Day 0 (Event Day)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	SANKYO CO.,LTD.	0.04 *	0.02	0.05 *	0.04	0.04	-0.01 *	-0.03	-0.05
2	DAIICHI PHARMACEUTICAL CO.,LTD.	0.04 *	0.02 *	0.01	-0.00	-0.00	0.07 *	0.02 *	0.02
3	NSK Ltd.	0.00	-0.00	-0.02	-0.02	-0.03	-0.04	-0.04	-0.05
4	Amatsuji Steel Ball Mfg.Co.,Ltd.	0.27 *	0.26	0.25	0.25	0.25	0.25	0.25	0.25
5	THE TOKYO-MITSUBISHI BANK,LTD	0.10 *	0.21 *	0.12 *	0.19 *	0.16	0.17	0.14	0.12
6	UFJ Holdings Inc.	0.17 *	0.11	0.09	0.05	0.05	0.09	0.09	0.09
7	THE NISHI-NIPPON CITY BANK,LTD.	0.06 *	0.05	0.03	-0.03 *	-0.04	-0.07	-0.06	-0.06
8	THE FUKUOKA-CITY BANK,LTD.	0.11 *	0.09	0.09	0.02 *	0.03	0.04	0.05	0.05
9	YAMANOUCHI PHARMACEUTICAL CO.,LTD.	0.06 *	0.08	0.08	0.11	0.07	0.09	0.07	0.09
10	FUJISAWA PHARMACEUTICAL CO.,LTD.	0.06	0.11	0.10	0.10	0.07	0.07	0.06	0.07
11	THE HOKURIKU BANK,LTD.	-0.06 *	-0.03	-0.03	-0.01	-0.00	-0.04 *	-0.05	-0.04
12	THE HOKKAIDO BANK,LTD.	0.12 *	0.04 *	0.05	0.06	0.07	0.10	0.12	0.13
13	NKK,LTD.	0.16	0.12	0.11	0.10	0.17 *	0.23	0.21	0.24
14	KAWASAKI STEEL,LTD.	0.04 *	0.03	0.04	0.01	0.04	0.09 *	0.08	0.09
15	TOKIO MARINE CO.,LTD.	0.02	0.00	0.03	0.06	0.03	0.05	0.02	0.02
16	NICHIDO FIRE INSURANCE CO.,LTD.	0.03	0.09 *	0.08	0.07	0.03 *	0.07 *	0.06	0.05
17	YASUDA FIRE INSURANCE CO.,LTD.	0.02	0.05	0.03	0.02	0.01	0.01	0.04	0.04
18	NISSAN FIRE INSURANCE CO.,LTD.	0.09 *	0.13 *	0.13	0.12	0.11	0.10	0.12	0.12
19	THE SHINWA BANK,LTD.	-0.02	-0.00	-0.01	0.01	0.02	0.01	0.01	0.00
20	THE KYUSHU BANK,LTD.	-0.01	0.00	0.02	0.02	0.02	0.03	0.03	0.02
21	THE MITSUI MARINE &FIRE INSURANCE CO.,LTD.	-0.02	-0.04	-0.05	-0.05	-0.11 *	-0.17 *	-0.14 *	-0.08 *
22	THE SUMITOMO MARINE &FIRE INSURANCE CO.,LTD.	-0.09 *	-0.17 *	-0.15	-0.20 *	-0.22	-0.24	-0.22	-0.18 *
23	NIPPON PAPER INDUSTRIES CO.,LTD.	0.20 *	0.17	0.14	0.12	0.15	0.17	0.15	0.18
24	DAISHOWA PAPER INDUSTRIES CO.,LTD.	0.09 *	0.06	0.01	-0.04	-0.06	-0.03	-0.06	-0.04
25	THE SANWA BANK,LTD.	0.13 *	0.07 *	0.03	0.02	-0.01	-0.03	-0.01	-0.03
26	THE TOKAI BANK,LTD.	0.11	0.12	0.07	0.03	-0.04	-0.06	-0.10	-0.15
27	THE TOYO TRUST AND BANK,LTD.	-0.03	-0.08	-0.05	-0.02	0.04	0.04	0.01	-0.03
28	THE TOKYO-MITSUBISHI BANK,LTD.	-0.03 *	-0.02	-0.05	-0.04	-0.02	-0.02	-0.06 *	-0.06
29	THE MITSUBISHI TRUST AND BANK,LTD.	0.09	0.03	-0.01	0.03	0.08	0.07	0.05	0.08
30	THE NIPPON TRUST AND BANK,LTD.	0.24	0.20	0.16	0.13	0.15	0.18	0.17	0.14
31	THE SUMITOMO BANK,LTD.	0.11 *	0.11	0.08	0.09	0.09	0.08	0.08	0.08
32	THE SAKURA BANK,LTD.	0.10 *	0.01 *	-0.10 *	-0.10	-0.11	-0.12	-0.11	-0.10

Notes: \* indicates significance at the 5 % level.