THE MITIGATION EFFECT OF BCP ON FINANCIAL DAMAGE — AN EMPIRICAL STUDY OF THE NON-MANUFACTURING INDUSTRIES IN THE GREAT EAST JAPAN EARTHQUAKE —

Noriaki MATSUSHITA¹, Eizo HIDESHIMA² and Hitoshi TANIGUCHI³

¹Member of JSCE, Deloitte Touche Tohmatsu LLC (1-1-1 Mieiki, Nakamura-ku, Nagoya, Aichi 450-8530, Japan)
E-mail: noriaki.matsushita@tohmatsu.co.jp

²Member of JSCE, Professor, Graduate School of Engineering, Nagoya Institute of Technology (Gokisocho, Showa, Nagoya, Aichi 466-8555, Japan)
E-mail: hideshima.eizo@nitech.ac.jp

³Deputy Chief Researcher, Tono Research Institute of Earthquake Science, Association for Development of Earthquake Prediction (1-63, Akiyo, Mizunami, Gifu 509-6132, Japan)
E-mail: taniguchi-jin@mail.tries.jp

Evaluating the benefits of disaster mitigation action quantitatively and sharing these results with the society are extremely useful in promoting mitigation action. Many studies, however, have focused on the investigation of the damage but not on the mitigation effects of preparedness. Hence, this study analyzed the mitigation effect of the Business Continuity Plan (BCP) on financial damage to non-manufacturing industries in the Great East Japan Earthquake. Our analysis showed the following: 1) In many companies, there is no difference in the direct damage to the company group with BCP and to the group without BCP. 2) The sales of the damaged group without BCP decreased about 5% compared to those of the damaged group with BCP for more than two years. In other words, the effect of mitigating financial damage by BCP is more than 10% of annual sales on the average. 3) The relationship between BCP and sales was analyzed under limited variables, and the coefficient of BCP showed positive effect on sales with significance at a 5% level. Although our result is only an indication, it could be said that this finding, which shows cost–benefit information on BCP, is useful to promote BCP.

Key Words: BCP, mitigation, direct damage, indirect damage, the Great East Japan Earthquake

1. INTRODUCTION

(1) Background
Along with the progress of urbanization and industry integration, the economic damage caused by disasters is showing an upward trend (¹). In recent years, enormous economic damage has taken place due to natural disasters including Hurricane Katrina in the United States (2005), the Sichuan earthquake in China (2008), and the Great East Japan Earthquake in Japan (2011).

Severe damage to the production units of a major company leads to a fall of the local economy and causes regional employment loss. A downturn in the local economy has a direct impact on the profitability of companies in damaged areas, and in some cases the amount of transactions is reduced. In addition, when the business is affected severely in the damaged areas, the impact will spread to non-damaged areas through the supply chain. As company activities steadily accelerate and grow globally, enhancing the resilience of business is not only important to the local economy, but also is essential for a stable world economy.

Many companies, however, do not promote mitigation measures. Japan, which occupies an important position in the world economy, faces many natural disasters every year, and is estimated to experience mega earthquakes, specifically the so-called Nankai Trough megathrust quakes. The economic damage of a Nankai Trough earthquake is expected to be about 220 trillion yen, which is about 10 times the damage of the Great East Japan Earthquake. Despite such a potential for damage anticipated in the near future, only 50% of large companies and 25% of mid-size and small companies have
their own Business Continuity Plan (BCP). Additionally, only 37% of companies have implemented earthquake resistance programs\(^2\).

Thus, there is still vast room for improving disaster reduction measures in many companies.

(2) Past studies

Promoting disaster mitigation measures has attracted the attention of many researchers and many studies have been made from different aspects. In particular, many psychological models have been proposed to promote disaster mitigation measures in the field of social psychology.

These psychological models have included the benefit of disaster mitigation actions as a key component. For example, the efficiency of the recommended preventive behavior is found to promote the protection motivation theory of Rogers\(^3\), and recognition of the benefit on act is pointed out as an important element in the theory of planned behavior by Ajzen\(^4\). From this knowledge, quantitative evaluation of the benefits of disaster mitigation action, and sharing the results with the society are extremely useful to promote mitigation action.

Many studies, however, have focused on the investigation of the damage, but not on the mitigation effect of preparedness. For example, research studies on recent disasters such as the Canterbury earthquake that occurred in 2010\(^5\), Pakistan's flood in 2010\(^6\), and the Great East Japan Earthquake in 2011\(^7\), 8) investigated the financial damage and recovery process.

Only a few studies focused on the analysis of disaster reduction measures. Webb and Tierney et al.\(^9\) pointed out that earthquake experience, preparations for the disaster, and external cooperation do not affect the long-term survival of a business. Some of the previous studies, such as Webb et al.\(^9\), insisted that advanced preparedness for disaster did not reduce direct damage. However, Xiao and Peacock\(^10\) clarified that pre-disaster preparedness was effective to reduce direct damage caused by Hurricane Ike. Matsushita and Hideshima\(^11\) revealed that companies with BCP had resumed business at an earlier stage compared to companies without any BCP. In addition, Matsushita et al.\(^12\) clarified that BCP had a positive impact on sales in the manufacturing industry. Cole et al.\(^13\), based on the questionnaire survey, showed that pre-disaster preparedness and support after the earthquake did not affect the recovery period in the short-term; on the other hand, sales were affected by both pre-disaster preparedness activities and post-disaster policy.

There are many other studies about companies and disasters like those above. However, the effect of BCP on mitigating financial damage, in which companies are very interested, has not been studied in detail.

In the present study, an attempt has been made to analyze the mitigation effect of BCP on reducing the financial damage to non-manufacturing industries during the Great East Japan Earthquake.

2. ANALYSIS OVERVIEW

Damage caused to a company can be categorized as either direct or indirect. Direct damage includes damage to raw materials, damage to work-in-process, loss of goods, restoration costs such as facilities and buildings, and fixed costs. Indirect damage means a decrease in sales due to damage to the facilities, disruption of the supply chain, decrease in consumer confidence, and so on.

A drastic fall in sales, an example of indirect damage, has a significant impact on the cash flow position of the company, which is of course an important element for the smooth running of any business. Thus, analyzing indirect damage is extremely useful information to manage business sustainably.

In this study, we have three types of analyses: 1) analysis of direct damage, 2) analysis of indirect damage, and 3) analysis of mitigating effect of BCP on sales (Fig. 1). The first analysis deals with the investigation of direct damage by the earthquake or subsequent tsunami, and analysis of the difference in total loss with BCP and without BCP. The purpose of BCP is to allow businesses to mitigate indirect damage after the incident. Companies with BCP might also implement reduction measures, such as earthquake-resistance, more aggressively in order to ensure the effectiveness of BCP. Hence, we ana-

![Fig. 1 Analysis Overview.](attachment:image.png)
lyzed the effect of BCP to mitigate direct damage. The second analysis investigates the difference in transition sales with BCP and without BCP. The third analysis is a panel analysis, which analyzed the mitigation effect of BCP on sales.

3. ANALYSIS DATA

(1) Target company

It was difficult to evaluate the companies uniformly because of their varying sizes. Thus, we focused on companies that were listed on the Tokyo Stock Exchange during its fiscal year from March 2011 to February 2012.

There were two reasons for targeting the listed companies. First, a number of past studies have not revealed the damage characteristics of large companies due to their survey method. Many previous studies used questionnaires, and a majority of respondents in the questionnaire were small- and medium-sized companies owing to the small percentage of large companies. Therefore, the results of many previous studies showed the damage characteristics of only small- and medium-sized companies.

Second, the companies listed on the stock exchange were very large and their impact on the country’s economy was huge. In the Financial Statements Statistics of Corporations by Industry, large companies with capital over 1 billion yen accounted for only 0.4% of the total number of companies. Sales and capital investment are about half of the Japanese economy (Fig.2). As many of the large companies had been listed, it was quite important to grasp the financial damage of the listed companies in order to understand the influence of the earthquake on the Japanese economy. Thus, we considered it useful to narrow down our study to the listed companies.

(2) Data

In this study, we used these companies’ financial reports and quarterly reports. As compared to the questionnaire, using financial reports has two benefits. The first benefit is that we can get the financial information from all listed companies, because the listed companies are required to submit financial reports and quarterly reports as per stock market regulations. On the other hand, a questionnaire is less likely to comprehensively grasp the financial information because the reply rate is generally low.

The second benefit is that it enables us to observe the transition of the financial figures every three months. It is quite difficult to capture time series data using the questionnaire method.

a) Loss on disaster (extraordinary loss)

In the accounting standards of Japan, disaster damage has to be disclosed as loss on disaster, which is part of extraordinary loss. The range of loss on disaster includes collapse of buildings or damage to raw material as per the Japanese Institute of Certified Public Accountants (Table 1). Therefore, we summarized the loss on disaster as a direct damage.

It should be noted that floods in Thailand and the Great East Japan Earthquake occurred in the same year (2011); a few companies had announced the total amount of damage caused by these two disasters as a loss on disaster. It could be assumed that the number of Japanese companies additionally damaged by the flood was limited. Therefore, in the present study, the losses on disaster disclosed in March 2011 to March 2012 were counted as damage by the Great East Japan Earthquake. If damage from floods in Thailand was noted, we excluded it from the analysis.

<table>
<thead>
<tr>
<th>Table 1 Range of loss on disaster (JICPA).</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Loss of fixed assets (tangible fixed assets such as buildings, intangible assets such as software, investment property loss, etc.) and inventory assets (products, etc.).</td>
</tr>
<tr>
<td>2) Inspection costs, removal costs.</td>
</tr>
<tr>
<td>3) Expenses for restoration and expenses for preventing the decrease in value.</td>
</tr>
<tr>
<td>4) Fixed costs during business pause period after disaster.</td>
</tr>
<tr>
<td>5) Solatium to the affected client partners, disaster recovery support funds.</td>
</tr>
<tr>
<td>6) Solatium to the affected employees, restoration costs such as hotel fees, etc.</td>
</tr>
</tbody>
</table>

Fig.2 Configuration percentage of companies in Japan 14).
In addition, if the company noted that loss on disaster was due to the Great East Japan Earthquake in financial reports in 2012 and 2013, we considered it as a direct damage caused by the Great East Japan Earthquake.

b) Transition of sales

We used financial reports and quarterly reports to analyze the transition of sales every three months. In this case, the affected span from the earthquake was different for each company because the settlement period differed from company to company. For example, the sales of a company that closed in March aggregated January to March, so such a company included one month of damaged period. The sales of a company that closed in April aggregated February to April, and thus included two months of damaged period. In this way, the affected span by earthquake was different based on the settlement period. If sales damage occurred for more than one month, the first quarter sales of a company that closed in April was seen to be worse than March. In analyzing the impact of the earthquake to the transition of sales, we considered it necessary to study the same time span. Thus, we targeted companies whose settlement period was March, June, September, or December.

c) Survey method of BCP

In the financial reports, companies described the risks surrounding their business and corresponding circumstances. Therefore, we searched for "BCP," or "business continuity plan" in the financial reports, and we extracted the companies that have formulated a BCP. It could be that some companies did not describe BCP in the financial report; hence, we collected as much information as possible from newspapers, magazines, HP, the CSR reports, etc. These additional procedures, however, did not always clarify whether the companies had or did not have BCP. As some companies with BCP might have been categorized in the group without BCP, the sales damage of the group without BCP group might have been underestimated.

In other words, it was difficult to observe the mitigation effect of BCP. The scope of this paper is to evaluate the mitigation effect of BCP; thus, we considered that evaluating the effect of BCP in this situation leads to more reliable results.

In addition, mitigation effect is determined not only through BCP but also through training for employees, duplication of facility, distributed stock, etc. However, mitigation factors other than BCP could not be considered in this study. Hence, it should be noted that the results of our analysis were not adopted uniformly in all companies.

4. LOSS ON DISASTER

The volume of assets was quite different for each company, and it was difficult to compare the loss on disaster in absolute value. Thus in the present study, we analyzed the ratio of the loss on disaster to ordinary income, which is one of the indexes representing company size. Sales are also an indicator of company size, but we saw analysis using ordinary income as intuitively easy to understand, and the results of analysis will be useful when the company discusses cash flow.

Out of the total 1854 companies that were analyzed, 410 companies recorded a loss on disaster. Here, we classified companies having loss on disaster into two groups: those having BCP and those which do not have BCP. Figure 3 shows the ratio of the loss on disaster to ordinary income by group.

We did not observe a significant difference between the group of companies with BCP and those without BCP. Damage degree was almost about 5%-10% of ordinary income. The number of companies with damage under 10% was 283 (69%).

In the group without BCP, 24 companies had serious damage to management of business where damage was over 50% of ordinary income. Out of the companies under review, nine companies had been damaged by the tsunami. It was assumed that companies located in the areas affected by the tsunami would have more serious damage compared to the companies damaged only by ground motion.

In order to analyze the mitigation effect of BCP on loss on disaster, Table 2 shows the result of the

![Fig.3 The ratio of the loss on disaster to ordinary income.](image)
t-test. The average value for the group with BCP is 0.0838, and 0.351 for the group without BCP. The P value shows a significant value at a 5% level (0.0119).

From Fig.3, however, it is clear that some companies that are in the group without BCP had serious damage. This had a strong impact on the calculation ratio of the loss on disaster to the ordinary income. Therefore, Table 2 also shows the result of the t-test that targeted companies whose ratio of the loss on disaster to ordinary income was below 100%. The average without BCP group was 0.0858 and P value was 0.9472, which did not show any significant value. In the development process of BCP, it is assumed that many companies try to implement mitigation measures such as earthquake resistance more aggressively; however, we did not observe the mitigation effect of BCP on direct damage.

5. TRANSITION OF SALES

(1) Transition of sales with or without BCP

Indirect damage is closely related to the transition of sales. Thus, as described in Chapter 3. (2), the companies whose closing dates were March, June, September, and December were taken into consideration for the analysis (Table 3).

Figure 4 shows the transition of sales divided into three groups: 1) No damage (n=476), 2) damaged with BCP (n=38), and 3) damaged without BCP (n=282). The lines of each group in Fig.4 are the average value of the group that was normalized in the December 2010 period as 1, which was the pre-damaged period. The analyzed period covered from May 2009 to March 2013, one year from the earthquake, is colored pink in the background.

Before the earthquake occurred, the group of companies without damage showed stronger sales than that of the group with damaged companies. We did not observe a difference in the transition of sales between the damaged group with BCP and that of the damaged group without BCP. In March 2011 when the earthquake occurred, there was almost the same transition in the group without damage and the damaged group with BCP. On the other hand, the sales in the damaged group without BCP was about 5% less compared to the others. This trend continued for two years even after the earthquake.

Focusing on the absolute value of the sales, the March 2010 period one year before the earthquake and the March 2011 period showed approximately the same sales in all the groups. In March 2012, all groups showed an increase in sales from March

### Table 2 T-test of Loss on disaster.

<table>
<thead>
<tr>
<th>Target company</th>
<th>Group</th>
<th>Average</th>
<th>Standard deviation</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All companies</td>
<td>with BCP (n=39)</td>
<td>0.0838</td>
<td>0.182</td>
<td>0.0119</td>
</tr>
<tr>
<td></td>
<td>without BCP (n=371)</td>
<td>0.351</td>
<td>1.959</td>
<td></td>
</tr>
<tr>
<td>Loss on disaster to ordinary income is below 100%</td>
<td>with BCP (n=39)</td>
<td>0.0838</td>
<td>0.182</td>
<td>0.9472</td>
</tr>
<tr>
<td></td>
<td>without BCP (n=357)</td>
<td>0.0858</td>
<td>0.165</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3 Number of target companies to analyze transition sales.

<table>
<thead>
<tr>
<th>Industry sector</th>
<th>BCP with</th>
<th>BCP without</th>
<th>Total</th>
<th>Industry sector</th>
<th>BCP with</th>
<th>BCP without</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Industry</td>
<td>7 (2)</td>
<td>101 (39)</td>
<td>108</td>
<td>Information and Communication</td>
<td>12 (2)</td>
<td>92 (25)</td>
<td>104</td>
</tr>
<tr>
<td>Wholesale</td>
<td>17 (13)</td>
<td>103 (59)</td>
<td>120</td>
<td>Fisheries, and Agriculture and Forestry</td>
<td>1 (1)</td>
<td>4 (3)</td>
<td>5</td>
</tr>
<tr>
<td>Shipping</td>
<td>2 (1)</td>
<td>10 (7)</td>
<td>12</td>
<td>Warehouse and Transportation-related Industries</td>
<td>1 (1)</td>
<td>26 (15)</td>
<td>27</td>
</tr>
<tr>
<td>Air Transportation</td>
<td>1 (1)</td>
<td>3 (2)</td>
<td>4</td>
<td>Electric Power &amp; Gas</td>
<td>1 (1)</td>
<td>21 (5)</td>
<td>22</td>
</tr>
<tr>
<td>Construction</td>
<td>14 (9)</td>
<td>92 (45)</td>
<td>106</td>
<td>Real estate Business</td>
<td>4 (2)</td>
<td>41 (14)</td>
<td>45</td>
</tr>
<tr>
<td>Mining</td>
<td>7 (3)</td>
<td></td>
<td>7</td>
<td>L and Transport Industry</td>
<td>5 (1)</td>
<td>36 (21)</td>
<td>41</td>
</tr>
<tr>
<td>Retail</td>
<td>2 (1)</td>
<td>60 (35)</td>
<td>62</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

※The numbers in parentheses ( ) show the number of damaged companies.
2011. Although it was difficult to define the terms ‘indirect damage,’ if the definition of indirect damage was simply that recovery time to get the same sales in the pre-earthquake period, it could be said that the indirect damage had been resolved in one year after the earthquake.

However, the political environment surrounding the Japanese economy has changed significantly since the earthquake. The Japanese administration changed hands from the Democratic Party of Japan to the Liberal Democratic Party after the earthquake. The Liberal Democratic Party changed the economy policy, taking several key economic measures such as large-scale monetary policy changes. As a result, stock prices increased 40% over three years following the earthquake, and the trend of the exchange market changed from a strong yen to weak yen, causing a significant depreciation of the yen of more than 20%. Sales were also affected by such external factors. Therefore, careful consideration was needed to use the analytic results for estimating the recovery period.

(2) Time series analysis

The previous analysis used the obtained data; however, time series data have seasonal variations. Hence, we analyzed the obtained data considering seasonal variations.

The observations made from the data are considered to be composed of trend, seasonal, and the remainder. Here, the trend is a relatively smooth term indicating some variations; seasonal is cyclically fluctuating components at a constant rhythm with time or season such as weeks, months, quarters; and the residual component is the remainder.

We attempted to understand in detail more about the ‘trend’ than the seasonal and the remainder. A analysis by the Loess method is shown in Fig.5. Note that the companies taken for analysis are the same (2).

Focusing on the remainder, the group of damaged companies without BCP had been affected most severely, as the earthquake impact appeared strongly during March 2011.

In the pre-earthquake period, the trend component showed higher sales in the group without damage than in the group with damage. The group with damage showed a similar trend whether they had BCP or not. However, the sales of the damaged group with BCP rose significantly after the earthquake, and it was almost the same transition as in the group without damage. On the other hand, the sales of the damaged group without BCP did not rise after the earthquake, and did not reach the same level as that of the group without damage even two years after the disaster.

One year after the earthquake, the absolute value of all group sales had recovered to pre-earthquake level. However, considering the sales trend of the damaged group without BCP has been lower than the other groups, it could be said that indirect damage continued for more than a year.

In addition, comparing the damaged group without BCP and the others, the sales of damaged group without BCP was about 5% lower. These lower sales have continued for more than two years at least since the earthquake. It could be said that the mitigating effect of BCP on economic damage is more than 10% of annual sales. We considered that the results of analysis represented useful cost-effective information for companies and it also contributed to promote BCP.
6. PANEL ANALYSIS

The previous chapter analyzed the transition of sales by focusing on BCP. However, sales are also affected by other factors. Hence, this chapter used panel analysis to consider several factors. This analysis used data obtained from financial reports. The data are: sales, tangible and intangible assets, investment cash flow, number of employees, with or without BCP, with or without risk finance, and loss on disaster. Here, with or without BCP and with or without risk finance are dummy variables. With or without BCP was researched and already mentioned in the financial reports. Risk finance was also studied through financial reports like BCP, and a company was categorized as having risk finance if the insurance proceeds from the disaster were considered in the financial report after the disaster. Our analysis did not consider all factors that affected sales, such as training of BCP, management decisions during the disaster, etc. Therefore it should be noted that this chapter was analyzed under limited data.

We estimate equation (1), where sales_{i,t} is total sales of company i for the period t, and X_{i,t} is a vector of variable.

\[ sales_{i,t} = u + \beta X_{i,t} + \epsilon_{i,t} \]  

The results of the panel analysis using a pooling model are shown in Table 4.

First, looking at the effects of BCP focused on the present study, BCP shows a positive effect on sales with significance at a 5% level. It is consistent with the results of the analysis in Chapter 5.

Both partial regression coefficient of tangible assets and intangible assets showed a positive value. In the manufacturing industry, it is easy to understand that with the increase in equipment, software, and plant, sales will increase. The results showed that the importance of assets in the non-manufacturing industry is the same as it is in the manufacturing industry. In addition, it suggests that severe damage to assets causes a decrease in sales. It is confirmed again that mitigating measures to direct damage, such as earthquake resistance, are useful for mitigating sales damage in the non-manufacturing industry.

The number of employees showed a positive value. The result seems to suggest that the post-disaster support extended to the employees, such as establishing a remote workstation and securing temporary house for workers, will be effective to mitigate sales damage.

![Fig.5 Results of time series analysis.](image-url)
7. CONCLUSIONS

This study analyzed the effect of BCP on mitigating financial damage targeting the listed companies of the Tokyo Stock Exchange belonging to non-manufacturing industries in the Great East Japan Earthquake. The findings of the present study are as follows:

1) It is assumed that the company with BCP tends to carry out earthquake resistance measures in making the BCP process; however, there is no difference in direct damage between many companies with BCP and those without BCP.

2) Focusing on the transition of sales, the damaged group with BCP showed almost the same sales transition as the group without damage. On the other hand, the damaged group without BCP decreased about 5% compared with the damaged group with BCP for more than two years. In other words, the mitigating effect of BCP on financial damage is more than 10% of annual sales on the average. Although this is only an indication, it could be said that this finding, which shows the cost-benefit information on BCP, is useful to promote BCP.

3) The relationship between BCP and sales was analyzed under limited variables, and coefficient of BCP shows a positive effect on sales with significance at a 5% level. In addition, it seems that assets and the number of employees also have a positive effect on sales. We consider that this analysis provides useful information to promote BCP.

Table 4 Results of panel analysis.

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>Partial regression coefficient</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tangible assets</td>
<td>2.9154×10^{-1}</td>
<td>16.2259</td>
<td>2.2×10^{-16} ***</td>
</tr>
<tr>
<td>Intangible assets</td>
<td>1.982</td>
<td>13.3007</td>
<td>2.2×10^{-16} ***</td>
</tr>
<tr>
<td>Investment Cash Flow</td>
<td>-1.221</td>
<td>-6.6165</td>
<td>4.378×10^{-11} ***</td>
</tr>
<tr>
<td>The number of employees</td>
<td>1.5391×10^{1}</td>
<td>19.489</td>
<td>2.2×10^{-16} ***</td>
</tr>
<tr>
<td>With or without BCP</td>
<td>1.8395×10^{1}</td>
<td>8.3049</td>
<td>2.2×10^{-16} ***</td>
</tr>
<tr>
<td>With or without risk finance</td>
<td>5.5806×10^{4}</td>
<td>2.7426</td>
<td>0.006134 ***</td>
</tr>
<tr>
<td>Loss on disaster</td>
<td>-4.8224×10^{-1}</td>
<td>-1.6227</td>
<td>0.10476</td>
</tr>
</tbody>
</table>

*** p<0.01

Note: The content and opinions expressed in this article do not represent the views of the organization to which the authors belong.

REFERENCES
1) EM-DAT (http://www.emdat.be)
12) Matsushita, N. and Hideshima, E.: A assessment of financial impacts of the Great East Japan Earthquake on the listed manufacturing industries -Mitigation effect of BCP and


(Received March 29, 2016)