

Post-disaster Business Recovery Susceptibility to Financial Conditions, especially for Small and Medium Enterprises

Huan Liu, Program-Specific Assistant Professor,
Disaster Prevention Research Institute, Kyoto University

1. Introduction

Businesses play an important role in local economies, but they are highly vulnerable to disasters and face significant challenges in mitigating them. At the same time, businesses face significant constraints regarding access to finance in the aftermath of disasters, exacerbating their financial vulnerability. Therefore, understanding, managing, and reducing the financial and fiscal impacts of natural disasters on businesses can effectively enhance post-disaster response and achieve “building back better” in recovery, rehabilitation, and reconstruction. However, due to the complexity of the post-disaster recovery process and data limitations, little evidence has been provided on how business financial status affects the post-disaster recovery from the individual firm perspective, especially the effect on different size firms. In this regard, this paper discusses the role of financial status in post-disaster recovery and provides empirical evidence of how financial status influences business recovery using 2052 firms’ post-disaster recovery data after the 2011 Great East Japan Earthquake. It is worth mentioning that this paper is an extension of the discussion of the journal paper “Modeling Post-disaster Business Recovery under Partially Observed States: A Case Study of the 2011 Great East Japan Earthquake” published by Huan Liu, Hirokazu Tatano, Yoshio Kajitani, and Yongsheng Yang in the *Journal of Cleaner Production* in 2022 [1]. This paper provides unique insight into the challenges of financing vulnerable industrial sectors, including the unique challenges of how governments use capital markets to finance building back better and sustainable developments. In Section 2, the case study and post-disaster data description are presented, as well as the reasons that caused financial difficulties in firms. In Section 3, the recovery curves under different financial statuses in industrial sectors are presented and compared using the case study data. Specifically, to investigate the heterogeneity of business size for financial difficulties, we further compared the recovery curves in Small and Medium Enterprises (SMEs) and large businesses under different financial difficulties. The conclusions and potential policy implications are discussed in Section 4.

2. Business recovery after the 2011 Great East Japan Earthquake

2.1. Data description and study area

After the 2011 Great East Japan Earthquake, we conducted two postal mail questionnaire surveys to collect business recovery data in the earthquake-affected areas (excluding tsunami-affected areas). The first survey was conducted in Miyagi and Iwate prefectures by the Central Research Institute of Electric Power Industry from November 15 to December 5, 2011 (Nakano et al., 2012). The second survey was conducted in Aomori, Akita, Yamagata, Fukushima, Tochigi, Ibaraki, and Chiba prefectures by the Disaster Prevention Research Institute and the International Institute of Disaster Science (IRIDeS) from November 7 to December 7, 2012 (Furuhashi et al., 2014). The details of the questionnaire are shown in Appendix A. To reduce the sample selection bias, it was made sure that firm damages were caused by the earthquake only, and firms suffering from both earthquake and tsunami damage were excluded from the samples.

In this research, we use the percentages of production capacity rate (PCR) to quantitatively describe and measure business recovery, and the pre-disaster PCR is defined as a baseline of 100%. A detailed description of the dataset used is summarized in Table 1, and the spatial distribution of the samples is presented in Figure 1. As shown in the figure, the surveyed firms were located in the Tohoku region (Aomori, Akita, Yamagata, Miyagi, and Iwate prefectures) and Kanto region (e.g., Tochigi, Ibaraki, and Chiba prefectures) in Japan. Firm size is defined as small and medium enterprises (SMEs) and large enterprises, and categorized under the Small and Medium-sized Enterprise Basic Act in Japan (The Small and Medium Enterprise Agency Japan, 1999) [2].

Table.1 Sample descriptions and number of firms in each category

Financial condition	Firm size	Sector		Total
		Manufacturing sector	Non-manufacturing sector	
Suffered from financial difficulties	SMEs	150	249	419
	Large enterprises	5	15	
Without suffering from financial difficulties	SMEs	498	965	1633
	Large enterprises	67	103	
Total		720	1332	2052

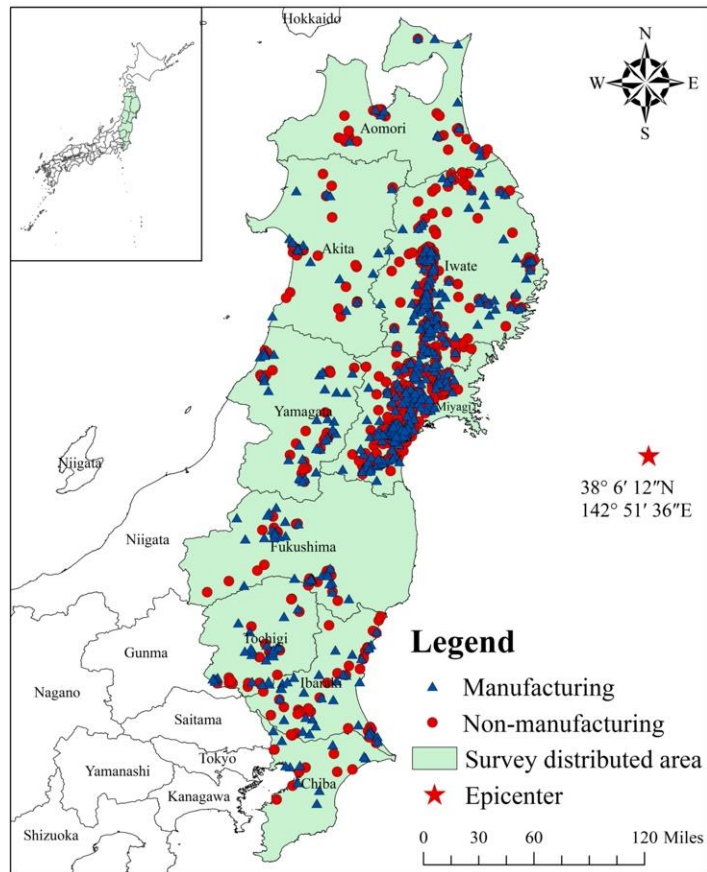


Figure 1. The spatial distribution of samples in this research

2.2 The reasons for faced with financial difficulties in firms in the aftermath of disasters

Reasons for SMEs and large enterprises facing with financial resources shortage after the 2011 Great East Japan Earthquake are described and compared in this section. Among collected samples, 419 out of the 2052 firms have suffered from recovery funding shortages or difficulties in raising such funding. The reasons for the financial difficulties that occurred in these firms are summarized in Figure 2. As shown in the figure, in both large firms and SMEs, the main reason for firms facing difficulties in obtaining recovery funds was the amount of insurance claims or subsidies were less than the actual amount incurred by damages or losses. The second reason was that the procedures for applying the recovery funding were too complicated. In SMEs, financial difficulties because of insufficient compensation to cover the damages accounted for 10.24% in manufacturing and 16.27% in non-manufacturing sectors; financial difficulties due to complicated application processes accounted for 10.84% in both manufacturing and non-manufacturing sectors. Meanwhile, unlike large enterprises, SMEs' financial difficulties were also caused by reasons such as rejection of recovery funding applications, not receiving insurance claims or recovery grants, or late payment of loans, insurance claims, and grants.

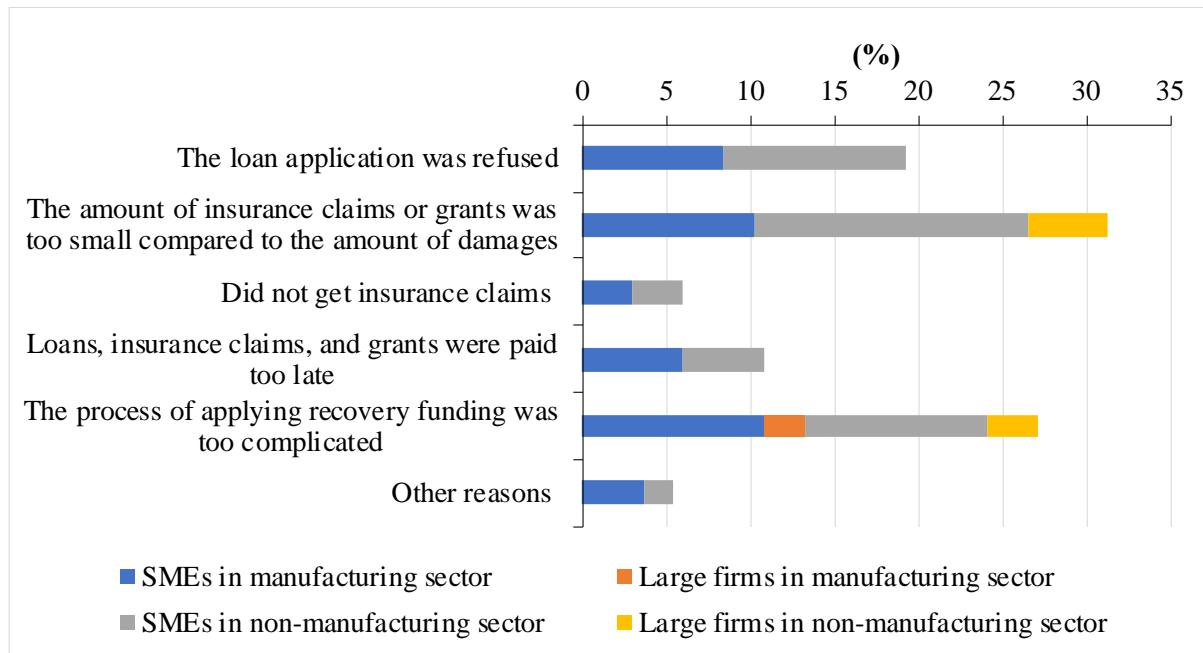


Figure 2. Reasons for faced with financial difficulties in firms

3. Insights into the recovery curves under different financial conditions

3.1 Recovery curves under different financial conditions

The state distribution parameters can be estimated by dividing the samples into different financial condition groups, that is, firms that have suffered from financial difficulties and have not suffered from financial difficulties during recovery in the manufacturing and non-manufacturing sectors, respectively. The recovery curves in the corresponding group were estimated and are presented in Figure 3. The results indicate that firms suffering from financial difficulties have experienced a longer and slower recovery as compared to firms without financial difficulties, which highlights the importance of financial support in post-disaster restoration. For example, in the manufacturing sector, 60 days after the earthquake, 85.82% of firms starting from initial state 1 achieved 100% full recovery if there were no financial difficulties, while only 1.29% of firms that started from initial state 1 (0%) achieved 100% full recovery if there were financial difficulties. Meanwhile, the recovery rate differences are significant among firms with and without difficulties. After the catastrophic 2011 Great East Japan earthquake, almost all firms without financial difficulties could achieve full recovery after 120 days, while only 20% achieved full recovery in the group of firms with financial difficulties. These results shed light on the importance of financial support in the post-disaster recovery process, especially for firms suffering from more severe damage. Since the more severely affected firms tend to face more severe financial pressure, the condition of the financial assistance for these firms cannot be solved; their recovery process will be slower, which will lead to a vicious cycle. Hence, developing a sustainable financial system is critical for building resilience in industrial sectors toward disaster,

among which establishing the catastrophe insurance system is an effective way to diffuse the risk of huge catastrophes.

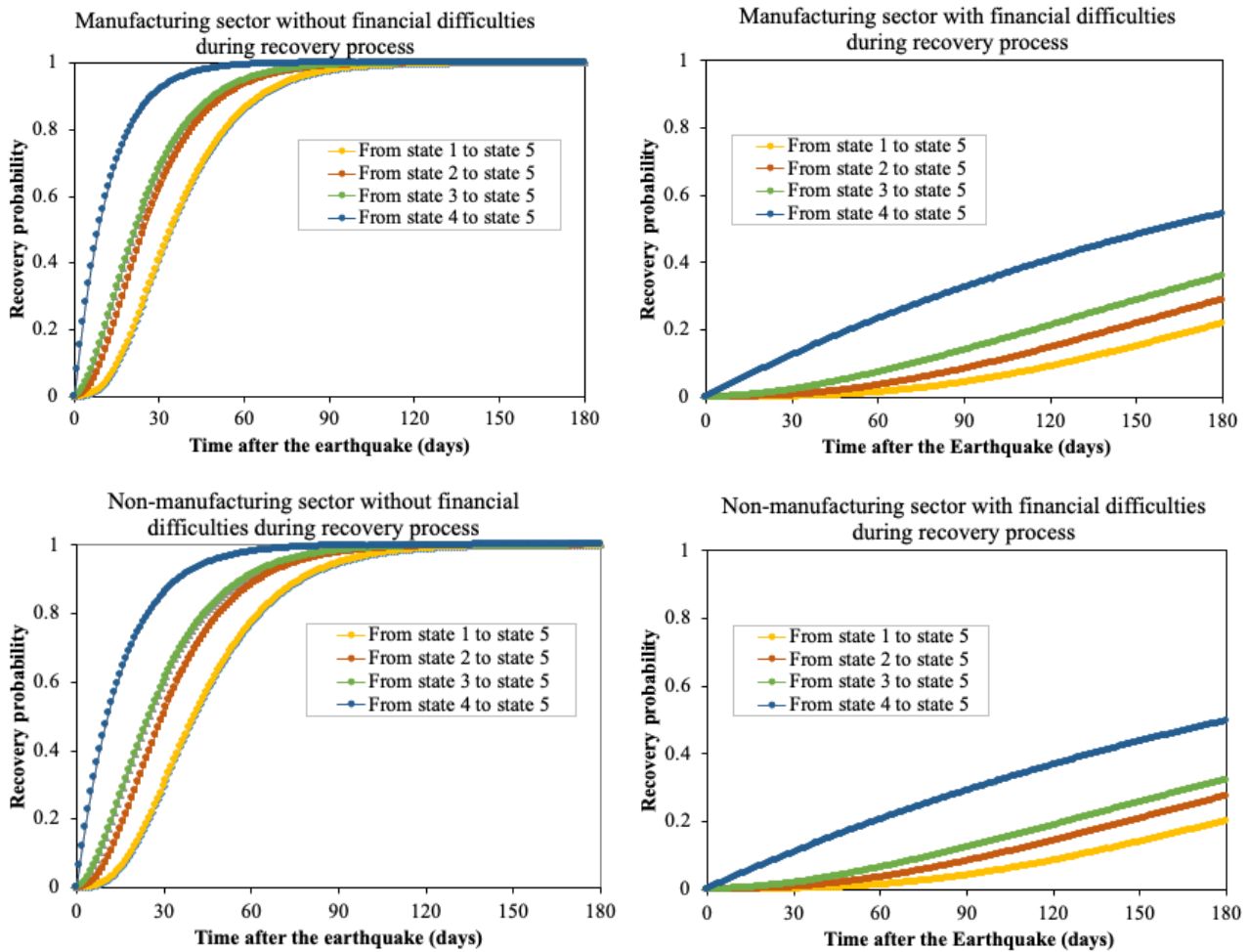


Figure 3. Recovery curves under different financial conditions

3.2 Comparison of the impact of post-disaster financial conditions in different size's firms

This section illustrates the recovery process of SMEs and large enterprises under different financial statuses. In particular, the recovery curves of SMEs and large enterprises are estimated and compared. Figures 4 and 5 present the recovery curves of firms of different sizes with and without financial difficulties, respectively. The recovery curve of large enterprises in the manufacturing sector, which suffered from financial difficulties, was not estimated because the observed number of samples was only five. To highlight the impact of financial condition in terms of firms of different sizes, all recovery curves presented in Figures 4 and 5 start from the initial FPCR at state 1 (PCR= 0%), until full recovery (PCR=100%).

When facing financial difficulties, larger enterprises are expected to achieve quicker recovery compared to SMEs. Without suffering from financial difficulties, the expected recovery rate in large firms is slightly slower than in the SMEs in both the manufacturing and non-manufacturing sectors.

Besides, it is noticed that when there are no post-disaster financial difficulties, large firms experience a slower and longer recovery process compared to SMEs; however, in the case of financial difficulties, large firms can expect a quicker recovery than SMEs. For instance, 50 days after the earthquake, 2.97% of large firms without suffered financial difficulties are expected to achieve full recovery while it is only 0.7% in SMEs regardless of sector type; 4 months after the earthquake, 17.23% of large firms are expected to achieve 100% recovery compared with 8.81% in the manufacturing sector and 8.56% in the non-manufacturing sector in SMEs. One possible reason for this phenomenon is that large firms are more likely to borrow money from banks because they have larger expected cash flows as compared to SMEs.

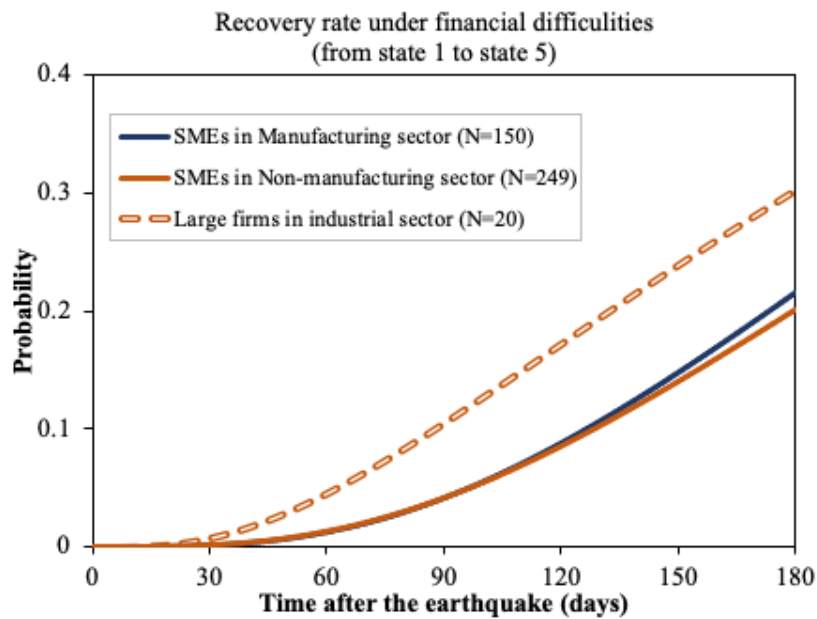


Figure 4. Recovery curves for firms of different sizes that suffered from financial difficulties

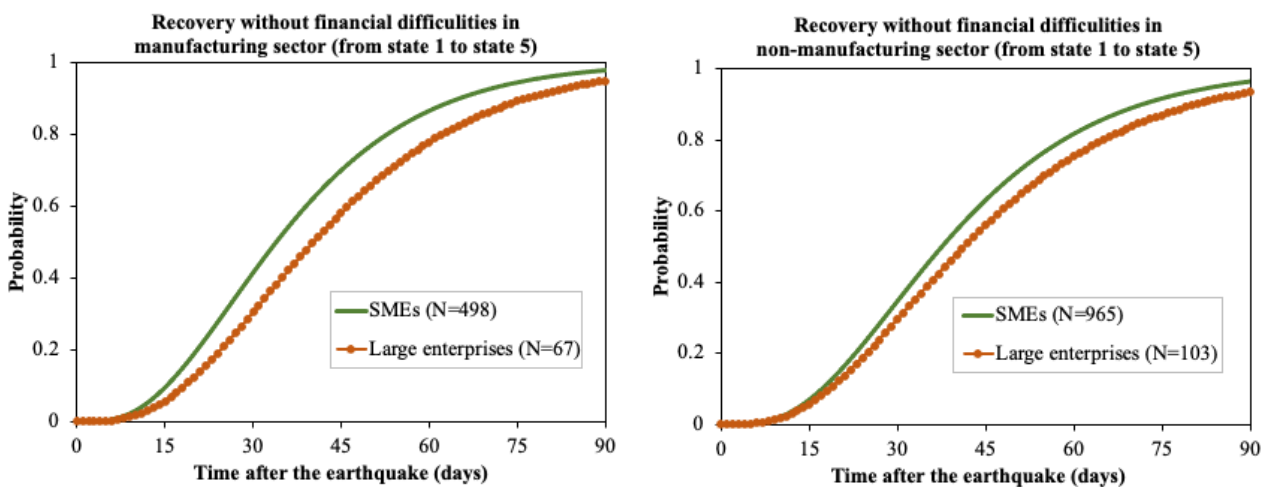


Figure 5. Recovery curves for firms of different sizes without financial difficulties

4. Discussion and conclusion

Understanding how financial status influences the process of business can effectively enhance the recovery process, thereby investing in and establishing more resilient industries. Using the recovery after the 2011 Great East Japan Earthquake as a case study, results indicate that disaster recovery is positively associated with business financial capacities. Specifically, firms that have suffered from financial difficulties are expected to experience a much longer recovery time compared to firms without financial difficulties; this leads to greater production capacity loss. As for the heterogeneity of firm size in terms of financial status, results indicate that: in the absence of financial difficulties, SMEs were expected to achieve a faster recovery compared to large businesses; while when financial difficulties are encountered, the estimated recovery process is opposite, that SMEs were expected to experience a slower recovery compared to large businesses. Findings are critical in providing empirical evidence for government decision-makers in the short-term government response and long-term disaster risk financing. According to our estimation results, the following discussions on potential policy implementation are proposed to build back better and build resilient industries.

(1) Building shock-responsive systems that link financial and business preparedness to ensure effective recovery and reconstruction. In the aftermath of a disaster, businesses can easily face a variety of challenges, including difficulty extending credit lines, lack of co-signers and collateral, and difficulty borrowing enough money to achieve long-term financial stability. Meanwhile, adequate financial resources can have a significant positive effect on facilitating the recovery process. Therefore, securing adequate disaster recovery funding can improve and ensure rapid recovery from disasters. Governments can use capital markets to finance the building of better and sustainable development.

(2) Establishing financial assistance policies for SMEs to borrow funds for rehabilitation and reconstruction. Currently, under the Credit Guarantee Corporation Act (1953), credit guarantee companies have been established in each prefecture to ensure that SMEs can easily borrow money from banks. Normally, credit guarantee companies can use their networks to provide financial services to local SMEs (Japan Federation of Credit Guarantee Companies 2018) [3]. However, according to the cases of financial difficulties presented in Figure 2, the results show that 19.28% of SMEs experienced financial difficulties during the recovery process because their loan applications were rejected under disaster scenarios. In contrast, there were no large enterprises in the sample that experienced financial difficulties due to the rejection of loan applications. This phenomenon is due to the various difficulties SMEs face when applying for credit from financial institutions, mainly caused by their relatively weak creditworthiness. When a disaster strikes, credit difficulties are exacerbated, and even SMEs with high credit ratings face challenges in borrowing funds for post-disaster

reconstruction. Therefore, establishing financial assistance policies are critical to helping SMEs overcome the difficulties of borrowing funds after a disaster.

References

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