The Impact of Earthquakes on Businesses

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Key Questions

1. Why are earthquake losses high in specific counties in Taiwan?
2. How to estimate earthquake losses in the future?

Introduction

April 3rd, 2024, there was a terrifying earthquake with magnitude 7.2 at Hualien, causing serious collapse of buildings and injuries. As a matter of fact, earthquakes also have a profound influence on businesses. Therefore, many companies need to secure their assets through earthquake insurance for businesses. This project combines knowledge of commercial earthquake insurance and earthquake risks, focuses on Science Parks in Taiwan, researches financial losses from earthquakes, and estimates losses from overall and specific events through Catastrophic Modeling.

Losses Distribution

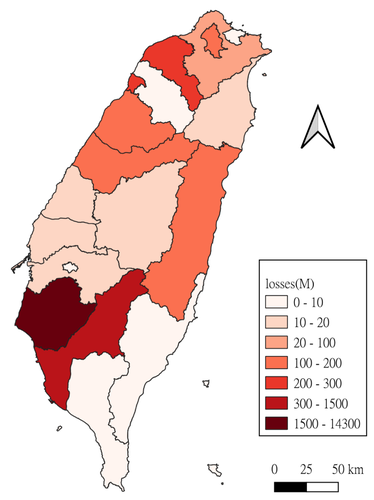

Fig 1. Total Earthquake Losses in Taiwan (2009~2022)

Fig 1. Losses from earthquakes during the period of 2009-2022 in Taiwan. The unit of losses is in million NTD. Losses in Tainan is the highest, reaching approximately 14.3 billion NTD. Besides, losses in Kaohsiung, Taichung, Miaoli, Hsinchu City, Taoyuan, and Hualien are quite high, too. They all have losses of more than 100 million NTD. (Source: AON)

Historical Losses

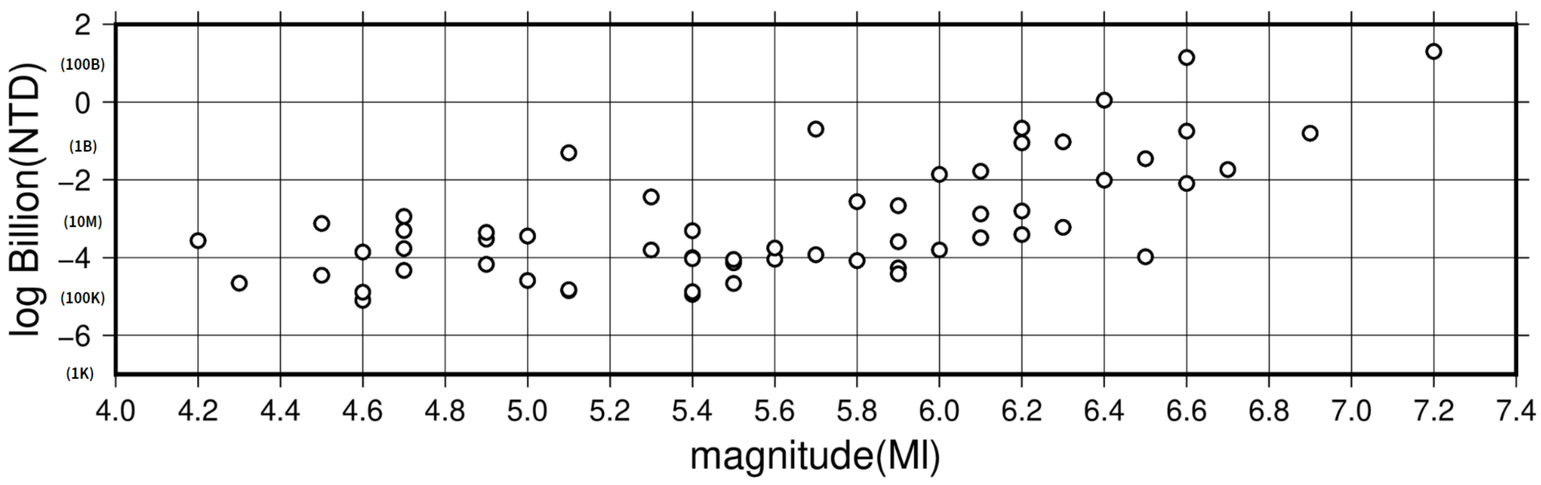

Fig 2. Magnitude and Losses of Earthquakes during the period of 2009-2024

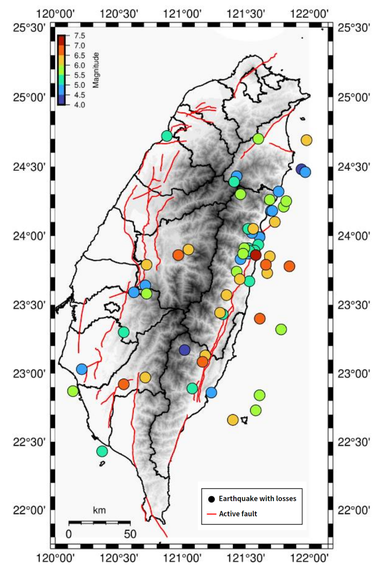

Fig 3. Earthquakes with Losses (2009~2024) and Active faults

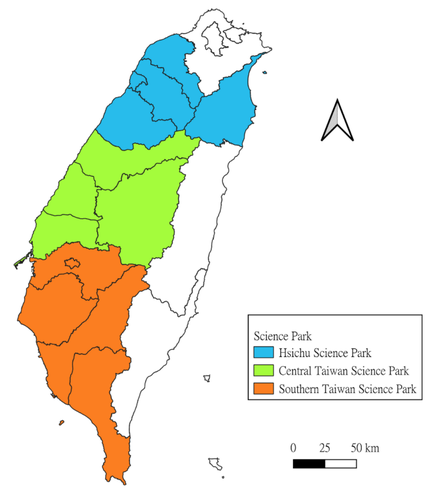

Fig 4. Distribution of Science Parks in Taiwan

- Fig 2. demonstrates earthquake magnitude and losses from 2009-2024. We find a positive correlation between these two statistics. The earthquakes with first five high losses have ones of over 200 Million NTD and over magnitude 5.7. (Source: AON, CWA)
- Fig 3. depicts the location and magnitude of those earthquakes and distribution of active faults. There are innumerable earthquakes at Hualien and plenty of active faults in western Taiwan, which also gives rise to many losses. (Source: CWA, Geological Survey and Mining Management Agency, MOEA)
- Fig 4. indicates the distribution of every science park in Taiwan, including Hsinchu, Central, and Southern science park. Most of the factories and buildings are situated in western area. Science parks' value of buildings, facilities, and output is immensely high, so we can reasonably deduce that losses from earthquakes in these areas will be considerable. (Source: NSTC)

Losses – Cases Study

Event	2016/02/06, Kaohsiung (Losses of 13.9 Billion)	2024/04/03, Hualien (Losses of 20 Billion)
Magnitude	6.6	7.2
Depth (km)	14.6 (very shallow)	22.5 (very shallow)
Max Intensity	7 at Tainan	6+ at Hualien

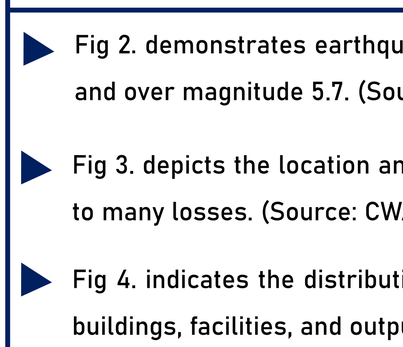

Fig 5. Separation Distance between ML6.6 Event and Southern Taiwan Science Park Administrations

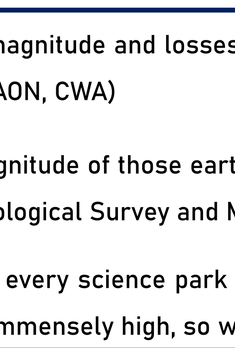

Fig 6. Separation Distance between ML7.2 Event and every Taiwan Science Park Administrations

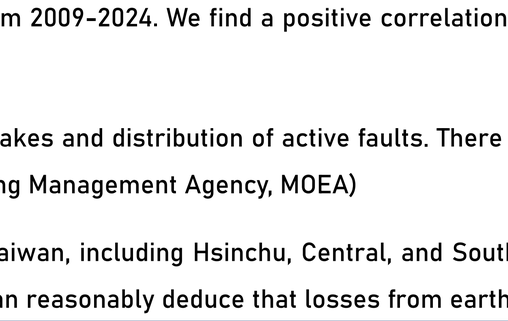

Fig 7. Histogram of real losses and modelled losses of ML6.6 Event at Meinong

- Fig 5. and 6. displays the relative position and distance between the epicenter of the earthquakes on February 6, 2016, Meinong & April 3, 2024, Hualien, and Science Park Administration Centers in Taiwan, which makes it able to affect four science parks more concurrently. (Source: NSTC, CWA)
- Fig 7. demonstrates the comparison of real losses and one estimated by Catastrophic Modeling from the earthquake on February 6, 2016, Meinong. The estimated loss is about 4.8 billion NTD lower than the real one. The error may result from accuracy of data, only considering ground motion, and the process of calculating vulnerability.

Estimate Losses

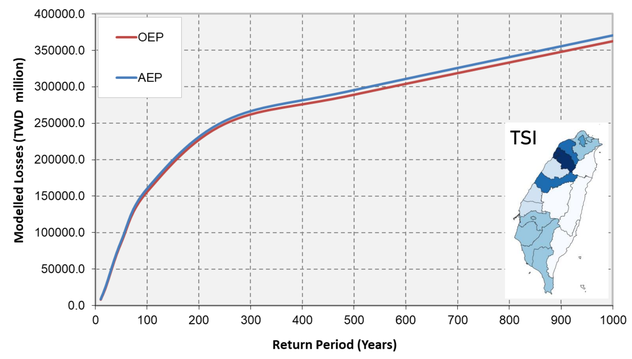

Fig 8. Exceedance Probability Curve of Earthquake Losses and Total Sum Insured in 2023 of Taiwan

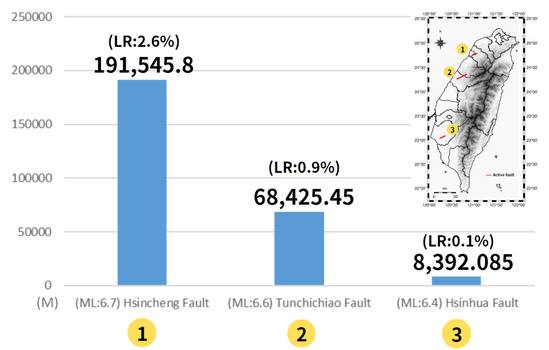

Fig 9. Estimated Losses from specific Earthquakes on Hsincheng, Tuntzuchiao, and Hsinhua Fault

- Fig 8. is the EP curve estimated by Catastrophic Modeling with Total Sum Insured, we can infer that in the following year, there will be 1% that losses may exceed 150 billion NTD. Fig 9. illustrates potential losses when specific earthquakes occur at these three faults. If an earthquake with magnitude 6.7 happens at Hsincheng Fault, there may be losses of 191 billion NTD in Taiwan. Although losses from earthquakes at Tuntzuchiao and Hsinhua Fault are not that exaggerating, there may still be losses of 68.4 billion and 8.4 billion NTD. (Source: AON, GSMMA)

Conclusion

- From two historical earthquakes in 2016 and 2024, we found that the major losses come from science parks, which is highly linked to earthquake risks.
- Estimated by Catastrophic Modeling, we know there will be large error (48 billion NTD) between real losses and modelled losses in 2016 Meinong earthquake, and earthquake at Hsincheng Fault may bring great damage to businesses (approximately 191 billion NTD).

Acknowledgments

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