



The Economics of Earthquakes since 1900: The Hybrid Natural Disaster Economic Index, Historical Loss Conversion, Future Impacts and Insurance Takeout.

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The newly formed CATDAT Damaging Earthquakes database contains economic damage and historical impact data on over 6500 earthquakes worldwide since 1900. This paper details the economic trends in earthquakes since 1900, as many economic loss values are not reported in existing databases. An extensive global database of exchange rate, insurance, CPI and GDP (nominal and real) information was created in order to be able to adjust and compare foreign earthquake loss estimates. Global databases of wage rate and other parameters such as PPP were also created as part of the study from many global sources as these details are required to effectively convert loss estimates from around the world into present-day costs.

It was found that the 1988 Spitak earthquake in Armenia caused the greatest impact on a country's economy as a proportion of nominal GDP (well over 300%), whereas the highest absolute economic loss was seen from Japan's 1923 Great Kanto Earthquake with approx. USD204 billion damage (2011 HNDECI adjusted). The 2010 Haiti Earthquake was the second highest earthquake economic loss over the last 110 years in terms of percentage of GDP losses, indicating the need for foreign aid. A separate analysis for earthquake shaking versus secondary effects (tsunami, liquefaction, landslide, fire etc.) as a proportion of historical economic losses is also shown, with approximately 85% of economic losses due to shaking effects.

Detailed economic analysis done as part of this study shows that the adjustment utilized by historical databases using simple inflation via Consumer Price Index greatly underestimates the impact of historic earthquakes, giving less significance to historic events. Thus, a hybrid index is shown to better account for the historical cost of earthquakes in today's terms, using a combination of wages, construction costs, workers' production, GDP, CPI and other tools which change for each country. In the Hybrid Natural Disaster Economic Index (HNDECI) developed as part of this study, components of the earthquake loss (direct and indirect) are assigned an inflation adjustment measure to bring the loss to present day value in much the same way as a project escalation index. Using the HNDECI, this paper also points out the error made in many databases trending international disaster losses based on United States CPI. The CPI is not the same in every country and can give very different results. Thus, economic trending must be done based on a country-by-country basis. Detailed examples from Japanese earthquakes (1923 Great Kanto, 1948 Fukui and 1964 Niigata) proving this are included in the paper.

The results of the global analysis using this index demonstrate that there is not a significant increasing trend in global annualized economic losses due to earthquakes, indicating that the second half of the century has not experienced a major developed urban centre affecting earthquake such as the 1923 Great Kanto earthquake. Insurance takeout for earthquakes has also been analyzed for historic earthquakes, with the Northridge earthquake of 1994 having the highest impact, but other recent earthquakes have certainly shown the increased demand for earthquake insurance. However, there is an increasing amount of smaller economic losses associated with earthquakes. The increase shown in this paper is not as marked as in other studies when different economic conversion indices are used.