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## **An Assessment of the Impact of Earthquakes on Global Capital Markets**

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# An Assessment of the Impact of Earthquakes on Global Capital Markets

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## INTRODUCTION

Reported frequency and damages caused by natural disasters, particularly hydro-meteorological disasters, has increased over the last decades. A growing literature analyzes the economic and broader socio-political impacts of natural disasters.

The literature has largely ignored the response of **global capital markets** to natural disasters in an increasingly connected world.

While it is often difficult to uncover connections between real and monetary shocks given the endogenous interactions of the two, **earthquakes are identifiable exogenous real shocks** with traceable impacts.

We estimate the impact of **177 large earthquakes** on the returns on **stock market indices in 35 different countries**. We explicitly address the **heterogeneity of impacts of the "average" earthquake** in different markets and investigate the **channels** through which stock markets capitalize earthquake shocks.

## BACKGROUND

### The economics of natural disasters

- In a world in which natural disasters are becoming more frequent and destructive, improving our understanding of which factors contribute to the resilience of economies to real shocks is of paramount importance.
- There is a vast literature on the impact of disasters on fatalities and economic growth (Cavallo and Noy, 2011).
- Earthquakes tend to have a negative impact on economic growth (Fomby, Ikeda and Loayza, 2013).

### Natural disasters and stock markets

- Is the negative impact of earthquakes on economic growth capitalized in stock markets?
- Previous literature has focused on sector-specific performance (insurance, construction, real estate markets) not on aggregate stock market returns.
- Previous literature consists mainly of case and event studies of "domestic" disasters.



Yamada Town after 3/11/2011 Tohoku earthquake & tsunami (Source: Katherine Mueller. IFRC)



Stock market trading (Source: Bloomberg)

## OBJECTIVES

- To assess the global economic impact of earthquakes:
  - Did large earthquakes cause abnormal returns in global capital markets?
- To identify which factors enhance the resilience of economies to real shocks:
  - Through which channels did earthquakes cause these abnormal returns?
- To understand the transmission of shocks in an increasingly connected world:
  - Did earthquakes affect countries other than the originating country? Which ones?

## METHODOLOGY

Seemingly Unrelated Regression (SUR) estimation of

$$R_{it} = \alpha_i + \gamma_i d_t + (\psi_i F_{i,t-1} + \lambda_i H_{j,t-1} + \phi_i G_{ij,t-1} + \theta_i E_{jt} + \delta_i D_{ijt}) d_t + \varepsilon_{it}$$

where

- $R_{it}$ : return on stock market index on day  $t$  in country  $i$  ( $i = 1, \dots, 35$ )
- $d_t$ : 1 on day  $t$  and  $t + 1$  if an earthquake happened on day  $t$
- $\alpha_i, \gamma_i, \psi_i, \lambda_i, \phi_i, \theta_i, \delta_i$ : country-specific parameters

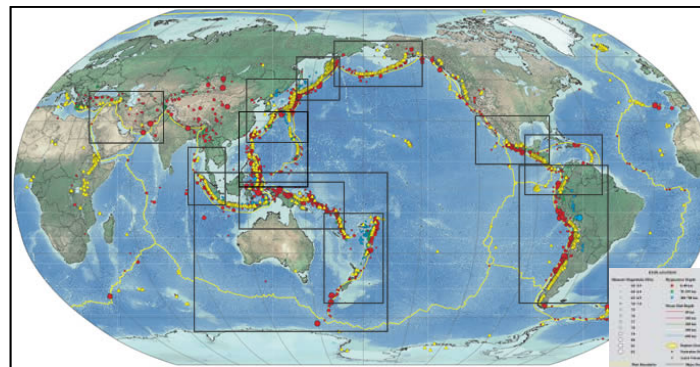


Figure 1: Seismicity of the Earth 1900-2012; location of the "great" earthquakes (M8.0 and larger) (Source: USGS; Tarr et al. 2010)

- $F_{i,t-1}$ : lagged macro controls for the financial market country  $i$  (GDP per capita, oil rents, trade openness).
- $H_{j,t-1}$ : lagged macro controls for the earthquake country  $j$  (GDP per capita, oil rents, trade openness).
- $G_{ij,t-1}$ : lagged indicators of the bilateral relationship between countries  $i$  and  $j$  (exports).
- $E_{jt}$ : characteristics of the earthquake (magnitude, deaths, population affected in a buffer of 200 km. from the epicenter, indicator of tsunamis, indicator of own-country earthquake).
- $D_{ijt}$ : distance between the earthquake epicenter and the financial market.

## DATA

- Stock market index data are in U.S. Dollars from **Datastream Global Equity Indices** between 1/1/1973 and 8/8/2013.
- Earthquake data come from **NOAA's Significant Earthquake Database**. We include **177 large earthquakes** occurred after 1/1/1973. Earthquakes are considered "large" if any of these two conditions hold:
  - Caused more than 1,000 fatalities
  - Caused "extreme" damages (>\$25 million)
- Trade and country-specific macro data come from the World Bank's **World Integrated Trade Solutions (WITS)** and **World Development Indicators (WDI)**.

## RESULTS

|              | $\alpha_i$ | $\gamma_i$ | $d_t$ | GDP | GDP | Oil rents | Oil rents | Trade open | Trade open | Exports | Exports | Magnitude | # Deaths | Affected population | Tsunami | Distance <sub>ij</sub> | Own country earthquake |
|--------------|------------|------------|-------|-----|-----|-----------|-----------|------------|------------|---------|---------|-----------|----------|---------------------|---------|------------------------|------------------------|
| Argentina    |            |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Austria      |            |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Canada       | +          |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Chile        |            |            |       |     |     |           |           |            | +          |         |         |           |          |                     |         |                        | n/a                    |
| Denmark      | +          |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Finland      |            |            |       |     |     | n/a       |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| France       |            |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Germany      | +          |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Greece       |            | +          |       |     |     |           |           |            |            |         | +       |           |          |                     |         |                        | n/a                    |
| Ireland      |            |            |       |     |     | n/a       |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Italy        |            |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Roma         |            |            |       |     |     |           |           |            |            | +       |         |           |          |                     |         |                        | n/a                    |
| Malaysia     |            |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Netherlands  |            |            |       |     |     |           |           |            |            |         | +       |           |          |                     |         |                        | n/a                    |
| Norway       |            |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Portugal     | +          |            |       |     |     | n/a       |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| South Africa |            |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Spain        |            |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Thailand     |            |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Turkey       |            |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| UK           |            |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |
| Venezuela    |            |            |       |     |     |           |           |            |            |         |         |           |          |                     |         |                        | n/a                    |

Notes: Table shows the signs of statistically significant (at 10% level) parameter estimates.

- Financial markets for which no significant effects are found:

Australia, Belgium, China, Hong Kong, Indonesia, Japan, Mexico, New Zealand, Philippines, Poland, Singapore, Sweden, USA

- Countries in which earthquake(s) occurred:

Afghanistan, Algeria, Argentina, Armenia, Australia, Austria, Belgium, Chile, China, Colombia, Costa Rica, Ecuador, Egypt, El Salvador, Georgia, Germany, Greece, Guatemala, Haiti, India, Indonesia, Iran, Italy, Japan, Kyrgyz Republic, Malawi, Mexico, Montenegro, Morocco, Nepal, Netherlands, New Zealand, Nicaragua, Pakistan, Papua New Guinea, Peru, Philippines, Portugal, Romania, Russian Federation, Rwanda, Samoa, Spain, Tajikistan, Trinidad and Tobago, Turkey, Uganda, USA, Venezuela, Yemen



Japan Recovery - March 14, 2011 (Source: www.courier.com)



Humanitarian response Haiti - Jan 15, 2010 (Source: Wikipedia)

## CONCLUSIONS

- No systematic effect of earthquakes on aggregate stock market indices**, either directly or through the control variables.
- Negative abnormal returns on earthquake days in Greece and Spain, but positive abnormal returns on earthquake days in Finland, Germany, and Portugal.
- Generally, earthquake characteristics do not have an impact (but sample includes only large earthquakes).
- Macro variables (*GDP* and *trade openness*) and bilateral relationships (*Exports*) mediate the impact of the average earthquake on abnormal returns, but specific channel is country-specific.
- While **aggregate** financial markets appear to be resilient to real shocks, stock market indices for sub-sectors, such as construction and insurance, might tell a different story.

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