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Resilience to natural disasters — Insurance penetration, institutions, and disaster types☆

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HIGHLIGHTS

- New empirical evidence about the economic effects of natural disasters.
- The effect of natural disasters is mitigated by access to insurance.
- Insurance penetration and good institutions are complements in mitigating disaster effects.
- Differences in effects across different types of disasters.

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ABSTRACT

Using newly available data, this note provides new evidence suggesting that private insurance penetration mitigates the negative economic effects of natural disasters. The results document heterogeneous effects across differentially institutionalized countries and across different disaster types.

1. Introduction

In contrast to widespread perception, the existing literature reveals surprisingly heterogeneous empirical findings regarding the consequences of natural disasters for economic development. The impact of disasters on income seems to depend on the type and severity of natural disasters, as well as on the economic and institutional environment. Most studies using cross-country panel data find negative effects of natural disasters on income in the short run, in particular in developing countries and for severe disasters and particular types of disasters (Noy, 2009; Hochrainer, 2009; Raddatz, 2009; Loayza et al., 2012; Fomby et al., 2013; McDermott et al. 2013; Felbermayr and Gröschl, 2014), whereas some evidence suggests a positive effect on income in developed economies, see, e.g. Noy (2009). The mechanisms behind these findings are not well understood; some suggest a mechanical explanation as reconstruction investment is part of GDP while the loss due to destruction of capital and structure is not (von Peter et al., 2012), others suggest disaster-specific differences in the type of destructions in terms of capital or durable consumption goods (Strulik and Trimborn, 2014). Some recent studies also provide evidence that access to finance can raise a country's resilience to natural hazards and that international openness, advanced financial markets and institutional quality act as attenuating factors that operate towards economic recovery in

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the aftermath of a natural disaster (Noy, 2009; McDermott et al., 2014; Felbermayr and Gröschl, 2014). Noy (2009) suggests that higher levels of government spending and higher literacy rates have an accommodating effect.

This note contributes to the debate in several ways. Our analysis provides new evidence for the heterogeneity in earlier estimates using a new, comprehensive data set on natural disasters that is combined with a novel measure of the damages caused by the disasters, and data on insurance penetration rates as measure for the development of private insurance markets. In contrast to most of the existing work, this data has global coverage on all losses, thus allowing for an accurate estimate of the economic consequences of natural disasters by distinguishing the extensive and intensive margin. Moreover, the data on private insurance penetration and insured losses as proxies for insurance market development allows for a systematic investigation of the question whether the heterogeneity in previous studies is driven by an interaction between private insurance and the quality of public institutions. The study thereby delivers new insights regarding the determinants of resilience to natural disasters.

2. Data and empirical framework

We use an unbalanced panel data set with annual data for 129 countries for the period 1980–2011. The first novel element of our analysis is data on natural disasters, provided by the NatCat Service of Munich Re, the largest reinsurance company worldwide. The data set contains detailed information on the incidence of natural disasters of different types (atmospheric, geophysical, hydrological), and their severity, which is classified into five categories (0–4) depending on thresholds for fatalities and monetary (economic) losses.[1] The data set is more comprehensive than previously used data sources, such as the Em-Dat data, especially along the intensive margin of losses. Information on losses distinguishes between insured losses and economic (overall) losses. Since this information is essential for an accurate tracking of reinsurance liabilities and an adequate risk pricing of contracts by Munich Re, the data set is of very high quality. The calculation of disaster-related losses is based on replacement and repair costs and draws on various sources, including the insurance industry, scientific reports, weather services, news agencies, NGOs and GOs. NatCat Service provides the most comprehensive data base of losses related to natural disasters in the world.[2] The second novel component of the empirical analysis is a unique data set on national private insurance market penetration rates in terms of the value of aggregated insurance premia for property and casualty insurance as share of GDP for a worldwide panel constructed by the Economic Research Unit of Munich Re. To our knowledge, this is the first time this data is available for research purposes.

Data on aggregate and per-capita GDP, as well as on population is obtained from the Worldbank's Development Indicators (WDI). Data on the capital stock and human capital in terms of a human capital index is taken from the Penn World Tables 8.0 (Feenstra et al., 2015). The human capital index draws on the database of Barro and Lee (2013) and reflects a function of the average years of schooling for the population aged 15 or older. Data on institutions in terms of civil liberties or political rights is taken from Freedom House.[3]

To investigate the effect of natural disasters on income we estimate the empirical model

$$\ln Y_{i,t} = \alpha + \beta \ln Y_{i,t-1} + \gamma DIS_{i,t} + \delta DIS_{i,t} * INS_{i,t-1} + \rho INS_{i,t-1} + \mu X_{i,t-1} + \nu_i + \nu_t + \nu_{i\times t} + \epsilon_{it}, \quad (1)$$

where the dependent variable $\ln Y_{i,t}$ is the log of per-capita income in country i and year t. One lag of the dependent variable is included to capture convergence effects. The variable $DIS_{i,t}$ represents the incidence of a natural disaster in country i and year t. The extensive margin of disaster incidence is coded as a binary measure for natural disasters which takes value 1 if a disaster occurred in country i in year t, and 0 otherwise. Part of the analysis restricts attention to severe disasters of severity category 4.[4] The measure of disaster intensity is the log of the sum of overall (monetary) disaster-related losses in country i, year t, normalized by the level of GDP (of the preceding year).[5] Specifications that include the intensive margin also include an indicator of the extensive margin in terms of a binary measure that reflects the incidence of any natural disaster. X denotes a set of control variables, including the capital stock, total population and human capital.[6] All control variables enter in lags to avoid endogeneity due to a simultaneous impact of a disaster on dependent and explanatory variables. Country fixed effects ν_i account for time-invariant country characteristics and year effects ν_t flexibly account for common time trends. Due to the large panel dimension with $T = 32$, the bias arising from combining fixed effects and lagged dependent variables (Nickell, 1981) does not constitute a major concern (Judson and Owen, 1999). Country-specific linear time trends $\nu_{i\times t}$ account for unobserved country-specific variation over time. The concern that the disaster measure is endogenous to economic development and insurance market development (Skidmore and Toya, 2007; Felbermayr and Gröschl, 2014) and overreporting of fatalities (Kahn, 2005) is minimized by the dichotomous disaster measure and the inclusion of country fixed effects and trends (McDermott et al., 2014). Extended specifications include a measure of the development of private insurance, $INS_{i,t-1}$, in terms of the insurance market penetration rate or the average share of insured losses in total losses, as well as its interaction with the disaster measure, which further alleviates this concern. The coefficients of primary interest are γ and δ.

3. Results

The main results regarding the effect of natural disasters on economic development are presented in Table 1. Panel A reports

[1] Geophysical events involve earthquakes, tsunamis, volcanic eruptions and dry mass movements (rockfalls or landslides). Hydrological events involve floods and wet mass movements such as avalanches. Atmospheric events involve climatological events like extreme temperatures (e.g. heat waves, cold waves, wildfires) as well as meteorological events like storms. For the severity classification, losses are normalized by a factor (current income to income in the respective year) which accounts for inflation and appreciation. Wirtz et al. (2014) provide an extensive description of data bases on natural disasters including the NatCat data.

[2] See https://www.munichre.com/en/reinsurance/business/non-life/natcatservice/index.html.

[3] The analysis uses two alternative measures. Civil liberties include freedoms of expression and belief, associational and organizational rights, rule of law and personal autonomy without interference from the state. Political rights include the quality of the electoral process, political pluralism and participation as well as the functioning of the government. See https://freedomhouse.org. We use version 20 Dec 13, see Teorell et al. (2013) for details.

[4] To be classified into category 4 in a high-income economy, a disaster must have caused either losses of at least US-$2.5 billion or 1000 fatalities.

[5] The log minimizes outlier problems, as indicated by the normal distribution of the resulting loss measure, and allows for a straightforward interpretation of the coefficients. We also consider shares of losses exceeding 0.1% of GDP in the baseline analysis to rule out that extremely small losses influence the estimates.

[6] The specification thus reflects the factors of production in a human capital augmented Solow growth model (Mankiw et al., 1992). In light of the control for lagged GDP in our specification, coefficient estimates can also be interpreted as effects on income growth.