**Project Narrative: Firm-level Economic Recovery from Natural Disasters**

This project aims to understand the mechanisms through which disasters can affect an economy in the long-run. The impact of natural disasters on the economy has proven to be a surprisingly difficult question to answer. Despite observations and anecdotal evidence suggesting that recovery from disasters is slow, simple economic theory suggests that, aside from their immediate threat to human life, disaster effects should be positive for the economy. This view, strongly held my many economists and policymakers, is based on the assumption that the only effect on an economy that a disaster causes is a one-time loss of capital, e.g., buildings collapse but are rebuilt, roads are rendered unusable but quickly repaired, businesses shutter their doors for a few days. The most prominent research support for this narrative are papers that dealt not with natural disasters, but with human-made ones: namely, war-time bombings in Japan (Davis and Weinstein, 2002) and Vietnam (Miguel and Roland, 2011). It is unclear that these results should hold for natural disasters, as they are often not accompanied by the total removal of threat and large post-destruction investment that characterized the war-time examples.

Early empirical evidence on natural disasters seemed to confirm the view that “disaster are good for business” (e.g., Toya and Skidmore, 2002), but these papers suffered from a number of limitations that made their conclusions questionable. Notably, they used coarse, nationally aggregated outcome variables and imprecise measures of hazard exposure. Measures of disaster severity in this work were often endogenous. For example, disaster damage data are largely self-reported, and are necessarily both more accurate and more frequently reported in wealthier places. The resulting correlation between wealth and disasters was often misinterpreted as causal. Additionally, disasters of different types were grouped together and disaster intensity was ignored. A major advance in this literature came with Hsiang and Jina (2014), which constructed a physics-based reconstruction of all tropical cyclones (i.e., hurricanes and typhoons) ever experienced since 1950, and showed that (when measured correctly) disasters suppressed economic growth for decades. In the years since, negative disaster effects have been shown across a number of recent papers (e.g., Hsiang and Jina, 2014; Deryugina, 2018; Basker and Miranda, 2018). However, no research has yet fully identified the mechanisms, and hence policy responses, that would help society cope with these longer-run effects. This is especially true in lower income countries, where governments are less able to provide general insurance and safety net policies.

This project aims to investigate firm dynamics in the wake of natural disasters, such as earthquakes and hurricanes. The main reason to study firms is drawn from theory: if disasters are not just a simple one-time shock to capital and they cause long-term economic damage, then they must be affecting investment behavior in the economy. We aim to establish a set of empirical facts about how disaster recovery manifests at the firm level, and interpret the economic and policy implications of these facts through the lens of macroeconomic models of firm dynamics and business cycle recoveries. For instance, we plan to analyze how disasters affect firm entry and exit, within-firm labor productivity, allocative efficiency across firms and industries, the composition of entering and exiting firms, and the innovative investment decisions of surviving firms. Do the losses during disasters and subsequent recovery trajectories differ across larger or smaller firms, more or less productive firms, more or less labor or capital-intensive firms, or firms in different industries? Do the effects of disasters differ across countries by level of income, by experience with a given disaster type, or by size of the country?

A key feature of this question is the global scope of the impacts of disasters, with over half of the countries in the world affected by severe earthquakes or tropical cyclones. This project uses several decades of global exogenous natural hazard data at high spatial resolutions for earthquake shaking and hurricane wind speeds, introduced into the economics literature by two of the researchers on this project, to calculate firm-level hazard exposure. Earthquake data consists of the universe of global relevant ground-shaking for almost 5 decades at about 1km spatial resolutions from Lackner (2018). This level of detail is unprecedented, and will allow us to look beyond merely Richter Scale measures of single events and examine the considerable spatial heterogeneity in damage that an earthquake is known to cause. Hurricane wind exposures are at a 0.1° by 0.1° global grid from Hsiang and Jina (2014) and extreme rainfall from the European Centre for Medium-range Weather Forecasting reanalysis of hourly rainfall data at 0.25° by 0.25° resolution. This will give us insight into two more disaster categories (flooding and tropical cyclones) that likely have different post-disaster dynamics than earthquakes. For firm data, in addition to manufacturing and service firm micro-data for 17 countries collected and assembled by one of the project researchers (Nath, 2020), we will also use manufacturing census data from 11 countries from Grover, Medvedev, & Olafsen (2019), and services census data from 20 countries from Nayyar, Hallward-Driemeier, and Davis (2021).

The project is rooted in the methods of economics and econometrics, but will also draw from earth sciences. Uniquely, in the case of our earthquake and tropical cyclone data, this is an instance where the social science determines the features of the natural science methods. The construction of ground shaking maps and wind speeds is done in such a way so as to capture the “social exposure” related to the disasters. This stands in contrast to the way in which these hazards are measured by earth scientists, which focuses on the physical characteristics (for example, total energy dissipated) with no regard to how people will be affected by the hazard. After the construction of these exposure datasets, the next major step will be to merge these together with the firm data. This is a considerable task, as there are hundreds of thousands of firms that need to be matched to environmental data by location, often requiring searching individual firm addresses. We will attempt to automate this process with machine learning tools where possible. Another major aspect of this data construction will be to standardize the firm datasets, all collected idiosyncratically at national level, across each country. Finally, we will empirically estimate the causal relationship between disasters and firm recovery, using statistical and econometric techniques that control for unobserved differences across firms and across locations, and trends through time.

For this project I will collaborate with Dr. Ishan Nath and Dr. Stephanie Lackner. Dr. Nath is an economist who holds a PhD from the University of Chicago, is currently a postdoctoral scholar at Princeton University, and will soon join the Federal Reserve of San Francisco. He has expertise in macroeconomics, having used firm-level data and censuses extensively in his prior work. Dr. Lackner is an interdisciplinary researcher with training in economics and seismology with a PhD from Columbia University. She is currently an assistant professor in IE University in Madrid. As an economist, she is uniquely trained in seismology and has produced a unique dataset on location specific ground-skaking intensity. She has written previously about the macroeconomic effects of earthquakes. The research assistant who would be supported by this grant is Alina Gafanova, who is currently working as a pre-doctoral fellow at the Becker Friedman Institute and who will apply for PhD programs for the 2022-23 academic year. All three principals on the project are interdisciplinary environmental economists who have studied the effects of the environment on society and the economy.

**References**

Basker, E. and J. Miranda (2018). Taken by storm: business financing and survival in the aftermath of Hurricane Katrina. Journal of Economic Geography 18 (6), 1285–1313.

Davis, D. R. and D. E. Weinstein (2002). Bones, bombs, and break points: the geography of economic activity. American Economic Review 92 (5), 1269–1289.

Deryugina, T., L. Kawano, and S. Levitt (2018). The economic impact of Hurricane Katrina on its victims: Evidence from individual tax returns. American Economic Journal: Applied Economics 10(2), 202–33.

Grover, A., D. Medvedev, and E. Olafsen (2019). High-growth firms. Facts, fiction, and policy options for emerging economies. World Bank Group, Washington, DC .

Hsiang, S. M. and A. S. Jina (2014). The causal effect of environmental catastrophe on long- run economic growth: Evidence from 6,700 cyclones. Technical report, National Bureau of Economic Research.

Lackner, S. (2018). Earthquakes on the surface: earthquake location and area based on more than 14 500 ShakeMaps. Natural Hazards and Earth System Sciences 18 (6), 1665–1679.

Miguel, E. and G. Roland (2011). The long-run impact of bombing Vietnam. Journal of Development Economics 96(1), 1–15.

Nath, I. B. (2020). The Food Problem and the Aggregate Productivity Consequences of Climate Change. National Bureau of Economic Research.

Nayyar, G., M. Hallward-Driemeier, and E. Davies (2021). At Your Service?: The Promise of Services-Led Development. World Bank Publications.

Skidmore, M. and H. Toya (2002). Do natural disasters promote long-run growth? Economic inquiry 40(4), 664–687.