



## Natural disasters, social protection, and risk perceptions

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### ABSTRACT

Natural disasters give rise to loss and damage and may affect subjective expectations about the prevalence and severity of future disasters. These expectations might then in turn shape individuals' investment behaviors, potentially affecting their incomes in subsequent years. As part of an emerging literature on endogenous preferences, economists have begun studying the consequences that exposure to natural disasters have on risk attitudes, perceptions, and behavior. We add to this field by studying the impact of being struck by the December 2012 Cyclone Evan on Fijian households' risk attitudes and subjective expectations about the likelihood and severity of natural disasters over the next 20 years. The randomness of the cyclone's path allows us to estimate the causal effects of exposure on both risk attitudes and risk perceptions. Our results show that being struck by an extreme event substantially changes individuals' risk perceptions as well as their beliefs about the frequency and magnitude of future shocks. However, we find sharply distinct results for the two ethnicities in our sample, indigenous Fijians and Indo-Fijians; the impact of the natural disaster aligns with previous results in the literature on risk attitudes and risk perceptions for Indo-Fijians, whereas they have little to no impact on those same measures for indigenous Fijians.

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### 1. Introduction

Natural disasters affected 232 million people, killed over 100,000 people, and caused more than US\$ 100 billion worldwide in damage each year between 2001 and 2010, on average (Guha-Sapir, Vos, Below, & Penserre, 2012). Strömberg (2007) observes that people in low-income countries are 12 times more likely to die from natural disasters and are similarly more likely to suffer serious economic consequences of disasters, despite the fact that high- and low-income countries do not differ significantly either in terms of the number of disasters experienced or in terms of the number of people affected.

Moreover, the number of natural disasters recorded per year has increased markedly since 1940 (Munang, Thiaw, Alverson, Liu, & Han, 2013), and factors such as population pressure and infrastructure development in risk-prone areas have increased the risk of loss and damage from natural disasters (IPCC, 2012;

Munang et al., 2013). It is likely that climate change will amplify the number and severity of such disasters over the next century (Bates, Kundzewicz, Wu, & Palutikof, 2008; Preston, Suppiah, Macadam, & Bathols, 2006).

To reduce the vulnerability of at-risk populations, policy makers are increasingly turning toward climate-change adaptation, defined by IPCC (2014) as “an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.” Examples of adaptation may involve altering land-use patterns, adjusting crop choices, and building protective infrastructure.

The existing literature points to potentially significant barriers to developing and implementing adaptation strategies for climate change that relate to the institutional and social dimensions of adaptation (Biesbroek, Klostermann, Termeer, & Kabat, 2013). Recent research has emphasized not only the need for adaptation, but also the opportunities and constraints inherent in these adaptive efforts (Berrang-Ford, Ford, & Paterson, 2011; Dovers & Hezri, 2010). As a result, there has been an increased focus on policy initiatives to encourage adaptation, creating an opportunity to

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identify correlates of effective adaptation in practice as well as the practical steps necessary to undertake adaptation (e.g. Tompkins et al., 2010). For example, Adger, Arnell, and Tompkins (2005) and Tullios et al. (2010) observe that successful adaptation stresses effectiveness, efficiency, equity, and legitimacy. They also note that adaptation can be motivated by preserving economic well-being, improving safety via market exchanges, and extending social and insurance networks.

Climate-change adaptation in small island states like Fiji is perceived to generate larger benefits when delivered in conjunction with other activities such as disaster-risk reduction and community-based approaches to development that address important social, economic, and environmental challenges (IPCC, 2014). Raising awareness and communicating risks to communities while acknowledging traditional institutions can also increase human and environmental resilience to the long-term impacts of climate change (Nunn, Aalbersberg, Lata, & Gwilliam, 2014).

To reduce the vulnerability of at-risk populations, policy makers are increasingly turning their attention toward climate-change adaptation. Adaptation may involve altering land-use patterns, adjusting crop choices, and building protective infrastructure, and although individuals may have limited say in broader adaptation policy, they may adapt their expectations or risk behaviors in less conspicuous ways, including altering their risk attitudes and risk perceptions. The importance of these subjective factors looms large in an environment that involves multiple hazards (Sullivan-Wiley & Gianotti, 2017) and heterogeneity in resilience (Arouri, Nguyen, & Youssef, 2015; Cutter et al., 2008).

Economists have recently begun examining the impact of negative shocks on risk attitudes (that is, risk tolerance), perceptions, and behaviors, including natural disasters as well as violent conflicts (Callen, Isaqzadeh, Long, & Sprenger, 2014; Kim & Lee, 2014; Voors et al., 2012), macroeconomic shocks (Malmendier & Nagel, 2011), and early life traumatic experiences (Bernile, Bhagwat, & Rau, 2016). This article belongs to a growing subset of this literature that focuses on the effect of natural shocks on risk attitudes, risk perceptions, and risk-taking behavior. The evidence on risk attitudes is mixed, and the literatures on risk perceptions and behaviors largely focus on developed countries.

Our contribution to this literature is fourfold: First, we complement the literature on risk attitudes and perceptions via a natural experiment in the form of a cyclone, the path of which was unpredictable and random. Second, we explicitly measure individuals' subjective expectations of future loss and damage using an experimental method that allows us to explore impacts on both the perceived frequency and perceived magnitudes of natural disasters. Third, our data include two populations affected by the same disaster but who respond very differently to the event. Fourth, to provide welfare implications for our results, we compare households' perceptions to predicted future disaster risk from climate and hydrological models, showing that average perceptions greatly exceed baseline predictions, even for households who did not suffer material loss and damage from Cyclone Evan.

Different theoretical models have contrasting predictions concerning the impact of exposure to natural disasters on risk perceptions and risk attitudes. In the disaster risk literature, perceptions of risk are shown to increase sharply after exposure to flooding in a variety of settings, including the Netherlands (Botzen, Aerts, & Van Den Bergh, 2009), New Zealand (Lawrence, Quade, & Becker, 2014), Slovenia (Brilly & Polic, 2005), Switzerland (Siegrist & Gutscher, 2006), Taiwan (Ho, Shaw, Lin, & Chiu, 2008; Lin, Shaw, & Ho, 2008) and post-Katrina New Orleans (Viscusi & Zeckhauser, 2006). For example, Botzen et al. (2009) find that the perceived probability of future flooding is significantly higher for

individuals who have previously been evacuated due to flooding.<sup>1</sup> Similar results have been established for avalanches (Leiter, 2011), earthquakes (Kung & Chen, 2012), landslides (Lin et al., 2008) and hurricanes (Peacock, Brody, & Highfield, 2005).<sup>2</sup>

Imagine an individual who observes whether a disaster occurs in any given year and its magnitude if it does occur. If she is a Bayesian learner, she will update her expected probability of occurrence and expected magnitude given her prior observations and the new observation according to Bayes' rule (Gerrig, Zimbardo, Campbell, Cumming, & Wilkes, 2011; Gallagher, 2014). Whether she personally experiences losses due to the disasters or observes neighbours who face similar likelihoods of suffering losses should not influence her perceptions for future risks. However, the psychological literature suggests that individuals often employ an "availability heuristic", meaning that the weights that people assign to signals accord to the ease with which they can bring an instance to mind (Tversky & Kahneman, 1974). If more recent and more salient observations are easier to retrieve from memory, then recent exposure to severe disasters will dramatically increase expectations of future risks. Meanwhile, empirical evidence also suggests that emotions or feelings with respect to risk play a role in how risk is perceived (see Baron, Hershey, & Kunreuther, 2000; Finucane, Alhakami, Slovic, & Johnson, 2000; Loewenstein, Weber, Hsee, & Welch, 2001). For example, Lerner, Li, Valdesolo, and Kassam (2015) find that experimentally induced fear causes people to express more pessimistic risk perceptions and to make more risk-averse choices. Recent disasters can trigger feelings of fear, helplessness, and loss of control (Botzen, Kunreuther, & Michel-Kerjan, 2015; Rüstemli & Karanci, 1999; Sartore, Kelly, Stain, Albrecht, & Higginbotham, 2008) and therefore evoke more pessimistic perceptions of risk.<sup>3</sup>

Furthermore, the availability of social protections can alter both the availability of a disaster memory in the cognitive process and the emotion that a disaster triggers; specifically, as unprotected individuals suffer from exposure to disasters, they have more salient and readily retrievable memories and may be more fearful of future events. Thus, Liebenehm (2017) attributes the lack of impact

<sup>1</sup> Botzen et al. (2009) also find that expected damages from future flooding falls with evacuation experience. The authors suggest that most of those who were evacuated did not experience property damage, thus lowering expectations of damage from flooding despite high perceived probabilities of flooding.

<sup>2</sup> As for risk attitudes, Cameron and Shah (2015) find that individuals in Indonesia who suffered loss and damage from flooding and/or earthquakes in the previous three years exhibit more risk aversion within the framework of a lab-in-the-field experiment. Similarly, Cassar, Healy, and Von Kessler (2017) find that individuals affected by the 2004 Asian tsunami are substantially more risk-averse four and half years after the disaster. In contrast, Eckel, El-Gamal, and Wilson (2009) analyze the risk attitudes of individuals who were displaced by Hurricane Katrina and Page, Savage, and Torgler (2014) analyze risk attitudes of home owners who suffered large losses in the Australian floods in 2011. Both studies find that respondents demonstrate high levels of risk-loving immediately after the disaster.

<sup>3</sup> With respect to behavior, Burn (1999) finds that victims of past flooding undertake more preventative measures against future flooding than people who have not experienced flooding but face similar future flooding risks. Lawrence et al. (2014) further find that people with previous exposure to flooding are more willing to make household-level changes and are better prepared against future flooding. Hoffmann and Muttarak (2017) find that individuals with recent experience of natural disasters in Philippines and Thailand are more likely to take preparedness actions, Cameron and Shah (2015) find that disaster victims in Indonesia exhibit more risk aversion in real-world behaviors, and Kousky (2010), Atreya, Ferreira, and Kriesel (2013), and Bin and Landry (2013) demonstrate that the price premium on housing located outside of flood plains rises significantly after extreme weather events in the United States. Furthermore, Botzen and Van den Bergh (2012) find that survey respondents in the Netherlands over-infer potential loss and damage from hypothetical flooding scenarios in that willingness to pay for low-probability flood insurance exceeds the expected value of losses from flooding. In contrast, Hanaoka, Shigeoka, and Watanabe (2015) provide evidence that risky behaviors such as smoking and drinking increases with the intensity of exposure to earthquakes among Japanese men. Regardless, it is not clear whether changed behaviors stem from changed attitudes toward risk or changed perceptions of risk.

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