The Impact of Natural Disasters on Risk Preferences, Subjective Beliefs, and Related Behavior: Evidence from Typhoon Ketsana

Sean Kiely & **Marcos Sugastti**

University of California, Davis

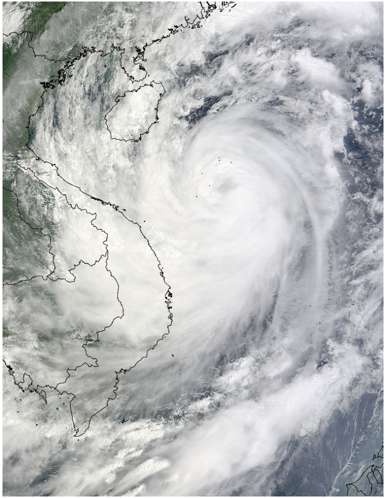
July 2024

Risk Preferences Over Time

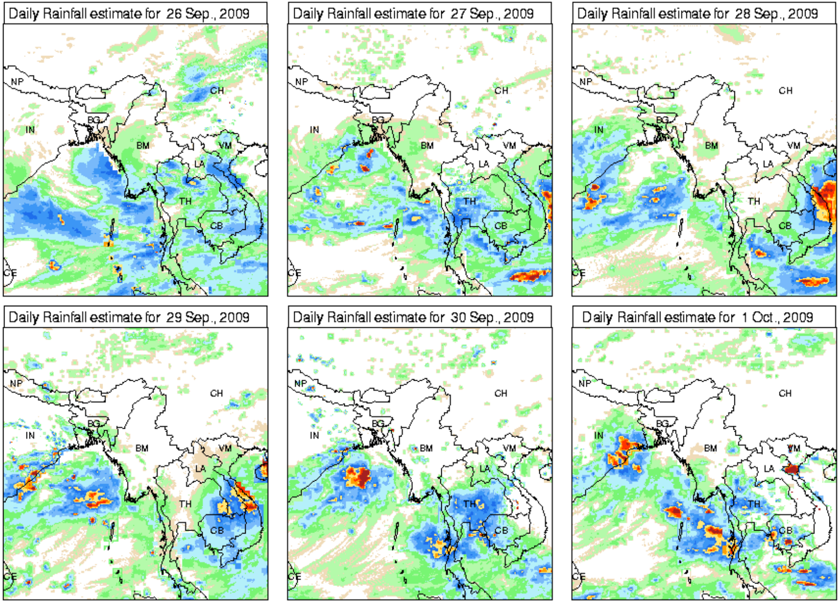
- Important to understand systematic changes in risk preferences as willingness to take risks can predict health outcomes, labor market/investment/migration decisions, addiction
- Many studies document the way risk preferences may be altered by negative shocks:
  - Financial crises (Dohmen et al., 2016; Guiso et al., 2018; Necker and Ziegelmeyer, 2016)
  - Violence/conflict (Callen et al., 2014; Jakiela and Ozier, 2019; Voors et al., 2012)
  - Natural disasters (Cameron and Shah, 2015; Cassar et al., 2017; Hanaoka et al., 2018)
- While financial shocks tend to make people more risk averse, no general consensus on the direction in which violence/conflict or natural disasters alter risk preferences
- If a change in risk preferences does occur in the wake of a natural disaster, almost no evidence showing whether the effect is transitory or persistent
  - Hanaoka et al. (2018) find men are more risk taking even 5 years after the Great East Japan Earthquake, with long-term estimates that are comparable to or larger than short-term ones

Typhoon Ketsana

- On September 29, 2009, Typhoon Ketsana made landfall in Central Vietnam
  - It brought high wind speeds and torrential rainfall over three days and led to massive floods
  - Classified as a Category 2 typhoon, an unusual event for the region
- Ketsana was the most devastating storm in Vietnam since at least 1990
  - 2.5 million people were affected by Ketsana, including 109,000 homeless, 860 injured, and 182 killed
  - Economic losses are estimated at USD 900 million
- Did Ketsana alter individual risk preferences? In what direction? Did the effect persist over time?
- What were the effects on subjective beliefs about future shocks and risk-related behavior?



Source

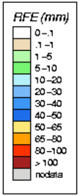


Precip. Estimate

through
1 Oct.
2009

Daily
Totals

Data:
NOAA–
RFE 2.0



Data Sources

- NOAA's Rainfall Estimation Algorithm 2.0 (RFE 2.0)
  - Treatment variable: Rainfall
    - ★ Excess rainfall within a 5 km radius of village during typhoon compared to normal times (average daily rainfall during the days of the typhoon minus average daily rainfall in days right before and right after the typhoon)
- NASA's Moderate Resolution Imaging Spectroradiometer (MODIS)
  - Water coverage
    - ★ Percentage of land area inundated within a 5 km radius of village during typhoon
- Thailand-Vietnam Socio-Economics Panel Survey (TVSEP)
  - Individual characteristics, socio-demographics, and self-reported shocks
  - Six waves — 2007, 2008, 2010, 2013, 2016, 2017
    - ★ 2 waves pre- and 4 waves post-Ketsana
  - Main outcome variable: Risk aversion measured on a 0-to-10 scale via self-reports
    - ★ Survey question: "Are you generally a person who is fully prepared to take risks or do you try to avoid taking risk?"
    - ★ The lower the number a person reports, the more risk averse they are — 0 indicates "completely unwilling to take risks" while 10 indicates "fully prepared to take risks"

Measuring Risk Preferences

- Two main measurement tools have become well-established:
  1. Self-reports
     - ★ 11-point (0 to 10) Likert scale (Wagner et al., 2007)
  2. Incentivized experiments
     - ★ Choice between gambles (Binswanger, 1980; Eckel and Grossman, 2002)
     - ★ Risky investment task (Gneezy and Potters, 1997)
     - ★ Price lists (Holt and Laury, 2002)
- A couple of ways to think about how to validate risk preference measuring tools
  - Internal validity: Do different tools for measuring risk preferences map into underlying "risk preferences" and capture a description of the same individual?
  - External validity: Do risk measurement tools have predictive power for actual risk-related behavior?
- Survey measures of general risk-taking are typically highly correlated across different risk domains such as health, career, or financial matters, thus suggesting a single underlying trait determining risk
- In terms of external validity, self-reports seem to outperform experiments (Dohmen et al., 2011)

Data Caveats

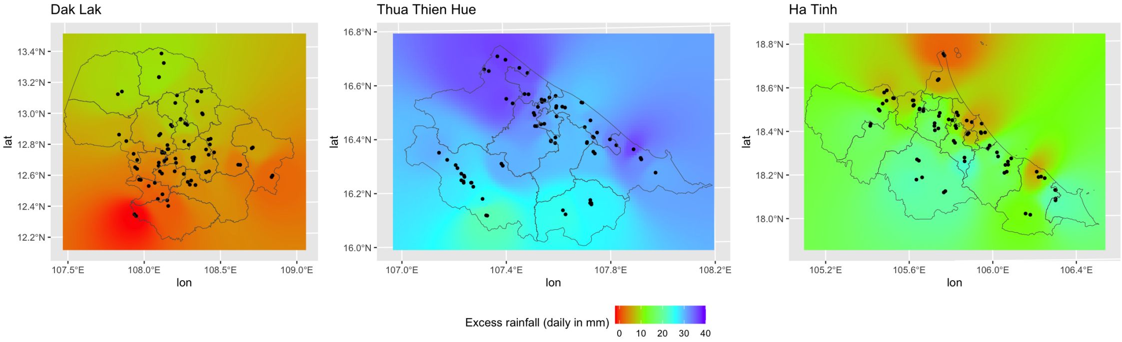
- The 2007 TVSEP wave does not collect risk preferences data, preventing us from testing for pre-trends on our dependent variable directly
  - We assess a few related variables for pre-trends instead
    - Total daily payments in insurance premiums is our preferred one
- We only use households where the respondent was the head of household and was the same respondent across 2007, 2008, 2010, and 2013 waves
  - Limiting analysis to the head of household assuming this individual makes the household's financial decisions (pre-trend variables) according to the head's own risk preferences

Summary Statistics at Baseline (2008)

	count	mean	sd	min	max
Risk Preference					
Risk Preference	572	3.44	3.04	0.00	10.00
Individual Characteristics					
Household Size	572	4.77	2.12	1.00	14.00
Daily Expenditure (per capita, USD)	572	2.04	1.61	0.11	24.03
Daily Insurance Premiums (household, USD)	572	0.21	1.10	0.00	21.43
Age	572	51.67	13.68	22.00	91.00
Gender (1 = Male)	572	0.74	0.44	0.00	1.00
Self-Employed	571	0.81	0.39	0.00	1.00
Subjective Beliefs on Occurrence of Shocks					
Floods	562	1.87	2.24	0.00	6.00
Storms	566	2.30	2.43	0.00	6.00
House Damage	559	0.33	0.76	0.00	5.00
Household Shocks since Last Wave					
Death	572	0.03	0.18	0.00	2.00
Accident	572	0.02	0.15	0.00	1.00
Drought	572	0.10	0.35	0.00	3.00
Pest/Livestock Disease	572	0.30	0.51	0.00	2.00
Storm	572	0.16	0.37	0.00	1.00
House Damage	572	0.02	0.15	0.00	1.00
Treatment Variable (measured in 2009)					
Excess Rainfall (mm)	572	15.22	11.23	-1.66	36.81

Treatment Variable

Excess rainfall within a 5 km radius of village (average daily rainfall during the days of the typhoon minus average daily rainfall in days right before and right after the typhoon)



Identification Strategy

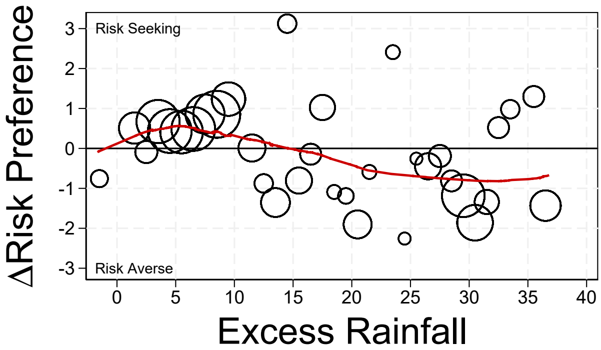
We use a difference-in-differences model with a continuous treatment variable exploiting variation in the intensity of the typhoon:

$$Y_{ivt} = Post_t + \beta T_v \times Post_t + \rho P_v \times Post_t + \mu H_v \times Post_t + \gamma X_{ivt} + \delta Z_{ivt} + \pi_i + \varepsilon_{ivt} \quad (1)$$

where

- i indexes the individual, v the village, t time ($t = 2008$, 2010, or 2013)
- Y_{ivt} is the self-reported risk preferences score for the main results
- $Post_t$ is a dummy that turns on when $t = 2010$ for short-term effects or $t = 2013$ for long-term effects
- T_v is a measure of excess rainfall within a 5 km radius of village v
- P_v is the water coverage within a 5 km radius of village v during normal times
- H_v is daily average rainfall during the same time window in past years in village v
- X_{ivt} is a vector of time-varying socio-demographic characteristics
- Z_{ivt} is a vector of controls for life changes and other shocks that may change risk preferences (Kettlewell, 2019), and subjective beliefs regarding risks that may be correlated with our risk measure
- π_i is individual-level fixed effects

Individuals exposed to higher excess rainfall during the 2009 typhoon seemingly become more risk averse over 2008–2010



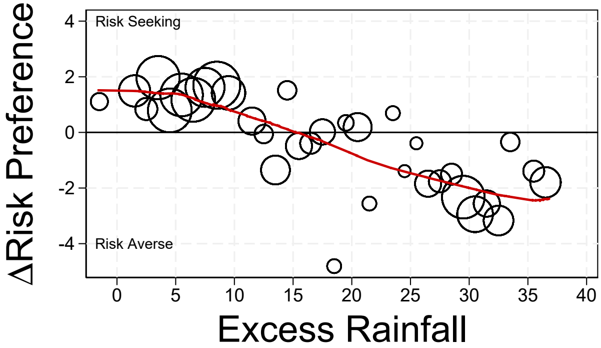
Notes: Individuals are classified into 1-millimeter bins according to the exposure to excess rainfall during the typhoon. The size of each circle represents the number of individuals in the corresponding bin. The red line is a *lowess* curve with a bandwidth of 0.8.

Results: Short-term Changes in Risk Preferences

	(1)	(2)	(3)	(4)
Excess Rainfall	-0.057***	-0.054***	-0.062***	-0.039*
	(0.014)	(0.014)	(0.014)	(0.022)
Observations	1144	1144	1106	1106
Basic Controls		✓	✓	✓
Subjective Beliefs			✓	✓
Historical Rainfall				✓

Notes: Basic controls include expenditure, assets, flooding propensity, age, change in marital status of respondent, household size, and exogenous shocks to the household including accidents, drought, pest and livestock diseases, landslides, crime, storms, and death of a household member. Subjective beliefs controls include anticipated frequency of storms, flooding, and house damage occurring in the following five years. Historical rainfall refers to average daily rainfall for the same time window around the typhoon in 2001–2008. Standard errors in parentheses and clustered at the subdistrict level. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Individuals exposed to higher excess rainfall during the 2009 typhoon seemingly become more risk averse over 2008–2013



Notes: Individuals are classified into 1-millimeter bins according to the exposure to excess rainfall during the typhoon. The size of each circle represents the number of individuals in the corresponding bin. The red line is a *lowess* curve with a bandwidth of 0.8.

Results: Long-term Changes in Risk Preferences

	(1)	(2)	(3)	(4)
Excess Rainfall	-0.067***	-0.064***	-0.065***	-0.049***
	(0.008)	(0.008)	(0.008)	(0.011)
Observations	1144	1144	1129	1129
Basic Controls		✓	✓	✓
Subjective Beliefs			✓	✓
Historical Rainfall				✓

Notes: Basic controls include expenditure, assets, flooding propensity, age, change in marital status of respondent, household size, and exogenous shocks to the household including accidents, drought, pest and livestock diseases, landslides, crime, storms, and death of a household member. Subjective beliefs controls include anticipated frequency of storms, flooding, and house damage occurring in the following five years. Historical rainfall refers to average daily rainfall for the same time window around the typhoon in 2001–2008. Standard errors in parentheses and clustered at the subdistrict level. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Results: Subjective Beliefs about Occurrence of Storms

How often do you think a storm will occur in next five years?

	(1) Short-term effect	(2) Long-term effect
Excess Rainfall	-0.067***	-0.022**
	(0.021)	(0.010)
Observations	1106	1105
Basic Controls	✓	✓
Subjective Beliefs	✓	✓
Historical Rainfall	✓	✓

Notes: Basic controls include expenditure, assets, flooding propensity, age, change in marital status of respondent, household size, and exogenous shocks to the household including accidents, drought, pest and livestock diseases, landslides, crime, storms, house damage, and death of a household member. Subjective beliefs controls include anticipated frequency of flooding and house damage occurring in the following five years. Historical rainfall refers to average daily rainfall for the same time window around the typhoon in 2001–2008. Standard errors in parentheses and clustered at the subdistrict level. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Results: Behavioral Implications—Insurance Purchasing

Total Amount of Premiums Paid (Daily, USD)

	(1) Short-term effect	(2) Long-term effect
Excess Rainfall	0.007	0.006^{**}
	(0.008)	(0.003)
Observations	1106	1084
Basic Controls	✓	✓
Subjective Beliefs	✓	✓
Historical Rainfall	✓	✓

Notes: Basic controls include expenditure, assets, flooding propensity, age, change in marital status of respondent, household size, and exogenous shocks to the household including accidents, drought, pest and livestock diseases, landslides, crime, storms, house damage, and death of a household member. Subjective beliefs controls include anticipated frequency of storms, flooding, and house damage occurring in the following five years. Historical rainfall refers to average daily rainfall for the same time window around the typhoon in 2001–2008. Standard errors in parentheses and clustered at the subdistrict level. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Discussion

- Individuals become more risk averse after the typhoon and this effect persists even four years after the event
- Results on subjective beliefs suggest that it is not the case that individuals just think storms are more likely to happen in the future
- The climate shock leads individuals to purchase more insurance in the long run, which is primarily driven by health insurance
- Preliminary results indicate that the typhoon also leads to an increase in expectations of shocks not directly related to the typhoon and to a decrease in non-agricultural self-employment
- We are also exploring the effects of the typhoon on additional changes in behavior such as the use of ex-ante coping strategies, as well as measures of subjective well-being
- As next steps, we are evaluating whether the empirical results we have found are robust to using other weather-related treatment variables and we are trying to tie our results together using theory, possibly through a model of household asset accumulation

Thank you!

marcosms@ucdavis.edu

References I

Binswanger, H. P. (1980). Attitudes toward risk: Experimental measurement in rural india. *American Journal of Agricultural Economics*, 62(3):395–407.

Callen, M., Isaqzadeh, M., Long, J. D., and Sprenger, C. (2014). Violence and risk preference: Experimental evidence from afghanistan. *American Economic Review*, 104(1):123–148.

Cameron, L. and Shah, M. (2015). Risk-taking behavior in the wake of natural disasters. *Journal of human resources*, 50(2):484–515.

Cassar, A., Healy, A., and Von Kessler, C. (2017). Trust, risk, and time preferences after a natural disaster: experimental evidence from thailand. *World Development*, 94:90–105.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., and Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association*, 9(3):522–550.

Dohmen, T., Lehmann, H., and Pignatti, N. (2016). Time-varying individual risk attitudes over the great recession: A comparison of germany and ukraine. *Journal of Comparative Economics*, 44(1):182–200.

References II

Eckel, C. C. and Grossman, P. J. (2002). Sex differences and statistical stereotyping in attitudes toward financial risk. *Evolution and Human Behavior*, 23(4):281–295.

Gneezy, U. and Potters, J. (1997). An experiment on risk taking and evaluation periods. *The Quarterly Journal of Economics*, 112(2):631–645.

Guiso, L., Sapienza, P., and Zingales, L. (2018). Time varying risk aversion. *Journal of Financial Economics*, 128(3):403–421.

Hanaoka, C., Shigeoka, H., and Watanabe, Y. (2018). Do risk preferences change? evidence from the great east japan earthquake. *American Economic Journal: Applied Economics*, 10(2):298–330.

Holt, C. A. and Laury, S. K. (2002). Risk aversion and incentive effects. *American Economic Review*, 92(5):1644–1655.

Jakiela, P. and Ozier, O. (2019). The impact of violence on individual risk preferences: Evidence from a natural experiment. *Review of Economics and Statistics*, 101(3):547–559.

References III

Kettlewell, N. (2019). Risk preference dynamics around life events. *Journal of Economic Behavior & Organization*, 162:66–84.

Necker, S. and Ziegelmeyer, M. (2016). Household risk taking after the financial crisis. *The Quarterly Review of Economics and Finance*, 59:141–160.

Voors, M. J., Nillesen, E. E. M., Verwimp, P., Bulte, E. H., Lensink, R., and Soest, D. P. V. (2012). Violent conflict and behavior: a field experiment in burundi. *American Economic Review*, 102(2):941–964.

Wagner, G. G., Frick, J. R., and Schupp, J. (2007). The german socio-economic panel study (soep)-evolution, scope and enhancements.