Temple University
Fox School of Business

Finance

Flirting with disasters: Do firms financially plan for disasters?

Balbinder Singh Gill (Balbinder.singh.gill@temple.edu)

Research Questions

Do firms prepare for disasters by precautionary hoarding cash holdings to prevent future short-term liquidity problems?

Do firms draw a distinction between natural and technological disasters in addressing disaster risk?

Motivation

Technological disasters can disrupt economies (e.g., the Deepwater Horizon oil spill (2010)

Natural disasters can disrupt economies (e.g., Impact of COVID-19 on different industries)

Cash holdings as a precautionary motive

- Firms save cash as a precaution because of financing constraints (see e.g., Keynes, 1936; Froot, Scharfstein, and Stein, 1993) which may prevent firms from taking advantage of positive NPV investment opportunities (Froot, Scharfstein, and Stein, 1993).
- Financing constraints arise when external financing is costly or income uncertainty is high (Riddick and Whited, 2009).
- The demand for precautionary cash is higher in environments with adverse shocks (e.g. recessions or periods of financial turmoil).
- These adverse shocks will make external financing for firms less accessible and costly (see e.g., Opler et al., 1999) or increase financial distress costs of firms (see e.g., Campello, Graham, and Harvey, 2010).
- Note: Firms can also solve short-term liquidity problems by using liquidity insurance instruments such as bank lines of credit (Holmstrom and Tirole, 1998), financial derivatives (Amess, Banerji, and Lampousis, 2015), or internal capital markets (Duchin, 2010).

Sample

25,875 firms with 191,439 firm-year observations in 59 countries from 1991 to 2016

Empirical specification

$$\text{Cash holdings}_{i,c,j,t} = \beta_0 + \boldsymbol{\beta_1} * \textbf{natural disaster risk}_{c,t} + \boldsymbol{\beta_2} * \textbf{technological disaster risk}_{c,t} + \beta_3 * X_{i,c,t-1} + \beta_4 * \text{industry cash holding volatility}_{j,t-1} + \beta_5 * Z_{c,t-1} + \nu_t + \eta_c + \omega_s + \varepsilon_{i,c,j,t} \quad (3)$$

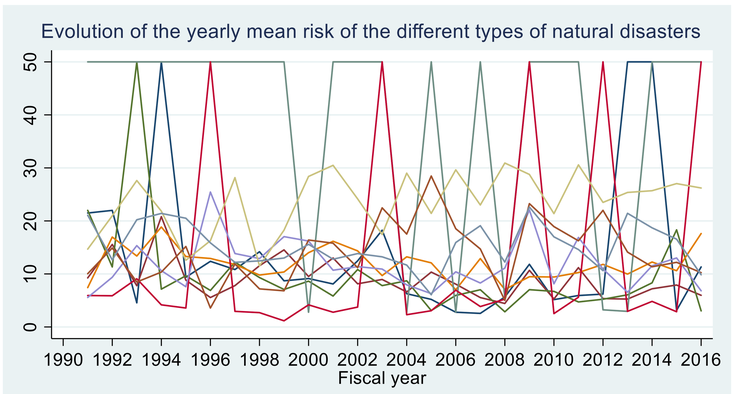
Note:

- Cash holdings is the ratio of sum of cash and short-term investments to net assets. Net assets are assets less cash and short-term investments.
- X is a vector of firm control variables (asset tangibility, leverage, equity issuances, dividend payer, financial distress, profitability, sales growth, noncash net working capital, firm size, capital expenditures, R&D, and acquisitions)
- Z is a vector of country control variables (annual GDP growth rate, GDP per capita, financial institutions, and financial markets)
- ν are time fixed effects, η are country fixed effects, and ω are industry 2-digit SIC Fama and French (1997) fixed effects.
- I use sampling probability weights to adjust the regression parameters and standard errors. The probability weight is the inverse of the number of firms in a country.

How do I measure disaster risk?

A. Natural disaster risk index

- Geophysical (earthquakes, mass movements, and volcanic activities), meteorological (extreme temperatures and storms), hydrological (floods and landslides), climatological (droughts and wildfires), and biological (epidemics) disaster groups
- Attributes of a natural disaster: Frequency, duration, economic cost, insured economic losses, human cost, complexity of natural disaster, overlapping natural disasters, and historical vulnerability of location to natural disaster
- Principal component analysis statistical estimation technique + normalization of score between 0 and 100



B. Technological disaster risk index

- Industrial accidents, transport accidents, and miscellaneous accidents
- Attributes of a technological disaster: Frequency, duration, economic cost, insured economic losses, human cost, complexity of technological disaster, overlapping technological disasters, and historical vulnerability of location to technological disaster
- Principal component analysis statistical estimation technique + normalization of score between 0 and 100

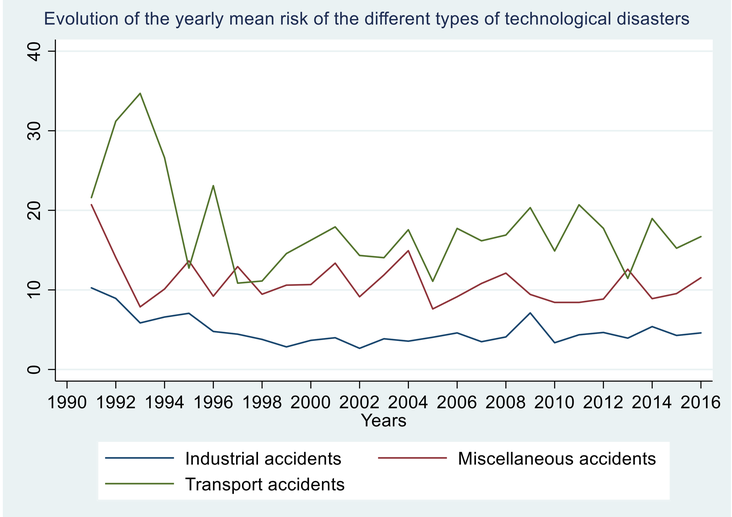


Table 4: The impact of disaster risk on cash holdings

Dependent variable:	Cash / book assets	Cash/net assets	Ln(Cash/net assets)	Cash/sales	Ln(Cash/sales)
	(1)	(2)	(3)	(4)	(5)
Natural disaster risk	0.00058***	0.00200***	0.00097***	0.00378***	0.00097***
	(5.42)	(5.70)	(5.60)	(3.13)	(5.38)
Technological disaster risk	-0.00003	-0.00030**	-0.00010*	-0.00030	-0.00009
	(-0.68)	(-2.65)	(-1.75)	(-0.55)	(-0.92)
Constant	0.22011***	0.55294***	0.30324***	0.30967	0.24883**
	(4.04)	(6.18)	(4.01)	(0.77)	(2.51)
Control variables	Yes	Yes	Yes	Yes	Yes
Year, industry, and country FE	Yes	Yes	Yes	Yes	Yes
Firm-year obs.	148,170	148,170	148,170	148,170	148,170
Adj. R2	0.47	0.43	0.48	0.45	0.55
Se cluster level	F-Y-C-I	F-Y-C-I	F-Y-C-I	F-Y-C-I	F-Y-C-I
Joint significance of risk indices	14.98***	22.97***	16.98***	5.07**	16.54***

Table 7: Short-term versus long-term effects of disaster risk on cash holdings

$$\text{Cash holdings}_{i,c,j,t} = \beta_0 + \underbrace{\boldsymbol{\beta_1} * \textbf{natural disaster risk}_{c,t}}_{\text{Short-term impact}} + \underbrace{\sum_{k=1}^{n} \boldsymbol{\beta_k} * \textbf{natural disaster risk}_{c,t-k}}_{\text{Long-term impact}} +$$

$$\underbrace{\boldsymbol{\beta_2} * \textbf{technological disaster risk}_{c,t}}_{\text{Short-term impact}} + \underbrace{\sum_{k=1}^{n} \boldsymbol{\beta_k} * \textbf{technological disaster risk}_{c,t-k}}_{\text{Long-term impact}} + \beta_3 * X_{i,c,t-1} +$$

$$\beta_4 * \text{industry cash holding volatility}_{j,t-1} + \beta_5 * Z_{c,t-1} + \nu_t + \eta_c + \omega_s + \varepsilon_{i,c,j,t} \quad (4)$$

Dependent variable	Cash/book assets								
	0 lag	1 lag	2 lags	3 lags	4 lags	5 lags	6 lags	7 lags	8 lags
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Natural disaster risk									
Short-term impact	0.0068***	0.0053***	0.0073***	0.0079***	0.0045***	0.0044***	0.0051***	0.0018	0.0009
	(5.42)	(5.66)	(3.97)	(3.95)	(3.76)	(2.96)	(3.04)	(1.100	(0.41)
Long-term impact		0.0082***	0.0135***	0.0170***	0.0194***	0.0189***	0.0182***	0.0171**	0.0128
		(3.42)	(3.75)	(3.45)	(3.43)	(4.49)	(4.61)	(2.21)	(1.57)
Technological disaster risk									
Short-term impact	-0.0008	-0.0016	-0.0030**	-0.0036***	-0.0005	-0.0022*	-0.0027**	-0.0022	-0.0017
	(-0.68)	(-1.55)	(-2.39)	(-2.98)	(-0.39)	(-1.70)	(-2.22)	(-1.62)	(-1.32)
Long-term impact		-0.0014**	-0.0058**	-0.0030	-0.0058**	-0.0036	-0.0017	-0.0026	-0.0121
		(-2.14)	(-2.09)	(-1.37)	(-2.06)	(-1.06)	(-0.28)	(-0.290	(-1.48)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year, industry, and country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-year obs.	148,170	148,170	122,710	102,932	86,785	73,696	62,753	53,538	45,735
Adj. R2	0.47	0.47	0.48	0.48	0.48	0.47	0.47	0.47	0.47
Joint significance of risk indices	14.98***	9.34***	8.08***	6.80***	17.69***	20.97***	34.74***	19.54***	15,686.00***

Table 9: Disaster risk, internal financial constraints, and cash holdings

Dependent variable:	Cash / book assets		
	Firm size	Dividend paying firm	Operating cash flow
	(1)	(2)	(3)
Internal constraint measure x natural disaster risk	-0.00007***	-0.00066***	0.00007
	(-3.02)	(-5.07)	(0.37)
Internal constraint measure x technological disaster risk	0.00003***	0.00017***	0.00019
	(3.70)	(3.66)	(1.06)
Constant	0.21387***	0.22159***	0.34098***
	(3.95)	(4.19)	(16.31)
Control variables	Yes	Yes	Yes
Year, industry, and country FE	Yes	Yes	Yes
Firm-year obs.	148,170	148,170	118,592
Adj. R2	0.48	0.48	0.48
Joint significance of interacted variables	208.89***	88.42***	3.83**

Conclusion and contributions to the literature

- This study sheds lights on the willingness of firms to prepare simultaneously for different types of disaster risk.
- Firms have a natural disaster management policy that cope with possible negative implications for natural disaster strikes through the cash holdings channel.
- Firms do not prepare for technological disasters possibly due to the existence of information asymmetries about the firm.
- This paper introduces disaster risk indices.

Doctoral research

- The role of disaster life cycle on corporate finance decisions
- Website: https://sites.google.com/view/bsgill