

A photograph of a dirt road in a village. On the left, there are large stacks of red bricks and a pile of sand. On the right, there are damaged buildings, some with missing roofs and exposed brickwork. In the background, there are trees and a utility pole. The scene suggests a village in the process of rebuilding after a disaster.

The Impact of Natural and Manmade Disasters On Household Welfare

By

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Rebuilding houses in Nagapattinam District, TN, INDIA

Purpose of My Talk

- To provide selective evidence on the impact of natural and manmade disasters on household welfare
- To link this issue to the existing development literature on risk
- To identify further research questions

Presentation Outline

1. Introduction: background, definitions, and overview
2. Ex ante risk management and ex post risk-coping behaviors against disasters: Selective evidence
3. Mutual insurance, aggregate rare events, and index insurance
4. The role of self-insurance
5. Public policy issues of emergency aid after disasters

1. Introduction:

Background, definitions, and overview

1. Background

- In developed as well as developing countries, people are at a wide variety of risks to their livelihood.
 - Health related risks (accidents, sickness, or sudden death)
 - Price & yield risks, contractual risks, and policy or political risks
 - Natural disasters
- Related studies:
 - A remarkable progress in the theory and empirics on risk and household behavior [Fafchamps (2003); Dercon ed. (2005)]
 - Yet, shocks generated by a natural disaster have rarely been investigated or utilized (due to data constraints)

1. Definitions of Disasters

- A disaster is defined as: An unforeseen event that causes great damage, destruction and human suffering, which overwhelms local capacity, necessitating national or international assistance (Centre for Research on the Epidemiology of Disasters, 2006).
- Examples: warfare, civil strife, economic crisis such as hyperinflation and **financial crisis**, hazardous material or transportation incident (such as a chemical spill), explosion, nuclear incident, building collapse, blizzard, hurricane, drought, epidemic, **earthquake**, fire, flood, or volcanic eruption.

1. Definitions of Disasters

- Three broad categories: natural, technological, and manmade disasters.

- The natural disasters

- 1) Hydro-meteorological disasters: Floods, storms, and droughts
- 2) **Geophysical disasters**: Earthquakes, tsunamis and volcanic eruptions
- 3) Biological disasters: Epidemics and insect infestations.

- The technological disasters

- 1) Industrial accidents: Chemical spills, collapses of industrial infrastructures
- 2) Transport accidents: By air, rail, road or water means of transport.

- Manmade disasters

- 1) **Economic crises**: Growth collapse, hyperinflation, and financial crisis
- 2) Violence: Terrorism, civil strife, riots, and war.

1. Overview of Natural Disasters

- The apparent increasing trend of natural disasters, especially of hydro-meteorological disasters.

1. Overview of Natural Disasters

- A closer look at the data for 1995-2004 by type of triggering hazards reveals seriousness of hydro-meteorological disasters but there are region-specific characteristics

Table 1 Number of Natural Disasters by Type of Triggering Hazards:
Regional Distribution 1995-2004

	Hydro-meteorological disasters						Geological disasters		Biological disasters	
	Floods	Wind Storms	Droughts and related Disasters	Landslides	Avalanches	Waves and Surges	Earthquakes and Tsunamis	Volcanic Eruptions	Epidemics	Insect Infestations
Africa	277	70	123	11	0	0	18	4	346	14
America	269	298	205	43	1	1	51	23	48	2
Asia	444	326	229	97	16	6	193	13	154	3
Europe	180	86	156	7	10	0	28	2	37	1
Oceania	35	68	37	8	0	0	9	6	10	3
World	1205	848	750	166	27	7	299	48	595	23

Source: EM-DAT: The OFDA/CRED International Disaster Database. <<http://www.em-dat.net>> UCL - Brussels, Belgium

1. Overview of Manmade (Economic) Disasters

- As to manmade disasters, the number of *complex* economic crisis is increasing

Table 2
Frequency of Economic Crises Over Time

Type of crisis	1970-79		1980-1995	
	Total	Average per year	Total	Average per year
Balance-of-payments	26	2.6	50	3.13
Twin	1	0.10	18	1.13
Single	25	2.50	32	2.00
Banking	3	0.30	23	1.44

Source: Table 1 of Kaminsky and Reinhart (1999)

1. Overview of Disasters

Yet, the estimated damage from natural disasters does not necessarily increase with that of the numbers of disasters and victims

1. Overview of Disasters

The level of damages from natural disasters is much higher in developed countries, while the impact of disasters to a national economy may be higher in LDCs

Table 1 Direct Damages from Natural Disasters

Event (Year)	Damages (US \$ billion)	Loss as percentage of GDP
Hurricane Katrina in the US (2005)	125	1.7
Tsunami in India (2004)	1.02	0.17
Tsunami in Indonesia (2004)	4.45	2.14
Tsunami in Sri Lanka (2004)	0.97–1.00	4.4–4.6
Chuetsu Earthquake in Japan (2004)	28.3	0.6
Great Hanshin-Awaji Earthquake in Japan (1995)	95–147	2.5
	40%: infrastructure	
	60%: residence	
Cyclone/floods in Bangladesh (1991)	1	5
Hurricane Mitch in Honduras (1998)	3 ⁱ	20 ⁱ
The Great Kanto Earthquake (1923)	32.6 (in 2003 price)	43.6

Source: Table 1 in Freeman, Keen, and Mani (2003) and the authors' calculation

**2. Ex ante risk management and ex post risk-coping:
Selective evidence**

2. Negative Welfare Costs of Risks

- Standard risk premium (m): how much money households would be willing to pay to completely eliminate income variability

$$u(\bar{y} - m) = E[u(\tilde{y})], \quad (1)$$

\tilde{y} : A stochastic income with its mean value, \bar{y}

- Arrow=Pratt risk premium:

$$\frac{m}{\bar{y}} = \frac{1}{2} \underbrace{\left(-\frac{u''(\bar{y})\bar{y}}{u'(\bar{y})} \right)}_{\text{Coefficient of RRA}} \times \underbrace{\left(\frac{\sqrt{\text{Var}(\tilde{y})}}{\bar{y}} \right)^2}_{\text{Coefficient of Var}}, \quad (2)$$

2. Negative Welfare Costs of Risks using Arrow=Pratt Measure

- The welfare cost of risks is at least 10% and can be 30-50% of household income
 - Non-diversifiable risk through ex ante risk management.
 - Lower-bound estimates for natural or manmade disasters.

Table 4 Quantifying the Seriousness of Risks Base on the Arrow=Pratt Risk Premium

	Coefficient of Relative Risk Aversion	Coefficient of Variation	Estimated m as a percentage of income (%)
Pakistan	1.12-3.34 ¹⁾	42.1-54.3 ²⁾	9.93-49.24
India	1.39 ²⁾ , 1.77-3.10 ³⁾	47.0 ⁴⁾	15.35-34.24

1) Table 5-3, 5-4, and 6-3 of Kurosaki (1998);

2) Morduch (1990);

3) Fafchamps (2003), p.184;

4) Table 10.6 of Walker and Ryan (1990)

2. Risk Management and Risk Coping Strategies

- Risk management strategies: Activities for mitigating risk and reducing income instability before the resolution of uncertainties (Walker and Jodha, 1986; Alderman and Paxson, 1992).
 - Ex ante management of the risks of natural disasters are known to be quite cost effective.
 - Yet, it is often difficult by nature because natural disasters are typically rare or unforeseen events.

2. Risk Management and Risk Coping Strategies

- Risk-coping strategies: Ex post strategies to reduce consumption fluctuations, provided realized income fluctuations [Alderman and Paxson (1992)].
 - 1) To reduce consumption expenditure with maintaining total calorie intakes.
 - 2) To use credit to smooth consumption by reallocating future resources to today's consumption.
 - 3) To use accumulated financial and physical assets (precautionary saving).
 - 4) To use returns to human capital through extended labor market participation
 - 5) To receive transfers.
- Against unexpected natural disasters, ex post risk-coping will be indispensable
- Let's look at examples: The Asian financial crisis, the Great Hanshin-Awaji (Kobe) earthquake, the Indian Ocean Tsunami Disaster

2. Risk Coping Strategies: The Asian Financial Crisis

- During the currency crisis in Indonesia, Korea, Thailand and Mexico, consumption reallocation was an important coping strategy

Table 5 Changes in per capita consumption in Indonesia
(unit: 1000Rupiah, per month value at Dec 1997 price)

	1997 (Rp)	1998 (Rp)	Change rate (%)
Urban households			
Per capita consumption	319	184	-42
Staple	41.4	37.9	-8
Meat	40.5	19.1	-53
Medical	5.5	2.7	-50
Education	15.7	8.3	-47
Leisure	8.2	3.8	-54

Source: Frankenberg, Thomas, and Beegle (1999)

2. Risk Coping Strategies: The Asian Financial Crisis

- In Korea, extended credit was important but not enough. The likelihood of facing credit constraints increased significantly [Kang and Sawada (2003)]

Table 6 Changes in per capital consumption in Korea
(unit: 10,000 Won, per year value at 1995 price)

	Aug 1996 – July 97	Aug 1997 – July 98	Change rate (%)
	mean (std. error)	mean (std. error)	
Food expenditure	351.54 (216.26)	297.99 (177.63)	-15.2
Education & medical expenditure	304.17 (371.30)	242.21 (336.21)	-20.4
Expenditures for luxuries (cultural activities, entertainment, dining out, and durable goods)	147.25 (333.75)	53.98 (86.36)	-63.3
Sales of assets (land, real estate, securities, and withdrawal of time deposits)	195.01 (1305.44)	203.62 (1089.94)	4.4
Outstanding debt (formal banks, informal banks, and personal)	842.02 (2177.78)	1074.34 (5252.27)	27.6

Source: Kang and Sawada (2003)

2. Risk Coping Strategies:

The Great Hanshin Awaji (Kobe) Earthquake

- Households borrow extensively against housing damages, whereas dissavings (self-insurance) are utilized for smaller damages [Sawada and Shimizutani (2005, 2006)]

Table 7. Damages and Coping-Strategies under the Great Hanshin-Awaji (Kobe) Earthquake

	Proportion of HHs (%)
<u>Shock Variables</u>	
Major or medium housing damage was caused by the earthquake	42.5
Minor housing damage was caused by the earthquake	43.1
Major or minor household asset damage was caused by the earthquake	86.7
<u>Coping Variables</u>	
Reallocations of the constituents of the consumption were the most significant means of coping	25.0
Dissaving was the most significant means of coping	53.7
Borrowing was the most significant means of coping	9.6
Receiving transfers was the most significant means of coping	11.7

Source: Sawada and Shimizutani (2005, 2006)

2. Risk Coping Strategies against the Kobe earthquake:

Sawada and Shimizutani (2005): Comparisons of Different Risk-Coping Strategies
Dep. Variable: Was Borrowing, Transfers, or Dissaving Important Coping Device?

(Sample A; multivariate Probit models)

Explanatory Variables	Borrowing	Transfers	Dissaving
	Coefficients (Std. Err.)	Coefficients (Std. Err.)	Coefficients (Std. Err.)
Dummy = 1 if major housing damage was caused by the earthquake	1.312 (0.568)**	0.097 (0.330)	0.164 (0.254)
Dummy = 1 if moderate housing damage was caused by the earthquake	1.436 (0.546)***	0.339 (0.257)	-0.044 (0.210)
Dummy = 1 if minor housing damage was caused by the earthquake	1.044 (0.525)**	-0.291 (0.240)	0.015 (0.184)
Dummy = 1 if major household asset damage by the earthquake	-0.327 (0.395)	-0.027 (0.393)	0.365 (0.303)
Dummy = 1 if minor household asset damage by the earthquake	-0.275 (0.261)	-0.145 (0.248)	0.326 (0.191)*
Dummy = 1 if health-related shocks by the earthquake	-0.160 (0.207)	0.046 (0.190)	0.077 (0.156)
Dummy = 1 if utility disconnection by the earthquake (> a month)	-0.517 (0.179)***	-0.217 (0.182)	0.226 (0.128)*
Dummy = 1 if household owned a house prior to the earthquake	0.423 (0.241)*	-0.247 (0.216)	0.201 (0.169)
Dummy = 1 if household had outstanding housing loans prior	-0.131 (0.214)	0.229 (0.214)	-0.271 (0.157)*
Age of the respondent	0.101 (0.075)	0.089 (0.070)	-0.076 (0.052)
Age squared	-0.001 (0.001)	-0.001 (0.001)	0.001 (0.001)*
Dummy = 1 if the respondent was single	0.037 (0.489)	-0.209 (0.484)	0.111 (0.344)
Dummy = 1 if the respondent lived with children	0.327 (0.205)	-0.014 (0.193)	-0.252 (0.146)*
Dummy = 1 if the respondent lived with parents or grandchildren	0.359 (0.198)*	-0.303 (0.222)	0.021 (0.158)
Constant	-4.105 (1.972)**	-2.779 (1.850)	0.552 (1.362)
Sample size	513	513	513

2. Risk Coping Strategies: Indian Ocean Tsunami Disaster

- In India, the number of deaths caused by tsunami was the highest in TN State, especially in the Nagapattinum district, where 6,065 people perished.
- The majority of the victims were women and children.

2. Risk Coping Strategies: Indian Ocean Tsunami Disaster

In India, the number of deaths caused by tsunami was the highest in TN State, especially in the Nagapattinum district, where 6,065 people perished.

The majority of the victims were women and children.

Table 8. Damages caused by Tsunami in India

Location	AP	Kerala	Pondicherry	TN	Total
Districts Affected*	7	7	2	13	29
Villages Affected*	301	187	33	376	935
Dead*	106	170	428	7,921	10,380
Damage to Fishery Assets**	51.8	50.8	94.7	801.3	998.6
Damage to Agriculture and Livestock Asset**	1.99	19.59	3.70	40.53	65.81
Damaged Houses***	481	13,042	10,061	130,000	153,585

* As of 5 Jan, UNICEF "Tsunami Relief Operation: Tamil Nadu" (Internal Information)

** In crore Rs., Asian Development Bank, United Nations, and World Bank (2005) "India Post Tsunami Recovery Program Preliminary Damage and Needs

2. Risk Coping Strategies: Indian Ocean Tsunami Disaster

- According to a survey of 400 households from eight villages in the Nagapattinum district that were affected by the Tsunami , the majority of households lost productive assets such as boats and faced income losses [Sawada (2006)].

Table 10. Damages under the Tsunami in India

Variable Description	Proportion (%)
Shock Variables	
Dummy = 1 if lost house	4
Dummy = 1 if house seriously damaged	16
Dummy = 1 if lost productive assets such as boats	78.5
Dummy = 1 if lost job	24
Dummy = 1 if income declined	60.3
Dummy = 1 if lost members	5.3

Source: Sawada (2006)

2. Risk Coping Strategies: Indian Ocean Tsunami Disaster

- Receiving aid from government, relatives and neighbors, self-help groups, and NGOs were important means of coping for more than 90% of households, followed by borrowing for around 41% of households [Sawada (2006)].

Table 10. Coping-Strategies under the Tsunami in India

Variable Description	Proportion (%)
<u>Coping Variables during the relief phase</u> <u>(Dec 26, 2004-April 30, 2005)</u>	
Dummy = 1 if sales of assets was the most important means of coping	0.088
Dummy = 1 if borrowing was the important means of coping	0.405
Dummy = 1 if receiving transfers was the important means of coping	0.905

Source: Sawada (2006)

3. Mutual Insurance, Aggregate Rare Events, and Index Insurance

3. Role of Market and Non-Market Institutions against Disasters

- Different types of risks by the level at which they occur
 - Idiosyncratic risks affect specific individuals
 - Mutual insurance is possible: Can be traded with other people in the same insurance network through informal mutual insurance as well as a well-functioning formal insurance or credit market.
 - Aggregate (correlated) risks affect groups of households, an entire community and region, or a country as a whole
 - Cannot be insured within the region and necessitates a formal market in which region-specific risks are diversified away across regions.
 - Natural disasters fall into this category: Even requires global re-insurance for a formal insurance.

3. Role of Market and Non-Market Institutions against Disasters

- A risk is idiosyncratic or correlated depends on the underlying causes

3. Full Insurance through Market or Non-Market Mechanisms

- Under full insurance, idiosyncratic household income changes should be absorbed by all other members in the same insurance network.
 - Most studies reject the very strict full-insurance hypothesis statistically, especially for the poorest households. Yet, in general, the degree of market incompleteness is much smaller than many had assumed. [Cochrane (1991), Mace (1991), Ligon (1997), Ogaki and Zhang (2004); Townsend (1994, 1995), and Udry (1994)].
- Natural disasters are often rare, unexpected, and aggregate events. Hence, it is even harder to design mutual insurance for natural disasters.
 - Sawada and Shimizutani (2006) investigate household data from the Great Hanshin-Awaji (Kobe) earthquake in 1995 and found that the full consumption insurance hypothesis is rejected overwhelmingly
 - The ineffectiveness of formal/informal insurance mechanisms against the earthquake.

3. Full Consumption Insurance Model

- Model of complete markets:

$$\text{Max} \sum_{t=0}^{\infty} \sum_{s^t \in \Omega^t} \left(\frac{1}{1+\delta} \right)^t \pi(s^t) u[c_{it}(s^t)]$$

$$(1) \quad \text{s.t.} \quad \sum_{t=0}^{\infty} \sum_{s^t \in \Omega^t} p(s^t) \omega_{it}(s_t) \geq \sum_{t=0}^{\infty} \sum_{s^t \in \Omega^t} p(s^t) c_{it}(s^t),$$

$$(2) \quad \Rightarrow \quad \left(\frac{1}{1+\delta} \right)^t \pi(s^t) u'[c_{it}(s^t)] = \lambda_i p(s^t), \text{ for all history of the states}$$

- Under complete markets and common discount factor assumptions:

$$(3) \quad \frac{u'(c_{it})}{u'(c_{it-1})} = \frac{u'(c_{jt})}{u'(c_{jt-1})} \text{ for all states.} \Rightarrow \Delta c_{it} = \Delta \left(\frac{1}{N} \sum_{j=1}^N c_{jt} \right) \text{ w/ CARA utility}$$

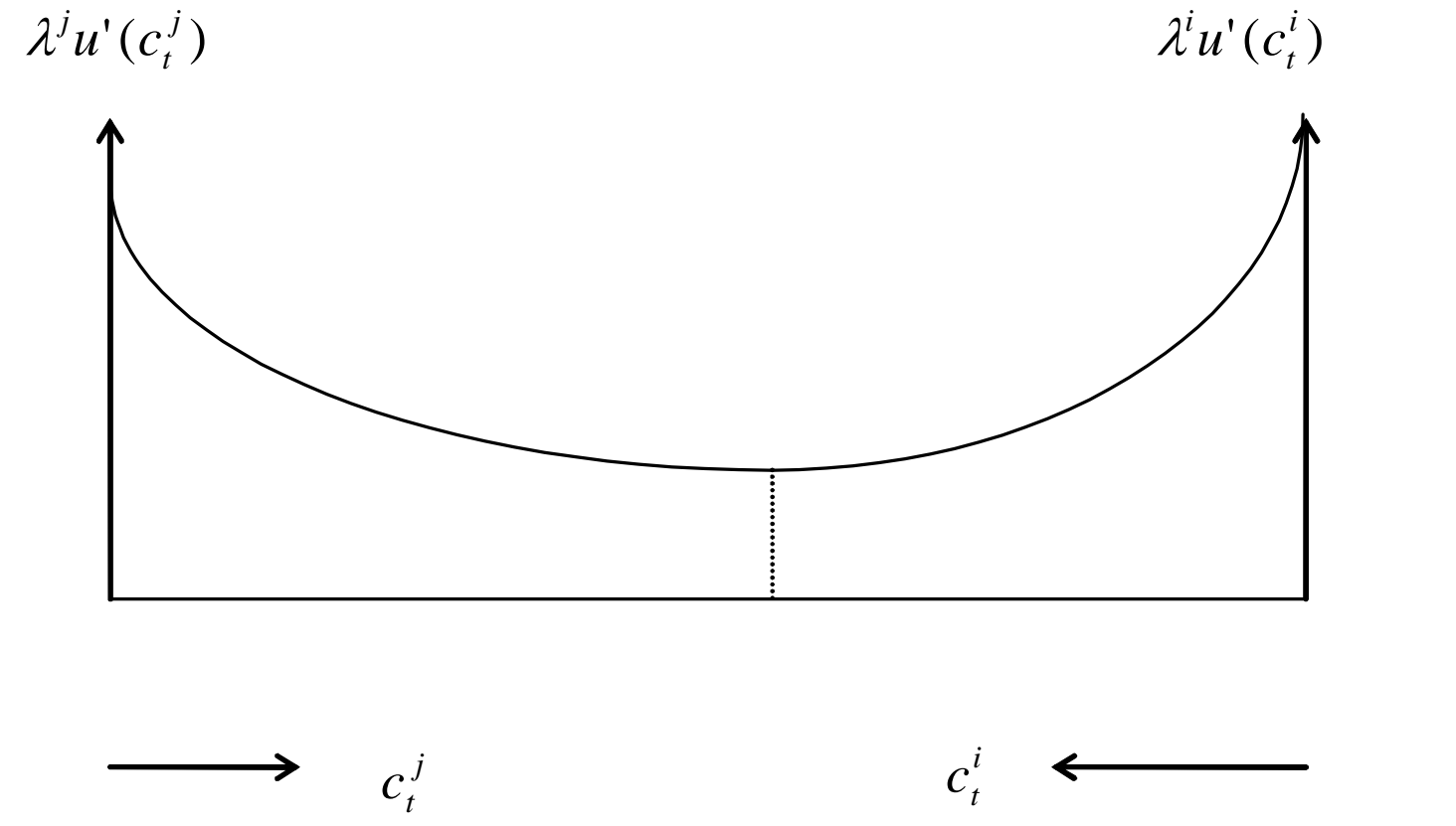
- Under incomplete markets, shadow price for non-traded claims by $p_i(s^t)$:

$$(5) \quad \Delta c_{it} = \underbrace{\Delta \left(\frac{1}{N} \sum_{j=1}^N c_{jt} \right) + \Delta \left(\frac{1}{N} \sum_{j=1}^N \log p_j(s^t) \right)}_{\text{Aggregate component}} - \underbrace{\Delta \log p_i(s^t)}_{\text{Individual component}}.$$

The Social Planner Solution:

Full Risk Sharing with Identical Time Preference

Note that we can derive the same condition as equation (3)



Tests of Complete Insurance using the Kobe earthquake data

(Sawada and Shimizutani, 2006)

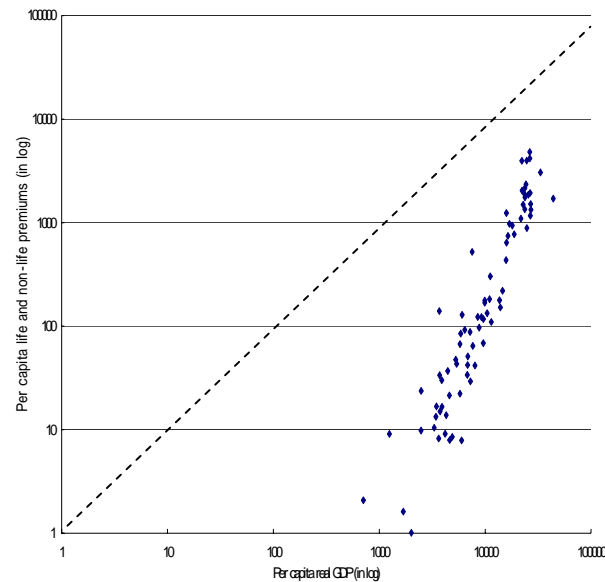
Explanatory Variables	Spec. (1)	Spec. (2)	Spec. (3)	Spec. (4)
Sample	All	All	Sample A	Sample B
<u>Income Shock Variables</u>				
Dummy = 1 if the positive income shock due to the earthquake	0.052 (0.146)			
Dummy = 1 if the negative income shock due to the earthquake	0.351 (0.077)***			
<u>Shock Variables</u>				
Dummy = 1 if major housing damage was caused by the earthquake		0.434 (0.155) ***	0.554 (0.232) **	0.888 (0.719)
Dummy = 1 if moderate housing damage was caused by the earthquake		0.393 (0.121) ***	0.606 (0.203) ***	-0.568 (0.496)
Dummy = 1 if minor housing damage was caused by the earthquake		0.094 (0.091)	0.126 (0.174)	0.158 (0.195)
Dummy = 1 if major household asset damage was caused by the earthquake		0.602 (0.196) ***	0.281 (0.300)	0.506 (0.737)
Dummy = 1 if minor household asset damage was caused by the earthquake		0.418 (0.098) ***	0.108 (0.178)	0.299 (0.179) *
Dummy = 1 if health-related shocks were caused to the family by the earthquake		0.359 (0.108) ***	0.436 (0.163) ***	0.623 (0.327) *
Constant	0.442 (0.107) ***	-0.201 (0.144)	-0.134 (0.251)	-0.382 (0.361)
Wald test statistics for a null hypothesis under which the coefficients on shock variables are jointly zero [p-value]	20.74 [0.00]***	74.71 [0.00]***	31.16 [0.00]***	15.01 [0.04]**
Sample size	1332	1289	512	246

Note: As a dependent variable, we employed a dummy variable which took the value of one if the household consumption behavior changed prior to and post earthquake. We also included the regional dummy variables that have not been reported here. The symbol, ***, indicates statistical significance at the 1% level.

3. Market versus Non-Market Insurance

- There is very little research on formal insurance market in LDCs [Outreville (1990); Enz (2000)].
- There is a positive relationship between volume of life and non-life premiums per capita and GDP per capita and the fitted slope > 1 . This suggests that formal insurance appears to be a luxury = people's preferences are characterized by increasing risk aversion? Supply constraints?

Figure 5. Cross-Country Income Elasticity for Life and Non-life Formal Insurance Demand In 2000



Source: Penn World Tables Version 6.1, and *Sigma*, Swiss Re.

3. Index Insurance for Natural Disasters?

- Index insurance contracts are written against specific aggregate events such as drought or flood defined and recorded at a regional level [Hazell (2003); Morduch (2004); Lilleor, Gine, Townsend, Vickery (2005); Skees, Varangis, Larson and Siegel (2006)].
 - Can cover the aggregate events
 - Affordable and accessible even to the poor
 - Easy to implement and privately managed
 - Free from moral hazard, adverse selection, and high transaction costs that have plagued traditional agricultural insurance contracts such as crop insurance schemes.

3. Index Insurance for Natural Disasters?

- Three major constraints to design index type insurance against natural disasters.
 - A “rare” event; making it difficult to design actuarially fair insurance and to set appropriate premium because obtaining historical data on natural disasters pattern is hard [Morduch (2004)].
 - The poor may find it difficult to recognize the value because natural disasters are often characterized by unforeseen contingencies and because the poor often are myopic with high time discount rates [Pender (1996)]. The existence of the “basis risk” also deters demand [Morduch (2004); Hazell (2003)].
 - The insurers have a potential need to secure their financial position by utilizing international reinsurance markets. However, it is known that reinsurance markets and trades of catastrophe (CAT) bonds are still thin with limited capacity. Also, the extent of overall international risk-sharing remains surprisingly small [Obstfeld and Rogoff (2001); Lewis (1996)].

4. The Role of Self-Insurance

4. The Role of Self-Insurance

- Market or non-market mutual insurance against natural disasters is difficult by nature, so the role of self-insurance. Self-insurance is defined as insurance against income uncertainty through own saving and dissaving (with limited borrowing opportunities) [HAK (1996); L&S (2005)]. We augment the consumption Euler equation with the possibility of a liquidity constraint ($\mu > 0$) [Zeldes (1989)]:

$$u'(c_{it}) = E_t \left[u'(c_{it+1}) \left(\frac{1+r}{1+\delta} \right) \right] + \mu_{it}, \quad (6)$$

- Then, we have the following optimal self-insurance equation [Flavin (1999); Kocher (2003); Sawada and Shimizutani (2005)]:

$$\underbrace{\Delta b_{it}}_{\text{Borrowing}} + \underbrace{\Delta d_{it}}_{\text{Dissaving}} = - \underbrace{\Delta y_{it}}_{\text{Income_shock}} - \underbrace{\Delta A_{it}}_{\text{Asset_shock}} + \frac{1}{\alpha} \left[\ln \left(\frac{1+r}{1+\delta} \right) \right] - \underbrace{\mu'_{it-1}}_{\text{Credit_const}>0} + \eta_{it}, \quad (7)$$

- The effectiveness of self-insurance risk coping strategies against natural and manmade disasters was weakened by increased seriousness of credit constraints.

4. Reality on the Role of Self-Insurance

- Morduch (2004): For 21% of Nicaraguan households, the main response to the Hurricane Mitch was not to use savings, nor to borrow money; the main response was a drastic reduction in consumption.
- Sawada and Shimizutani (2005): Victims of the Kobe earthquake without credit constraints can borrow and/or dissave to respond to damages caused by the earthquake.
- Credit market accessibility seriously affects the effectiveness of self-insurance possibilities. Importance of facilitating self-insurance capabilities by providing (subsidized) credits to the victims.

Sawada and Shimizutani (2006)
Comparison of Different Risk Coping Strategies in Kobe earthquake

Explanatory Variables	Borrowing				Dissaving				Private Transfer			
	Under a Constraint		No Constraint		Under a Constraint		No Constraint		Under a Constraint		No Constraint	
	One of the Means	Most Important	One of the Means	Most Important	One of the Means	Most Important	One of the Means	Most Important	One of the Means	Most Important	One of the Means	Most Important
Dummy = 1 if major housing damage was caused by the earthquake	0.137	0.067	0.119	0.135	0.003	-0.152	-0.095	0.179	0.316	0.108	0.290	0.130
	(0.090)	(0.060)	(0.041)***	(0.071)*	(-0.022)	(0.085)*	(0.052)*	(0.082)**	(0.055)***	(0.060)*	(0.037)***	(0.052)**
Dummy = 1 if moderate housing damage was caused by the earthquake	-0.010	-0.003	0.111	0.110	0.007	-0.151	-0.045	0.096	0.270	0.052	0.302	0.091
	(0.086)	(0.029)	(0.041)***	(0.053)**	(0.019)	(0.082)*	(0.035)	(0.067)	(0.073)***	(0.032)	(0.049)***	(0.034)***
Dummy = 1 if minor housing damage was caused by the earthquake	-0.091	-0.030	0.050	0.039	0.015	-0.106	-0.030	0.070	0.075	0.008	0.032	0.005
	(0.077)	(0.025)	(0.044)	(0.035)	(0.012)	(0.078)	(0.026)	(0.058)	(0.093)	(0.012)	(0.075)	(0.011)
Dummy = 1 if major household asset damage was caused by the earthquake	-0.065	-0.020	-0.064	-0.040	-0.072	0.197	-0.044	0.089	0.111	0.015	0.049	0.008
	(0.100)	(0.027)	(0.061)	(0.033)	(0.069)	(0.133)	(0.055)	(0.098)	(0.133)	(0.025)	(0.100)	(0.019)
Dummy = 1 if minor household asset damage was caused by the earthquake	-0.152	-0.073	-0.004	-0.003	-0.010	0.171	-0.142	0.036	0.209	0.015	-0.019	-0.003
	(0.088)*	(0.057)	(0.041)	(0.032)	(0.019)	(0.078)**	(0.022)	(0.058)	(0.128)	(0.010)	(0.069)	(0.011)
Dummy = 1 if health-related shocks were caused to the family by the earthquake	0.018	0.007	0.040	0.033	-0.021	0.083	0.009	-0.021	-0.013	-0.001	-0.024	-0.003
	(0.065)	(0.024)	(0.030)	(0.027)	(0.026)	(0.076)	(0.018)	(0.045)	(0.081)	(0.007)	(0.053)	(0.007)
Dummy = 1 if the household owned a house prior to the earthquake	0.170	0.093	0.025	0.017	0.001	-0.004	-0.033	0.107	-0.234	-0.014	-0.067	-0.012
	(0.094)*	(0.079)	(0.054)	(0.035)	(0.023)	(0.126)	(0.013)***	(0.061)*	(0.163)	(0.009)	(0.071)	(0.015)
Dummy = 1 if the household had outstanding housing loans prior to the earthquake	-0.017	-0.006	-0.005	-0.004	-0.021	0.077	0.031	-0.078	0.142	0.022	0.034	0.005
	(0.121)	(0.039)	(0.029)	(0.021)	(0.056)	(0.160)	(0.016)*	(0.041)*	(0.145)	(0.038)	(0.048)	(0.007)
Age of the respondent	-0.011	-0.004	0.003	0.002	-0.003	0.018	-0.003	0.008	-0.026	-0.002	-0.008	-0.001
	(0.038)	(0.013)	(0.010)	(0.008)	(0.007)	(0.036)	(0.006)	(0.013)	(0.046)	(0.004)	(0.016)	(0.002)
Age squared	0.0002	0.00006	-0.00005	-0.00004	0.00003	-0.0002	0.00001	-0.00002	0.0003	0.00003	0.00003	0.000005
	(0.0004)	(0.0002)	(0.0001)	(0.00007)	(0.00008)	(0.0004)	(0.00005)	(0.0001)	(0.0005)	(0.00005)	(0.0002)	(0.00002)

Note: In this table, we reported the marginal effects. Huber-White consistent robust standard errors are shown in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

5. Public Policy Issues

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- A serious lack of insurance markets or non-market mechanisms for damages arising from natural and manmade disasters, so governments can play an important role:
 - (1) In its attempt to provide ex post public support in the event of a natural disaster, the government may create a moral hazard problem [Horwich (2000)].
 - ① Index type insurance should be free from moral hazard problems, but such an insurance contract would be difficult to design and sell against disasters.
 - ② Providing subsidized loans, rather than direct transfers, to victims can be a good example of facilitating ex post risk-coping behavior without moral hazard.
 - (2) Yet, it would be still imperative to design ex ante risk-management policies against the disasters as much as possible, particularly for natural disasters with relatively high frequency such as floods, droughts, high winds, and cold weather. “Frequency” is an important parameter.

5. Public Policy Issues

(3) Under the “emergency rescue” phase after a disaster, transfers play an important role. Matching of emergency demands and massive proliferations of aid supply under imperfect information and uncertainties will be a major problem:

① Targeting failure: wrong people are targeted or right targets are excluded

② Moral hazard: Even under “tagged” targeting interventions, there are perverse incentives to change their characteristics to gain eligibility, e.g. “Tsunami marriages”

③ Data collection and evaluation of the matching efficiency after a disaster will be important. The July 2006 report of Tsunami Evaluation Coalition (TEC) found:

1) Tsunami victims received US\$7,100 on average

2) Relief is not necessarily given on the basis of need

3) Relief is allocated in response to political pressure or to the donating public.

GDN 2008 FASID Session
A list of related papers (into three groups) on disasters and households

Yasuyuki Sawada
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(1) A survey article

- Sawada, Y. (2007), "The Impact of Natural and Manmade Disasters on Household Welfare," Agricultural Economics 37 (s1), 59-73.

(2) Korean households before and after the financial crisis in 1997

- Kang, S. J. and Y. Sawada (2008). "Credit Crunch and Household Welfare: The Korean Financial Crisis," forthcoming in Japanese Economic Review.
- Kang, S. J. and Y. Sawada (2008), "Did Public Transfers Crowd Out Private Transfers in Korea During the Financial Crisis?" forthcoming in Journal of Development Studies.
- Goh, C., S. J. Kang, and Y. Sawada (2005) "How Did Korean Households Cope with Negative Shocks from the Financial Crisis?" Journal of Asian Economics 16, 239-254.
- Kang, S. J. and Y. Sawada (2003) "Are Private Transfers Altruistically Motivated? The Case of the Republic of Korea before and during the Financial Crisis," Developing Economies 41 (4) , 2003, 484-501.

(3) Kobe and Chuetsu earthquakes

- Sawada, Yasuyuki and Satoshi Shimizutani (2008) "How Do People Cope With a Natural Disaster? Evidence from the Great Hanshin-Awaji Earthquake," Journal of Money, Credit, and Banking 40 (2-3), 463-488.
- Sawada, Yasuyuki and Satoshi Shimizutani (2007a) "Consumption Insurance and Risk-Coping Strategies under Non-Separable Utility: Evidence from the Kobe Earthquake," CIRJE Discussion Paper F-512, Faculty of Economics, University of Tokyo
<<http://www.e.u-tokyo.ac.jp/cirje/research/dp/2007/2007cf512.pdf>>
- Sawada, Yasuyuki and Satoshi Shimizutani (2007b). "Consumption Insurance against Natural Disasters: Evidence from the Great Hanshin-Awaji (Kobe) Earthquake," Applied Economics Letters 14 (4) March 2007, pages 303 – 306.
- Sawada, Yasuyuki, and Satoshi Shimizutani. (2005). "Are People Insured against Natural Disasters? Evidence from the Great Hashin-Awaji (Kobe) Earthquake," CIRJE Discussion Paper F-314, Faculty of Economics, University of Tokyo.
<<http://www.e.u-tokyo.ac.jp/cirje/research/dp/2005/2005cf314.pdf>>
- Ichimura, Hidehiko, Yasuyuki Sawada and Satoshi Shimizutani (2007), "Risk Coping against an Earthquake: The Case of Yamakoshi Village," a paper presented at the international workshop on consumption on March 19, 2007 at Hitotsubashi University.

(4) Other on-going projects on natural disasters

- Impact of Indian Ocean Tsunami Disaster in TN State of India, especially in the Nagapattinum district, where 6,065 people perished. I have collected data of 400 households randomly Chosen from the coastal areas of Nagapattinum dist.
- Typhoon Milenyo which hit Metro Manila of the Philippines in Sep 2006. In Jan-April, 2007, we have collected data from an "East Laguna Village," a village which has been investigated by Yujiro Hayami and Masao Kikuchi for more than 30 years with a collaboration of International Rice Research Institute. We match this data with the baseline data collected before Milenyo.
- Highly Pathogenic Avian Influenza (HPAI) in Vietnam since Dec 2003. In Jan, 2008, we plan to conduct a resurvey of 2,000 households interviewed in VHLSS 2004. Also, I am completing a drafted paper using small scale household panel survey.