Catastrophic Risk Management, Insurance, and the Hyogo Framework For Action 2005-2015

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Over the past few decades, nations have suffered great losses in lives and economic assets from an increasing number of natural disasters, which may be possibly due to climate change, combined with rapid economic and population growth particularly in hazard-prone areas. Although the number of people killed by natural disasters decreased steadily over the past few decades, the number of natural disasters, the number of people affected by natural disasters, and the economic losses caused by natural disasters increased substantially. According to the Emergency Events database (EM-DAT Database) from the Centre for Research on the Epidemiology of Disasters (CRED), the number of natural disasters increased from around 50 in 1960 to more than 400 in 2011, representing a 700 percent increase over the past five decades.[1] The number of people affected by natural disasters increased substantially over the past few decades as well, even as the number of people killed by natural disasters decreased steadily since the 1960s. The estimated economic damage caused by reported natural disasters increased from less than 1 billion (USD) in 1950 to more than 100 billion (USD) in 2011.[2] Due to the increasing incidence and severity of these natural disasters, identifying determinants of natural disaster losses and understanding the difference across nations has become an important issue. More and more nations are aware of the significant negative impacts of natural disasters and realize the importance of catastrophic risk mitigation cooperation among nations.

The purpose of this paper is to examine the relationship between catastrophic risk mitigation, insurance, and the Hyogo Framework for Action 2005-2015 (HFA) in 193 participating nations from 1993 to 2011 by investigating a nation's level of the HFA participation and performance, macroeconomic factors, and insurance market conditions related to the number of deaths and economic losses resulting from natural disasters based on panel data analysis. The global risk reduction policy, the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters, was established at the World Conference on Disaster Reduction in 2005 with the participation of all 193 member states of the United Nations to enhance cooperation

[1] Natural disaster as defined by the CRED refers to a natural event which has killed ten or more people, an event which has affected (injured or made homeless) one hundred or more people, an event with a declaration of a state of emergency, or an event with international assistance provided. (For more information, please visit http://www.emdat.be/).

[2] The estimated damage data obtained from the OFDA/CRED International Disaster Database are entered in US dollars in the value of the year of occurrence. The natural disaster economic losses data used in this paper are converted to constant 2005 US dollars.

among regions and nations to develop disaster risk reduction measures (UN/ISDR, 2007). Participating countries have submitted Hyogo progress reports every two years since 2007 to evaluate its natural risk mitigation progress based on the self-reporting assessments of the twenty-two indicator suggested by the HFA. These biennial assessment reports help nations conveniently monitor disaster risk reduction progress at both the country level and region level across years. Our research employs the overall score of these twenty-two indicators obtained from the HFA progress reports as proxies for a nation's HFA performance in natural disaster risk mitigation. We also consider participation levels of countries. The primary contribution of this study is to investigate the importance and effectiveness of the systematic international risk mitigation policy, the HFA, in insurance markets at the international level. The HFA promotes the awareness of disaster risk reduction and provides a sustainable development of risk mitigation management at the international and regional levels in an effort to reduce vulnerabilities and risks to hazards.

Our study extends Kahn's (2005) research and considers the effectiveness of governments' intervention in catastrophe risk management. Kahn (2005) identified several macroeconomic factors which may contribute to the number of deaths resulting from natural disasters within a country. He investigated the importance of a nation's income, geography, and democracy level in determining the number of deaths from natural disasters based on the data of 73 countries from 1980 to 2002. He found that nations with better economic development, less income inequality, and more democratic governments may suffer fewer deaths from natural disasters. We extend his research and evaluate macroeconomic factors, insurance market conditions, and level of the HFA participation in relation to human and monetary losses from natural disasters using panel data analysis. We further investigate how national determinants may influence the implementation of the HFA, and how the HFA efficiently improves catastrophe risk mitigation and decreases economic losses resulting from natural disasters. We employ a pooled ordinary least square (POLS) regression model and a zero-inflated negative binomial model used by Kahn (2005) to investigate the determinants of the number of deaths from natural disasters. For the natural disaster economic loss model, the HFA performance model, and the catastrophic risk mitigation model, we use three estimation models: the POLS model, a fixed effects model, and a random effects model with year effects. We do not employ a two-way fixed effect panel data model which includes both year and country dummy variables since certain macroeconomic variables (i.e., real GDP per capita, population, and land area) vary little (or not at all) and will capture the country effect.

Our initial sample is based on approximately 2,000 observations of 193 member states of the United Nations from 1993 to 2011. We are limited to data from 1993 to 2011 because the macroeconomic data from the World Bank are only available for those years. The sample is further reduced to 788 observations as we include the insurance market condition variables to our models.

This data is also available only from 1998 to 2011. The data for the number of deaths, the estimated economic losses (US dollars in the year of occurrence) from natural disasters over the period of 1993 to 2011 were collected directly from the EM-DAT Database created by the Centre for Research on the Epidemiology of Disasters (CRED). We converted the natural disaster economic losses to 2005 US dollars. Real GDP per capita (2005 US dollars), national income level, urban population, population density, and land area were collected from the World Bank database. Democracy level data were taken from the Polity IV: Regime Authority Characteristics and Transitions Datasets (Annual Time-Series 1800-2011) published by the Integrated Network for Societal Conflict Research (INSCR).[3] Data for insurance premiums and the market shares of world insurance markets were collected directly from the Swiss Re Sigma annual world insurance reports 1999 -2011.[4] The scores of the twenty-two HFA indicators were obtained from the Hyogo Progress Reports (2007-2009, 2009-2011, and 2011-2013), which are available on the Prevention Web.

Our results are as follows: (1) Table 1 shows that nations that did not submit any HFA progress reports with high urban population ratio, low population density, small land area, and sound insurance market conditions (high insurance density, penetration, and world market share) tend to suffer fewer deaths from natural disasters. Our results also show that rich nations with high urbanization may experience fewer losses of lives possibly due to the economies of scale in providing risk mitigation measures against natural disasters. (2) Table 2 shows that nations that submitted at least one of three available HFA progress reports with a well-developed economy, high urban population ratio, high population density, large land area, a democratic government, and sound insurance market conditions suffered more economic losses from natural disasters. These results might be caused by high property values of households in risk-prone areas and potential morale and moral hazard problems within insurance markets. In other words, developed countries (high income countries) tend to have higher economic losses from natural disasters in absolute values, (consistent with Cummins and Mahul (2009)). (3) Table 3 shows that rich nations with more democratic governments and better urban development may achieve better performance of the HFA. (4) Table 4 shows that nations with better performance of short-term mitigation measures do not necessarily reduce their economic losses from natural disasters immediately. We do not find evidence that the HFA performance in previous years efficiently improves a nation's economic losses from natural disasters. This may provide evidence that the short-term risk mitigation policies may not improve a nation's disaster losses immediately. Nations, therefore, should employ long-term risk mitigation measures to manage catastrophic risks due to the unpredictable nature of natural disasters.

[3] For more information, please visit http://www.systemicpeace.org/inscr/inscr.htm.
[4] The Swiss Re Sigma world insurance report in 1999 also includes the insurance data for 1998.

These national and insurance market factors may play a critical role in reducing the negative impacts of mega catastrophes or climate change and help both governments and international organizations in implementing adequate catastrophic risk mitigation strategies in the near future. Moreover, this study provides some insights about the Arrow-Lind Public Investment Theorem by showing that insurance market conditions are significantly related to a nation's natural disaster losses, and macroeconomic factors may be important to the evaluation of government involvement in catastrophic risk management, in addition to the policy of risk neutrality suggested by Arrow and Lind (1970). Our study may provide governments, regulatory agencies, and insurance companies with useful information related to climate change and natural disaster risk management and enhance the effectiveness of catastrophic risk policy enactment.

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AUTHORS' NOTE

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APPENDIX

TABLE 1

The Natural Disaster Death Model
United Nations 193 Countries 1993-2011
Zero-Inflated Negative Binomial Estimation
Dependent Variable: Number of Death from Natural Disasters

	Macroeconomic Factors				Total Insurance Market			Life Insurance Market			Non-life Insurance Market		
Independent Variables	**Model (1)**	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**	**Model (7)**	**Model (8)**	**Model (9)**	**Model (10)**	**Model (11)**	**Model (12)**	**Model (13)**
ln(GDP per capita) (2005 US dollars)	-3.71e-07**	5.30e-06*											
	(1.55e-07)	(2.87e-06)											
Developed Country (Binary Variable)			-0.2460	-0.3600	0.2570	0.1330	0.4880	0.5720	0.9230**	0.5130	0.0120	-0.3210	0.0922
			(0.2310)	(0.9230)	(0.3420)	(0.3780)	(0.4120)	(0.3620)	(0.3810)	(0.4330)	(0.3340)	(0.3630)	(0.4180)
HFA Country (Binary Variable)	0.3270**	0.3560***	-0.0717	-0.0692	0.4010*	0.5540**	0.6660***	0.4140*	0.5050**	0.3860*	0.4030*	0.6170***	0.6830***
	(0.1350)	(0.1360)	(0.1270)	(0.1290)	(0.2170)	(0.2280)	(0.2250)	(0.2120)	(0.2150)	(0.2330)	(0.2220)	(0.2380)	(0.2360)
Urban Population Ratio (%)	-0.0245***	-0.0226***	-0.0181***	-0.0182***	-0.0208***	-0.0098*	-0.0034	-0.0230***	-0.0180***	-0.0189***	-0.0230***	-0.0129**	-0.0061
	(0.0029)	(0.0031)	(0.0031)	(0.0033)	(0.0059)	(0.0055)	(0.0059)	(0.0056)	(0.0055)	(0.0061)	(0.0061)	(0.0058)	(0.0067)
ln(Population Density)	0.7780***	0.7840***	0.8320***	0.8300***	0.7060***	0.6350***	0.8570***	0.7260***	0.7240***	0.7780***	0.7170***	0.6440***	0.7430***
	(0.0649)	(0.0649)	(0.0730)	(0.0743)	(0.1110)	(0.1160)	(0.1370)	(0.1080)	(0.1110)	(0.1390)	(0.1140)	(0.1190)	(0.1400)
ln(Land Area)	0.7550***	0.7530***	0.7840***	0.7840***	0.8200***	0.8580***	1.1360***	0.8180***	0.8420***	0.9930***	0.8280***	0.8780***	1.0250***
	(0.0387)	(0.0386)	(0.0406)	(0.0407)	(0.0627)	(0.0692)	(0.1070)	(0.0622)	(0.0651)	(0.0933)	(0.0645)	(0.0735)	(0.1240)
Democracy Level	-0.0464***	-0.0464***	-0.0297***	-0.0297***	0.0209*	0.0307**	0.0329***	0.0234**	0.0344***	0.0261**	0.0175	0.0220	0.0272**
	(0.0042)	(0.0042)	(0.0038)	(0.0038)	(0.0123)	(0.0120)	(0.0115)	(0.0110)	(0.0091)	(0.0109)	(0.0135)	(0.0147)	(0.0132)
Africa (Binary Variable)	0.4030	0.3350	0.2780	0.2850	0.8800	1.6550***	1.5620**	0.9300	1.6580***	0.9230	0.8450	1.6990***	1.6240**
	(0.2670)	(0.2700)	(0.2860)	(0.2910)	(0.5770)	(0.6330)	(0.6280)	(0.5890)	(0.6310)	(0.6310)	(0.5780)	(0.6360)	(0.6320)
Asia (Binary Variable)	0.8980***	0.8350***	0.8650**	0.8760**	1.8810***	2.8090***	2.9370***	1.9270***	2.6040***	2.4610***	1.8870***	3.1320***	3.0100***
	(0.3110)	(0.3130)	(0.3400)	(0.3490)	(0.6330)	(0.7050)	(0.6960)	(0.6470)	(0.7050)	(0.6860)	(0.6320)	(0.7010)	(0.6940)
America (Binary Variable)	0.8570***	0.7700***	1.1970***	1.209***	0.8140	2.2090***	2.2660***	0.8570	1.7660***	0.8610	0.8310	2.3980***	2.4040***
	(0.2910)	(0.2940)	(0.3310)	(0.3440)	(0.6120)	(0.6750)	(0.6640)	(0.6220)	(0.6680)	(0.6190)	(0.6130)	(0.6770)	(0.6710)
Europe (Binary Variable)	1.4170***	1.3990***	0.9250***	0.9410**	2.3820***	3.0640***	3.3790***	2.2270***	2.490***	2.8610***	2.3470***	3.0520***	3.3540***
	(0.3370)	(0.3360)	(0.3570)	(0.3790)	(0.5690)	(0.5970)	(0.6010)	(0.5730)	(0.5970)	(0.5820)	(0.5750)	(0.6060)	(0.6270)
ln(GDP per capita)* Urban Population Ratio		-1.32e-07**											
		(6.50e-08)											
Developed Country* Urban Population Ratio				0.0015									
				(0.0119)									
ln(Insurance Density) (2005 US dollars)					-0.1750**			-0.1690***			-0.0947		
					(0.0745)			(0.0512)			(0.0881)		
ln(Insurance Penetration)						-0.4370***			-0.4410***			0.1470	
						(0.1560)			(0.0685)			(0.2100)	
ln(Market Share of World Insurance Market)							-0.3320***			-0.2250***			-0.1990
							(0.0977)			(0.0802)			(0.1300)
Constant	0.1820	0.1280	0.0314	0.0353	2.1390	-2.1070**	-5.9500***	1.7610	-2.3870***	-3.2520**	0.7320	-2.4980***	-4.4500***
	(0.3980)	(0.3990)	(0.4020)	(0.4030)	(1.5210)	(0.8410)	(1.3620)	(1.1420)	(0.8290)	(1.3330)	(1.7200)	(0.8730)	(1.5860)
Observations	1,763	1,763	1,924	1,924	787	796	796	787	796	661	787	796	797

1. Robust standard errors in parentheses
2. Significance Level: * significant at 10%; ** significant at 5%; *** significant at 1%
3. Developed Country variable is a binary variable which equals to one for developed countries. The classification of country development follows World bank's methodology. Countries with high income are classified as the developed countries; countries with low income, lower middle income, and upper middle income are classified as developing countries.
4.HFA Country is a binary variable which equals to one for countries submitting at least one of three available Hyogo Framework for Action (HFA) progress reports (HFA 2007-2009, HFA 2009-2011, and HFA 2011-2013).

TABLE 2

The Natural Disaster Loss Model
United Nations 193 Countries 1993-2011
Fixed Effects Regression Estimation (Year Effects)
Dependent Variable: ln(Natural Disaster Economic Losses + 1) (2005 US dollars)

	Macroeconomic Factors				Total Insurance Market			Life Insurance Market			Non-life Insurance Market		
Independent Variables	**Model (1)**	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**	**Model (7)**	**Model (8)**	**Model (9)**	**Model (10)**	**Model (11)**	**Model (12)**	**Model (13)**
ln(GDP per capita) (2005 US dollars)	1.4380***	1.9110***											
	(0.2400)	(0.5200)											
Developed Country (Binary Variable)			2.9740***	8.1430**	0.0496	1.6080	-0.0977	0.4190	1.6550	0.4470	0.2020	1.9460	-0.0825
			(0.6960)	(3.3100)	(1.2010)	(1.2300)	(1.4700)	(1.0850)	(1.0950)	(1.5280)	(1.1630)	(1.1710)	(1.4640)
HFA Country (Binary Variable)	1.0000**	1.0190**	0.9940**	1.1020***	0.4120	0.2740	0.2190	0.2780	0.1820	-0.5380	0.2790	0.0967	0.0518
	(0.4520)	(0.4540)	(0.3910)	(0.3730)	(0.8070)	(0.8280)	(0.8100)	(0.8130)	(0.8310)	(0.7950)	(0.8020)	(0.8210)	(0.8240)
Urban Population Ratio (%)	0.0223	0.0919*	0.0769***	0.0816***	-0.0233	0.0039	-0.0278	-0.0057	0.0136	-0.0111	-0.0305	-0.0020	-0.0383
	(0.0175)	(0.0477)	(0.0116)	(0.0114)	(0.0281)	(0.0246)	(0.0272)	(0.0252)	(0.0245)	(0.0250)	(0.0313)	(0.0269)	(0.0307)
ln(Population Density)	2.6730***	2.7160***	2.6730***	2.6800***	2.5240***	2.3480***	1.3440***	2.3180***	2.2080***	1.6120***	2.7350***	2.5840***	1.4220***
	(0.1810)	(0.1690)	(0.1840)	(0.1800)	(0.2840)	(0.2830)	(0.4000)	(0.2820)	(0.2810)	(0.3340)	(0.2940)	(0.3010)	(0.4120)
ln(Land Area)	2.0210***	2.0550***	1.9610***	1.9780***	2.3920***	2.2630***	1.2430***	2.2770***	2.1940***	1.6370***	2.5220***	2.4070***	1.2320***
	(0.0980)	(0.0973)	(0.1020)	(0.1020)	(0.2100)	(0.2080)	(0.3480)	(0.2080)	(0.2130)	(0.2820)	(0.2220)	(0.2080)	(0.3670)
Democracy Level	0.0372*	0.0371*	0.0437**	0.0420**	0.0900	0.09810	0.0848	0.0880	0.0971	0.0391	0.0964	0.1060	0.0910
	(0.0198)	(0.0200)	(0.0177)	(0.0174)	(0.0650)	(0.0703)	(0.0609)	(0.0660)	(0.0700)	(0.0765)	(0.0661)	(0.0725)	(0.0614)
ln(GDP per capita)* Urban Population Ratio		-0.0090											
		(0.0069)											
Developed Country* Urban Population Ratio				-0.0703									
				(0.0427)									
ln(Insurance Density) (2005 US dollars)					1.1090***			0.7500***			1.2150***		
					(0.2650)			(0.1440)			(0.3320)		
ln(Insurance Penetration)						1.3040**			0.7210***			1.4870*	
						(0.4700)			(0.1780)			(0.6870)	
ln(Market Share of World Insurance Market)							1.1410***			0.9140***			1.3180***
							(0.3360)			(0.2720)			(0.3910)
Constant	-22.0200***	-25.7500***	-13.8100***	-14.1900***	-28.1900***	-9.4370***	4.8590	-20.3500***	-7.7210**	1.6570	-30.3500***	-9.8970***	5.2970
	(0.9690)	(3.0470)	(1.1480)	(1.0730)	(5.0370)	(2.7060)	(4.9890)	(3.4810)	(2.7290)	(3.7790)	(5.8300)	(2.6930)	(5.5210)
Observations	1,765	1,765	1,794	1,794	788	787	787	788	787	657	788	787	788
R-squared	0.264	0.265	0.246	0.248	0.164	0.157	0.161	0.163	0.157	0.165	0.163	0.155	0.162
Number of Years	18	18	18	18	13	13	13	13	13	13	13	13	13

1. Robust standard errors in parentheses
2. Significance Level: * significant at 10%; ** significant at 5%; *** significant at 1%
3. Developed Country variable is a binary variable which equals to one for developed countries. The classification of country development follows World bank's methodology. Countries with high income are classified as the developed countries; countries with low income, lower middle income, and upper middle income are classified as developing countries.
4. HFA Country is a binary variable which equals to one for countries submitting at least one of three available Hyogo Framework for Action (HFA) progress reports (HFA 2007-2009, HFA 2009-2011, and HFA 2011-2013).

TABLE 3

The HFA Performance Model
United Nations 193 Countries 2007-2011
Fixed Effects Regression Estimation (Year Effects)
Dependent Variable: Hyogo Progress Report Performance (HFA) (score is out of 110)

	Macroeconomic Factors				Total Insurance Market			Life Insurance Market			Non-life Insurance Market		
Independent Variables	**Model (1)**	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**	**Model (7)**	**Model (8)**	**Model (9)**	**Model (10)**	**Model (11)**	**Model (12)**	**Model (13)**
ln(Natural Disaster Economic Losses+ 1) (2005 US dollars)													
(one year lagged value)	0.1770*	0.1890**	0.2030	0.2490**	-0.0710	-0.0290	-0.0602	-0.0491	-0.0232	0.1910**	-0.0817	-0.0334	-0.0702
	(0.0760)	(0.0591)	(0.1010)	(0.0855)	(0.1130)	(0.1100)	(0.1170)	(0.1040)	(0.1150)	(0.0438)	(0.1140)	(0.1100)	(0.1160)
ln(GDP per capita) (2005 US dollars)	-1.5830	-5.8660*											
	(0.8190)	(2.6920)											
Developed Country (Binary Variable)			-3.3430	-52.8200***	-2.5550	-7.0690	-0.9540	-7.0700	-8.3650	-12.3400	-1.3090	-7.1390	-0.9630
			(4.3360)	(11.4300)	(12.0200)	(6.0170)	(10.6400)	(12.2400)	(7.4830)	(13.1500)	(10.3400)	(4.4150)	(8.6610)
Urban Population Ratio (%)	0.1310**	-0.4600	0.0981*	0.0078	0.1390	0.0937	0.1450	0.1130	0.1240	0.2510	0.1820	0.1100	0.1750
	(0.0438)	(0.3690)	(0.0425)	(0.0533)	(0.1240)	(0.0741)	(0.1140)	(0.0923)	(0.0749)	(0.1470)	(0.1380)	(0.0813)	(0.1170)
ln(Population Density)	6.6730**	6.3490**	6.5170**	5.7430**	4.8620**	5.0680**	7.5400	4.9500**	4.7270*	4.1060	4.4940**	4.8950**	7.6970
	(1.8090)	(1.6620)	(1.6280)	(1.3630)	(1.4060)	(1.7950)	(4.1820)	(1.6090)	(1.9140)	(3.2710)	(1.2920)	(1.7020)	(3.7260)
ln(Land Area)	4.0510**	3.9650**	3.8150**	3.6450**	2.5850	2.7930	5.4040*	2.4650	2.4760	1.8630	2.3520	2.6670	5.6900**
	(1.2220)	(1.2380)	(1.0960)	(1.0480)	(1.6680)	(1.4860)	(2.0460)	(1.6340)	(1.4710)	(1.0770)	(1.7860)	(1.5590)	(1.7100)
Democracy Level	0.5850***	0.5610**	0.4970***	0.5140***	1.9960**	1.6530*	1.9580*	1.5330	1.2250	1.5560	2.0000*	1.6520	1.9170*
	(0.1220)	(0.1320)	(0.0978)	(0.0947)	(0.7010)	(0.7110)	(0.7390)	(0.7390)	(0.7160)	(0.9420)	(0.7300)	(0.7750)	(0.7790)
ln(GDP per capita)* Urban Population Ratio		0.0752											
		(0.0474)											
Developed Country* Urban Population Ratio				0.6890**									
				(0.2070)									
ln(Insurance Density) (2005 US dollars)					-2.3610			-0.2710			-3.3290		
					(3.4710)			(2.7080)			(3.3540)		
ln(Insurance Penetration)						-1.4390			0.5400			-2.5130	
						(3.4400)			(2.7830)			(2.2880)	
ln(Market Share of World Insurance Market)							-2.8800			-0.4900			-3.4580
							(3.0330)			(2.8850)			(2.7480)
Constant	-11.8000	21.4000	-21.6200	-13.9800	25.6900	-13.1300	-47.4500	-8.1680	-10.5300	-16.8700	41.4000	-13.3800	-50.9000
	(11.1100)	(17.3600)	(10.3900)	(9.0650)	(59.3600)	(12.4400)	(39.5900)	(44.7100)	(12.0900)	(32.4500)	(56.2900)	(12.5100)	(34.4000)
Observations	436	436	475	475	230	231	232	227	228	197	230	231	232
R-squared	0.097	0.103	0.099	0.118	0.051	0.044	0.050	0.036	0.033	0.044	0.053	0.045	0.051
Number of Years	5	5	5	5	5	5	5	5	5	5	5	5	5

1. Robust standard errors in parentheses
2. Significance Level: * significant at 10%; ** significant at 5%; *** significant at 1%

3. Developed Country variable is a binary variable which equals to one for developed countries. The classification of country development follows World bank's methodology. Countries with high income are classified as the developed countries; countries with low income, lower middle income, and upper middle income are classified as developing countries.

TABLE 4

Catastrophic Risk Mitigation Model
United Nations 193 Countries 2007-2011
Fixed Effects Regression Estimation (Year Effects)
Dependent Variable: ln(Natural Disaster Economic Losses + 1) (2005 US dollars)

	Macroeconomic Factors				Total Insurance Market			Life Insurance Market			Non-life Insurance Market		
Independent Variables	**Model (1)**	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**	**Model (7)**	**Model (8)**	**Model (9)**	**Model (10)**	**Model (11)**	**Model (12)**	**Model (13)**
Hyogo Progress Report Performance (HFA)													
(score is out of 110) (one year lagged value)	0.0223***	0.0223***	0.0231**	0.0233**	0.0479*	0.0512*	0.0479*	0.0460*	0.0489*	0.0464*	0.0480*	0.0510**	0.0481*
	(0.0034)	(0.0034)	(0.0050)	(0.0047)	(0.0176)	(0.0164)	(0.0177)	(0.0183)	(0.0173)	(0.0183)	(0.0176)	(0.0159)	(0.0176)
ln(GDP per capita) (2005 US dollars)	1.9120**	1.8560											
	(0.3950)	(0.8650)											
Developed Country (Binary Variable)			4.2740**	2.8240	2.5100	3.4390	2.7790	2.0140	2.9630	1.5600	3.0670	3.9660*	3.6500
			(1.2140)	(2.4860)	(1.9070)	(1.4870)	(1.8910)	(1.8240)	(1.5410)	(2.6980)	(1.7990)	(1.3670)	(1.7130)
Urban Population Ratio (%)	0.0038	-0.0036	0.0752**	0.0730*	0.0190	0.0404	0.0232	0.0273	0.0493	0.0213	0.0207	0.0406	0.0308
	(0.0299)	(0.0723)	(0.0223)	(0.0243)	(0.0529)	(0.0407)	(0.0504)	(0.0428)	(0.0366)	(0.0324)	(0.0628)	(0.0493)	(0.0588)
ln(Population Density)	2.7050***	2.6990***	2.6690***	2.6500***	2.9860***	2.9100***	2.3810*	2.8390***	2.7550**	2.1540*	3.0610***	2.9910***	2.6950**
	(0.2200)	(0.1990)	(0.2460)	(0.2570)	(0.3940)	(0.4480)	(0.7900)	(0.4550)	(0.4760)	(0.6910)	(0.3160)	(0.3410)	(0.8060)
ln(Land Area)	2.1350***	2.1310***	2.1190***	2.1020***	2.3820***	2.3500***	1.7670**	2.3140***	2.2780***	1.5780**	2.4340***	2.4020***	2.0810**
	(0.2060)	(0.1890)	(0.2100)	(0.2140)	(0.3190)	(0.2890)	(0.4330)	(0.3020)	(0.2710)	(0.4550)	(0.3340)	(0.2830)	(0.5420)
Democracy Level	0.0116	0.0112	0.0123	0.0122	-0.0860	-0.0932	-0.0830	-0.0990	-0.1050	-0.1120*	-0.0771	-0.0799	-0.0720
	(0.0676)	(0.0646)	(0.0675)	(0.0673)	(0.0549)	(0.0601)	(0.0549)	(0.0478)	(0.0521)	(0.0415)	(0.0626)	(0.0720)	(0.0651)
ln(GDP per capita)* Urban Population Ratio		0.0010											
		(0.0107)											
Developed Country* Urban Population Ratio				0.0204									
				(0.0416)									
ln(Insurance Density) (2005 US dollars)					0.6830			0.6720			0.5500		
					(0.4930)			(0.2890)			(0.6390)		
ln(Insurance Penetration)						0.8090			0.7230*			0.4110	
						(0.5740)			(0.2640)			(1.0470)	
ln(Market Share of World Insurance Market)							0.6060			0.9790			0.3180
							(0.4940)			(0.4730)			(0.5880)
Constant	-26.2400***	-25.8000**	-15.7000***	-15.4700***	-26.2400**	-15.2900**	-7.6230	-24.5800***	-13.7000*	-4.3180	-24.2300**	-15.4200**	-11.6000
	(1.6070)	(4.7480)	(2.4760)	(2.6220)	(6.1030)	(4.3660)	(9.2410)	(4.0950)	(4.6060)	(7.5280)	(7.4140)	(4.0220)	(10.3700)
Observations	438	438	445	445	238	237	238	238	237	210	238	237	238
R-squared	0.290	0.290	0.271	0.272	0.221	0.224	0.220	0.226	0.229	0.243	0.218	0.222	0.217
Number of Years	4	4	4	4	4	4	4	4	4	4	4	4	4

1. Robust standard errors in parentheses
2. Significance Level: * significant at 10%; ** significant at 5%; *** significant at 1%

3. Developed Country variable is a binary variable which equals to one for developed countries. The classification of country development follows World bank's methodology. Countries with high income are classified as the developed countries; countries with low income, lower middle income, and upper middle income are classified as developing countries.

TABLE 5

The HFA 22 Indicators

Priority	Description	Number of Indicators	Score
1	Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation	4	20
2	Identify, assess and monitor disaster risks and enhance early warning	4	20
3	Use knowledge, innovation and education to build a culture of safety and resilience at all levels	4	20
4	Reduce the underlying risk factors	6	30
5	Strengthen disaster preparedness for effective response at all levels	4	20
Total		22	110

THE HFA THREE STRATEGY GOALS, FIVE PRIORITIES AND TWENTY-TWO INDICATORS

Strategy 1: The integration of disaster risk reduction into sustainable development policies and practices.

Strategy 2: Development and strengthening of institutions, mechanisms and capacities to build resilience to hazards.

Strategy 3: The systematic incorporation of risk reduction approaches into the implementation of emergency preparedness, response and recovery programs.

Priority 1: Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.

Indicator1.1: National policy and legal framework for disaster risk reduction exists with decentralized responsibilities and capacities at all levels.

Indicator1.2: Dedicated and adequate resources are available to implement disaster risk reduction plans and activities at all administrative levels.

Indicator1.3: Community Participation and decentralization is ensured through the delegation of authority and resources to local levels.

Indicator 1.4: A national multi sectorial platform for disaster risk reduction is functioning.

Priority 2: Identify, assess and monitor disaster risks and enhance early warning.

Indicator 2.1: National and local risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors.

Indicator 2.2: Systems are in place to monitor, archive and disseminate data on key hazards and vulnerabilities.

Indicator 2.3: Early warning systems are in place for all major hazards, with outreach to communities.

Indicator 2.4: National and local risk assessments take account of regional / trans boundary risks, with a view to regional cooperation on risk reduction.

Priority 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels.

Indicator 3.1: Relevant information on disasters is available and accessible at all levels, to all stakeholders (through networks, development of information sharing systems etc.)

Indicator 3.2: School curricula, education material and relevant trainings include disaster risk reduction and recovery concepts and practices.

Indicator 3.3: Research methods and tools for multi-risk assessments and cost benefit analysis are developed and strengthened.

Indicator 3.4: Countrywide public awareness strategy exists to stimulate a culture of disaster resilience, with outreach to urban and rural communities.

Priority 4: Reduce the underlying risk factors.

Indicator 4.1: Disaster risk reduction is an integral objective of environment related policies and plans, including for land use natural resource management and adaptation to climate change.

Indicator 4.2: Social development policies and plans are being implemented to reduce the vulnerability of populations most at risk.

Indicator 4.3: Economic and productive sectorial policies and plans have been implemented to reduce the vulnerability of economic activities.

Indicator 4.4: Planning and management of human settlements incorporate disaster risk reduction elements, including enforcement of building codes.

Indicator 4.5: Disaster risk reduction measures are integrated into post disaster recovery and rehabilitation processes.

Indicator 4.6: Procedures are in place to assess the disaster risk impacts of major development projects, especially infrastructure.

Priority 5: Strengthen disaster preparedness for effective response at all levels.

Indicator 5.1: Strong policy, technical and institutional capacities and mechanisms for disaster risk management, with a disaster risk reduction perspective are in place.

Indicator 5.2: Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programs.

Indicator 5.3: Financial reserves and contingency mechanisms are in place to support effective response and recovery when required.

Indicator 5.4: Procedures are in place to exchange relevant information during hazard events and disasters, and to undertake post-event reviews