The Institute of Actuaries of Japan
The Great Tohoku Earthquake

ANNUAL MEETING 2011
CASUALTY ACTUARIAL SOCIETY

Agenda

1. The Great Tohoku Earthquake
   - Daisuke Nishihara, Swiss Reinsurance Company
2. Insurance Scheme for Earthquake
   - Yuki Nii, National Mutual Insurance Federation of Agricultural Cooperatives
3. Impacts of the Great Tohoku Earthquake on insurance companies
   - Masato Tomihari, Mitsui Sumitomo Insurance Co., Ltd

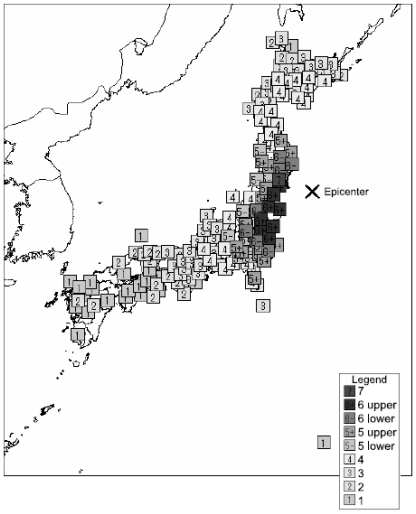
1. The Great Tohoku Earthquake

The Tohoku Earthquake

Earthquake summary

- Date and Time: 11 March 2011 14:46 JST
- Magnitude: 9.0 (the largest earthquake recorded in Japan)
- Epicenter: 130km off the Pacific coast of Tohoku region, 24km depth
- Seismic Intensity: 7 (Max) Kurihara City of Miyagi Prefecture by Japan Meteorological Agency
- Insurance Loss : USD 36bn (Financial Services Agency, Jul 19)
- Economic Loss : USD 211bn (Cabinet Office, Jun 24)

Note : USD @ JPY 80 is used through this presentation.



source : Japan Meteorological Agency
http://www.jma.go.jp/jma/en/News/2011_Earthquake_01.html

Largest Earthquakes in the World Since 1900

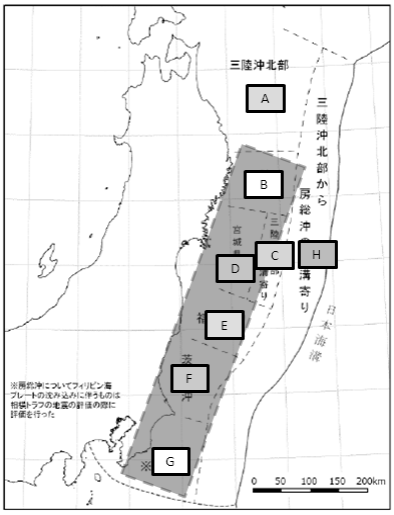
	Location	Date UTC	Magnitude
1	Chile	May 22 1960	9.5
2	Prince William Sound, Alaska	Mar 28 1964	9.2
3	Off the West Coast of Northern Sumatra	Dec 26 2004	9.1
4	**Near the East Coast of Honshu, Japan**	**Mar 11 2011**	**9.0**
5	Kamchatka	Nov 04 1952	9.0
6	Offshore Maule, Chile	Feb 27 2010	8.8
7	Off the Coast of Ecuador	Jan 31 1906	8.8
8	Rat Islands, Alaska	Feb 04 1965	8.7
9	Northern Sumatra, Indonesia	Mar 28 2005	8.6
10	Assam - Tibet	Aug 15 1950	8.6
11	Andreanof Islands, Alaska	Mar 09 1957	8.6
12	Southern Sumatra, Indonesia	Sep 12 2007	8.5
13	Banda Sea, Indonesia	Feb 01 1938	8.5
14	Kamchatka	Feb 03 1923	8.5
15	Chile-Argentina Border	Nov 11 1922	8.5
16	Kuril Islands	Oct 13 1963	8.5

source : USGS
http://earthquake.usgs.gov/earthquakes/world/10_largest_world.php

Government Prediction vs Tohoku EQ

Area	Predicted Magnitude		Chance of EQ within next 30 yrs	Average RP (yrs)
A	M8.0		0.5%-10%	97
C	M7.7	M8.0	80%-90%	105
D	M7.5		99%	37
E	M7.4		7%	400+
F	M6.7-M7.2		90%+	21
H	M8.2		4%-7%	400-750

- Government predicted a EQ combination with only 2 sources (e.g Area C & D)
- Tohoku EQ triggered EQ associated with 6 sources (Area B – G)



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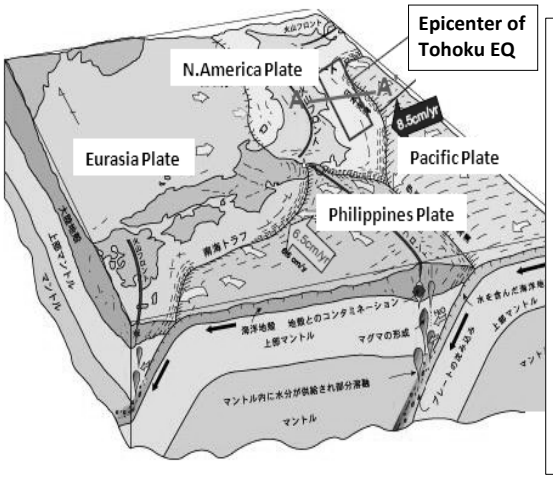
Plates surrounding Japan Islands



- Pacific plate moves 8.5 cm / year to North America Plate.
- Philippines Plate moves 6.5cm / year towards Eurasia Plate.
- Thus, frequent EQ sources are
  - Boundary of Pacific Plate and North America Plate
  - Boundary of Philippines Plate and Eurasia Plate

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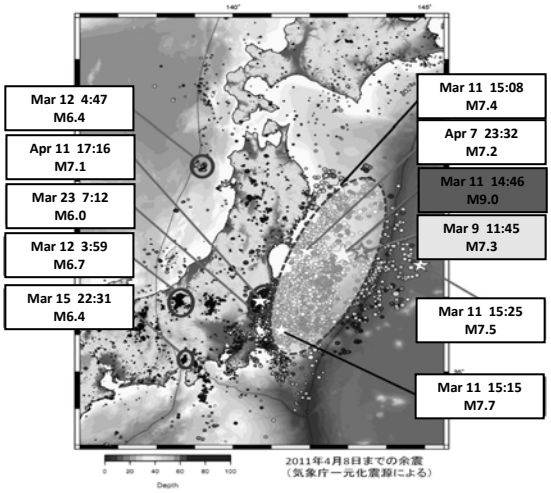
Following events

- Aftershocks
- Tsunami
- Liquefaction

The events affected

- Supply chain globally
- Nuclear power plants in Fukushima

Aftershocks



- Aftershocks of Tohoku Earthquake had been very active.
- Until 16 March, the aftershocks larger than magnitude 7.0 occurred 4 times, and those larger than 6.0 occurred 48 times.
- The largest aftershock occurred at 15:25 JST, 11 March (magnitude 7.5).
- The aftershocks have occurred in the large area off the coast of Iwate, Miyagi, Fukushima, and Ibaraki Prefectures.
- Compared to past cases, the activity of aftershocks is very high.

source : Japan Meteorological Agency
http://www.jma.go.jp/jma/en/News/2011_Earthquake_04.html

Large EQs Trigger Another EQs

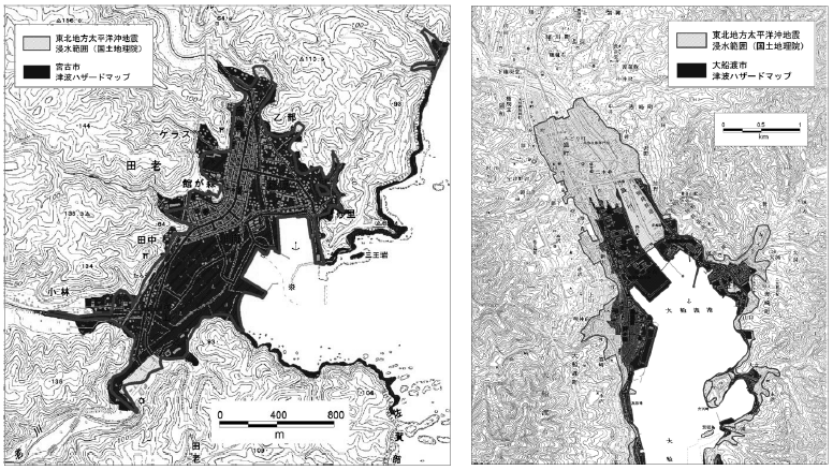
- Historically it is known that another earthquake occurs, once large earthquake happens. For example,

  In Japan;
  - Tokai EQ (M8.4) in 1854 and Nankai EQ (M8.4) in 32 hours
  - Tonankai EQ (M7.9) in 1944 and Nankai EQ (M8.0) in 1946

  In Indonesia;
  - Sumatora EQ (M9.1) in Dec 2004 and Nias Iland EQ (M8.4) in following March

  In New Zealand;
  - Cunterbury(NZ) EQ (M7.3) in Sep 2010 and Christchurch (M6.3) in following February

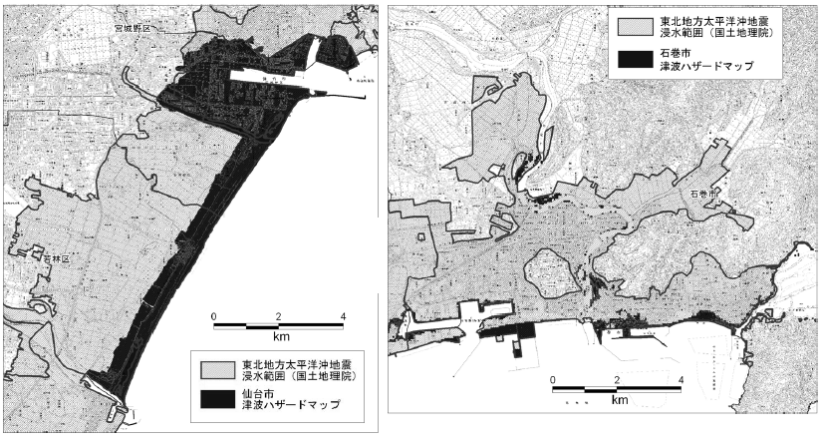
Tsunami Warning (Hazard Map 1)



Blue area : City office estimate
Red Area : Actual inundated are

Source : Cabinet Office, Government of Japan
http://www.bousai.go.jp/jishin/chubou/higashinihon/7/4.pdf

Tsunami Warning (Hazard Map 2)



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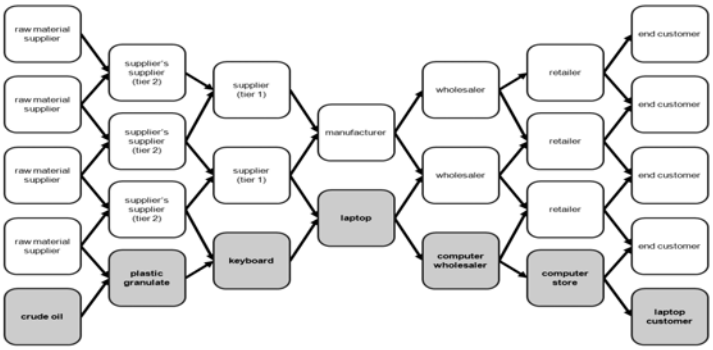
EQ impacted on complex supply chain

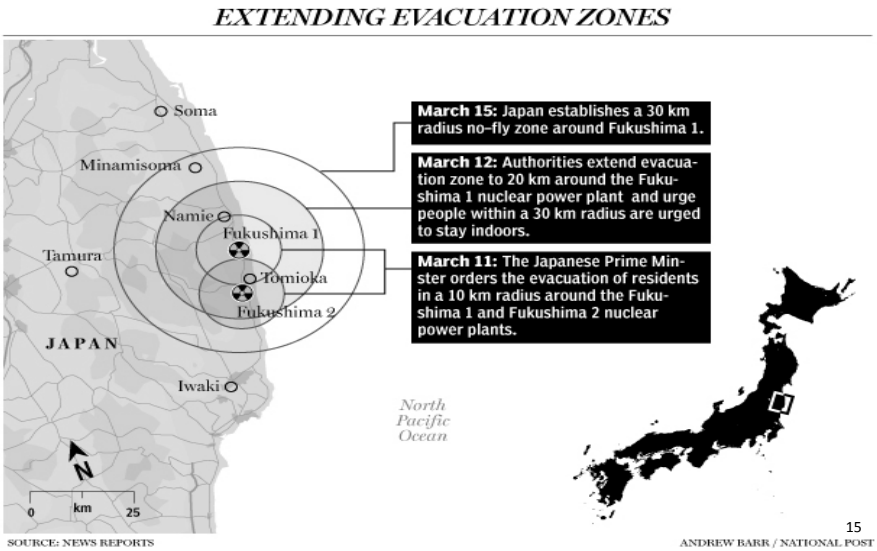


NY Times (March 17 2011)

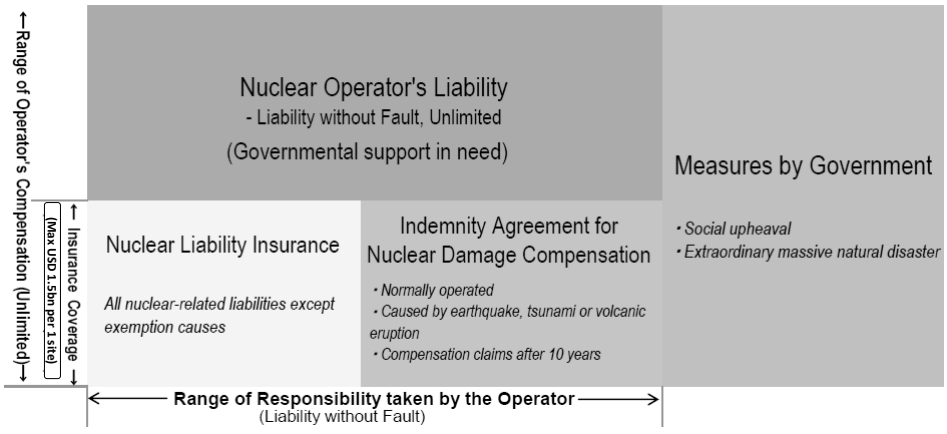
- " General Motors said Thursday that it would temporarily shut a truck plant in Louisiana because it could not get enough Japanese-made parts"
- "At Volvo, for example, about 10 percent of the parts come from 33 Japanese suppliers, seven of which were in the catastrophe area, including one on the edge of the nuclear security zone"

Source : NY Times
http://www.nytimes.com/2011/03/18/business/global/18auto.html

Evacuation Map around Fukushima NPP



Compensation scheme



(source) : TEPCO
http://www.tepco.co.jp/en/corpinfo/ir/tool/presen/pdf/110426setsu-e.pdf

Summary

- Tohoku Great Earthquake was unprecedented event in terms of size as well as following events caused.
- Following new/unusual events were
  - Aftershocks
  - Tsunami
  - Liquefaction
  - Damage to complex supply chain
  - Nuclear power plant accidents
  - Blackout / Power shortage
- Even scientists nor government was not able to predict this chain of events caused by the EQ.
  - 6 EQ sources were triggered against an estimate of 2 sources
  - Tsunami hazard maps
- The study of EQ (natural catastrophe) is a never-ending area, thus, continuous and further analysis is required for future.

2. Insurance Scheme for Earthquake

Focusing on Personal Lines

Main Products (1)

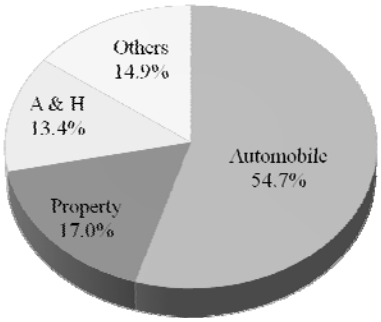
- Insurance for Automobile
  - Compulsory Automobile Liability Insurance (CALI)
  - Voluntary Automobile Insurance
- Insurance for Household
  - Fire Insurance
  - Residential Earthquake Insurance
- Insurance for Accident & Health
  - Personal Accident Insurance

Main Products (2)

Product	Coverage	EQ Risk(*1)
CALI	Bodily injury liability (Compulsory)	
Voluntary Automobile	Bodily injury, Physical damage, Personal accident, Own damage, etc	excluded(*2)
Fire	Physical damage to own building and its contents caused by fire, wind storm, flood, etc	excluded(*3)
Residential Earthquake	Physical damage to own building for residential use and its household goods caused by earthquake shock & fire, tsunami and volcanic eruption (Attached to fire insurance)	covered
Personal Accident	Personal accident	excluded(*2)

(*1) Including earthquake shock & fire, tsunami and volcanic eruption
(*2) EQ extension rider: full indemnity
(*3) EQ extension rider for non-residential use: reduced indemnity
Extra expenses coverage for residential use: fire caused by earthquake, 5% of sum insured

Gross Written Premiums by Line of Business

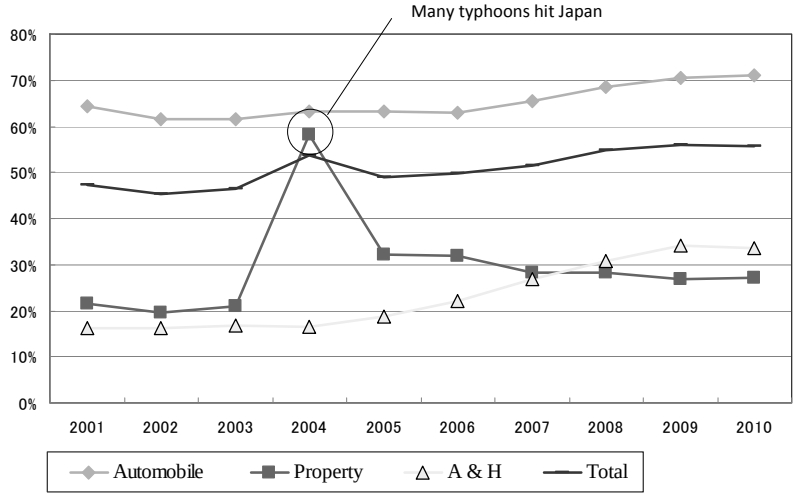


(In US$ billion)

Category	Business	Premiums	
			Share
Automobile	CALI	100.8	10.4%
	Voluntary Auto	428.9	44.3%
Property	Fire	146.5	15.1%
	Residential EQ	18.0	1.9%
A & H	Personal Accident	130.0	13.4%
Others	Marine and Inland Transit	32.2	3.3%
	Miscellaneous Casualty	112.1	11.6%
Total		968.5	100.0%

* all figures are for FY 2010 (the Japanese insurance companies)
(The fiscal year in Japan begins on April 1 and ends on March 31 of the next year)

Loss Ratios by Line of Main Business



* FY 2001 -- 2010 (the Japanese insurance companies)
* *Loss Ratio : “gross paid claims” / “gross written premiums”

NLIRO

- Non-Life Insurance Rating Organization of Japan (NLIRO)
  - Established under '' The Law Concerning Non-Life Insurance Rating Organizations ''
  - Non-profit private organization
  - Supervised by FSA (Financial Services Agency)
  - Calculating premium rates

Residential Earthquake Insurance

Product	Coverage	EQ Risk(*1)
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Difficulties of Making Seismic Risk Insurable

- Law of Large Numbers is not applicable
- Possibility of huge accumulation of losses
  - Wide area is possibly under risk simultaneously
  - The number of big cities has increased
- Uneven distribution of seismic risk
  - Possibility of the occurrence in any region of Japan
  - On the Pacific side, huge EQ experience in past, repeatedly

⇨It took a long time to establish EQ insurance system

Residential EQ Insurance System

- Established in 1966 with Niigata EQ in 1964 as a turning point
- For contribution to the stabilization of the lives of the suffered people
- Operated jointly by Government and companies
  - Premium rates are required to be as low as possible while maintaining equilibrium between income and expenses
  - Reinsurance contracts are underwritten by Government
  - The total amount of paid premiums, excluding necessary expenses for contracts, is accrued as fund reserved

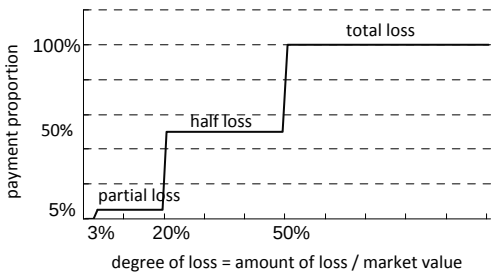
Product (1)

Coverage of insurance	Building for residential use and its household goods
Incident	Attached to fire insurance automatically(*1)
Insured amount	(1) Within a range of 30% to 50% of the insured amount for fire insurance (2) Cover Limit Building: US$ 625 thousand Household Goods : US$ 125 thousand
Policy term	1 year (*2)
Insured events	Earthquake, Tsunami and Volcanic eruption
Limit of total amount of insured risks	US$ 68.75 billion per insured event

(*1) Policyholders can exclude the earthquake risk by explicitly showing their intent in the application forms

(*2) On the certain conditions, less than 1 year contract or more than 1 year contract is available

Product (2)

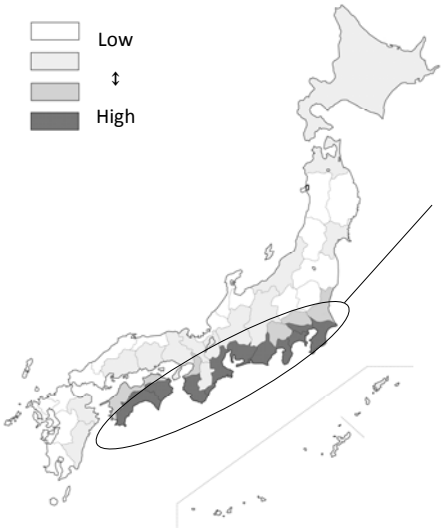
Scheduled payment	Total loss: 100% of the insured amount Half loss: 50% of the insured amount Partial loss: 5% of the insured amount *Payment proportion for building 

Premium Rates

- Standard full rates provided by NLIRO
  - Breakeven

    Premium Rates = Risk Premium Rates + Loading Cost Rates - Cumulative Balance of Income and Expenditure - Cumulative Investment Return
  - Apply to all insurance companies
- Calculated based on the risk factors:
  - Locations
  - Wooden/Non wooden structure

Premium Rates by prefectures (As of Jan 1, 2010)



Large-scale EQs are anticipated

Expected Paid Loss (In US$ billion)

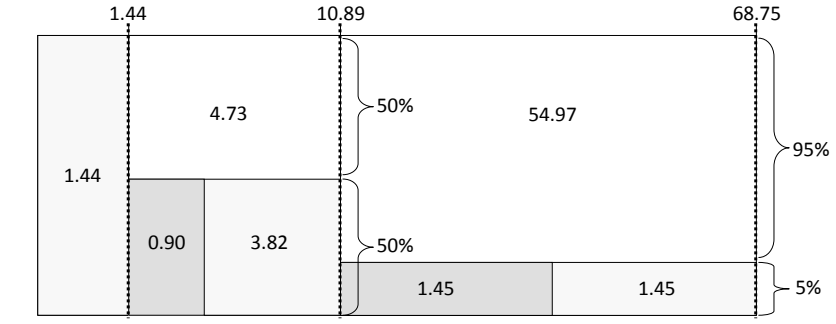
Tokyo Inland EQ : 37.5

Tokai, Tonankai and Nankai EQ : 52.5

By NLIRO

XoL Reinsurance by Government (As of May 2, 2011)

(In US$ billion)

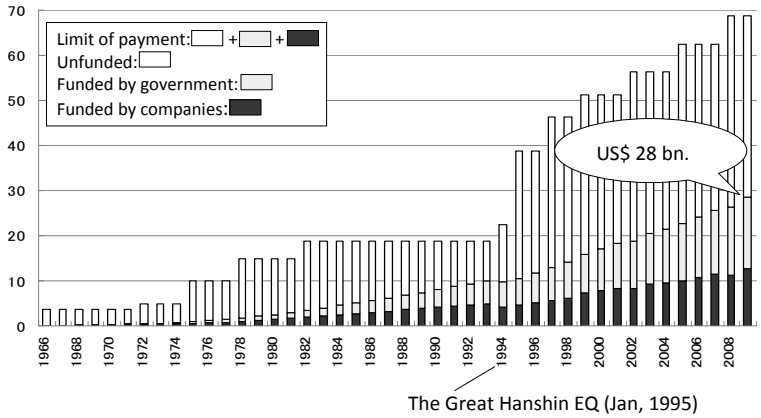


Government
Insurance Companies
Japan Earthquake Reinsurance Co., LTD
(Specific company which deals with earthquake reinsurance only)

Fund Reserved

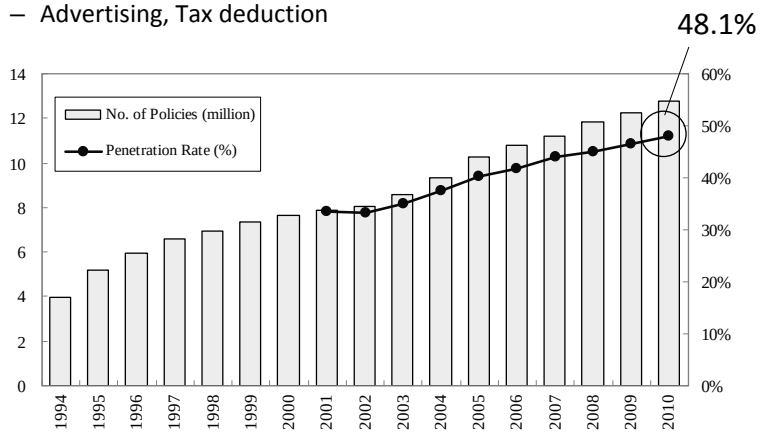
- Increasing fund: around US$ 30 billion
  - Increase of policies (especially after the Great Hanshin EQ)

(In US$ billion)



Penetration Rate

- Half of the fire insurance policyholders engaged
  - Advertising, Tax deduction



*Penetration Rate (for dwelling houses)

= "the number of residential EQ insurance policies" / "the total number of fire insurance policies"

The Top 10 Paid Losses(As of Aug 3, 2011)

(In US$ billion)

⇨ Residential EQ insurance has been useful in many regions

Other EQ Coverage

Product	Coverage	EQ Risk(*1)
CALI	Bodily injury liability (Compulsory)	
Voluntary Automobile	Bodily injury, Physical damage, Personal accident, Own damage, etc	excluded(*2)
Fire	Physical damage to own building and its contents caused by fire, wind storm, flood, etc	excluded(*3)
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Products

Product	Object		Coverage
Fire	Building Contents	For Residential Use	5% of sum insured, in the case of fire caused by EQ etc
		For Non-Residential Use	By the EQ extension rider, reduced indemnity
Voluntary Automobile	Vehicle		By the EQ extension rider, full indemnity
Personal Accident	People		By the EQ extension rider, full indemnity

- Provided only by private companies
  - Companies are not willing to underwrite these riders because of the characteristics of EQ risk

Trend after the Great Tohoku EQ

- Increasing demand for vehicles' EQ coverage
  - Many vehicles were totally damaged by the tsunami
  - But few of them had EQ coverage

Comparison

- Cooperative
  - Non-profit private organization
  - Established voluntarily by a group of people who desire to improve their lives
    - small and medium-sized enterprises and their employees
    - people engaged in the agriculture, forestry, and fisheries industries, etc
  - Providing various kinds of insurance for the members
- EQ coverage by cooperatives
  - Mainly for households
  - Limited insured amount
    - 50% of the insured amount for fire insurance, etc
  - Provided only by cooperatives

Summary

- Residential EQ insurance
  - The purpose is to contribute to the stabilization of the lives of the suffered people
  - The insured amount is limited, but residential EQ insurance is needed by many people
  - The residential EQ insurance system has been operated jointly by Government and companies

⇨ We need to maintain the residential EQ insurance system stably over the long term

- Other EQ coverage by insurance companies
  - Companies are not willing to underwrite the EQ extension riders because of the characteristics of EQ risk
  - Demand for vehicles' EQ coverage increased after the Great Tohoku EQ
  - How to respond to this demand is a challenge for insurance companies

⇨ As in the residential EQ insurance, the concept of "For contribution to the stabilization of the lives of the suffered people" will become one of solutions

3. Impacts of the Great Tohoku Earthquake on insurance companies

Impacts on operations

- The number of claims on residential EQ insurance :

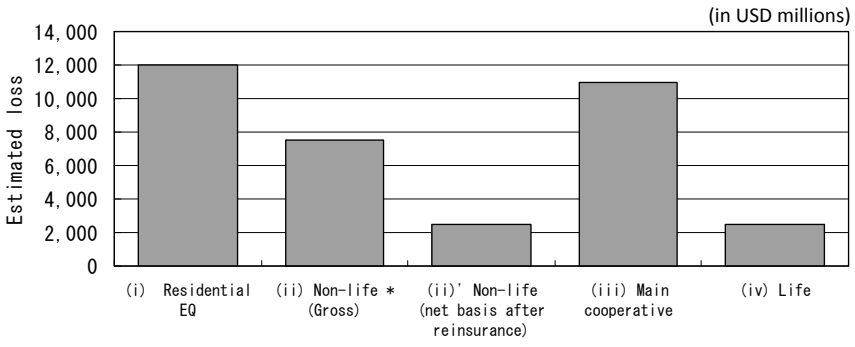
  Around 820,000

  (as at October 12, by the General Insurance Association of Japan)

  →Estimation of the total number of claims : 1,000,000
- Temporary re-allocation of the staff
- Automatic full amount settlement in severely damaged areas by using Aerial photos and Satellite photos
- In some cases, dispense with adjuster's survey

Financial impacts (1) : loss

- Losses in the Great Tohoku earthquake



* Non-life insurance other than residential EQ insurance

(Source: Financial Services Agency of Japan)

(Note) the figures are estimated in April in each company)

Financial impacts (2)

: Comparison of losses with the natural disasters in the world

- The 10 most costly losses 1970-2009 + the Great Tohoku EQ

Insured loss (in USD millions, indexed to 2009)	Victims	Date	Event	Country
71,163	1,836	25.08.2005	Hurricane Katrina	US
33,750	**19,670**	**11.03.2011**	**Great Tohoku earthquake**	**Japan**
24,479	43	23.08.1992	Hurricane Andrew	US,Bahamas
22,767	2,982	11.09.2001	Terror attack on WTC and others	US
20,276	61	17.01.1994	Northridge earthquake	US
19,940	136	06.09.2008	Hurricane Ike	US,Caribbean et al
14,642	124	02.09.2004	Hurricane Ivan	US,Caribbean et al
13,807	35	19.10.2005	Hurricane Wilma	US,Mexico at al
11,089	34	20.09.2005	Hurricane Rita	US,Gulf of Mexico,Cuba
9,148	24	11.08.2004	Hurricane Charley	US,Cuba,Jammaica et al
8,899	51	15.09.1989	Typhoon Mireille/NO.19	Japan
…				
3,482	6,425	17.01.1995	Great Hanshin earthquake in Kobe	Japan

* The data of the disasters except Great Tohoku EQ :
  from Swiss Re "sigma No.1/2010 natural catastrophe and man-made disasters in2009"
* Insured loss of Great Tohoku EQ: the amount as of July 19 by Financial Services Agency of Japan
* Victims of the Great Tohoku EQ: as of December 17 by National Police Agency of Japan

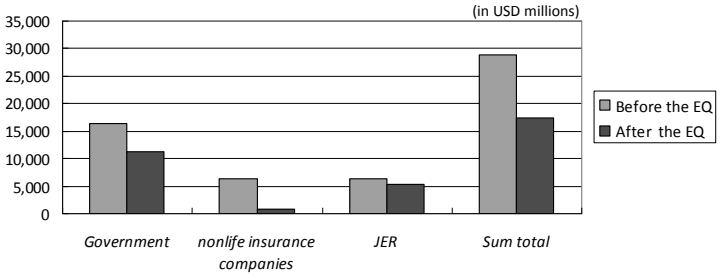
Financial impacts (3) : impacts by residential EQ insurance (i)

- In this earthquake, the losses are covered by reserves.

  ⇒ With regard to residential EQ insurance, there is no direct financial impact.

- In the meantime, reserves are reduced to a half.

<Changes of the reserves for residential EQ insurance>



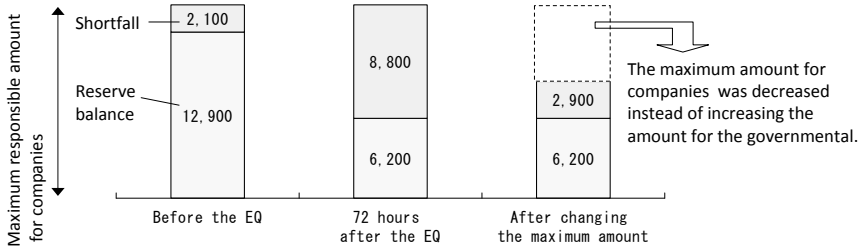
* As of June 21, by the General Insurance Association of Japan and JER Co.

Financial impacts (3) : impacts by residential EQ insurance (ii)

- The reserve balance has fallen short of the maximum responsible amount borne by the insurance companies for a single EQ event.
  - By changing the maximum amount between the government and the insurance companies, the companies' burden has significantly been released.

(note) The EQ which occurred within 72 hours after the time of occurrence of the original EQ is regarded as the same EQ, and the same limit is applied.

<Changes of the shortfall of reserves for residential EQ insurance> (in USD millions)



* As of June 21, by the General Insurance Association of Japan and JER Co.

Financial impacts (4)

: impacts by Insurances other than residential EQ insurance

- The earthquake occurred on March 11, most of the payments had not been made by the end of March (the fiscal year end in Japan).
  →Most of the claims had outstanding loss reserve.
- Gross loss of 7.5 billion dollars and net loss of 2.5 billion dollars indicates large amount of reinsurance recoveries.
- The loss ratio goes up by 3% temporarily.
  (2.5 billion divided by 74 billion*)

* the total net premium of top5 companies with large incomes of premium in FY2010

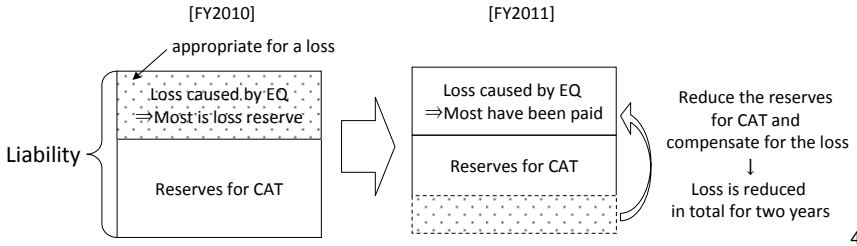
Financial impacts (5)

: effect of equalization reserve of Insurances other than residential EQ insurance

- Japanese companies have been maintaining appropriate equalization reserves as liabilities on the BS , a kind of pre-event CAT loss reserve.

  If the loss ratio exceeds the threshold, the reserve could be withdrawn.

  Therefore, it is supposed that certain amount of loss would be compensated in fiscal year 2011.



Financial impacts (6) : solvency margin ratio (i)

- Solvency margin ratio is calculated by the following formula in the Japanese regulatory system.

$$\text{The solvency margin ratio} = \frac{\text{The total amount of solvency margin}}{1/2 \times \text{The total amount of risks}}$$

- 200% is required as minimum standard for sound business operation.
- The ratios of the most of the companies are over 500% in FY2010.
- “The total amount of solvency margin” includes CAT loss reserves.
- “The total amount of risks” includes CAT risk.

Financial impacts (6)：solvency margin ratio (ii)

- Since most of the payment of residential EQ insurance is completed,

  the reserves is reduced in FY2011.

  - It is presumed that the solvency margin would be reduced by 6.3 billion dollars or more among the all Japanese companies.

- Even with the reduction, the SM ratio will range in a financially sustainable and sound level.

<The solvency margin ratio of sum total of top five companies>

(in USD millions)

	FY2010	FY2011
(A)Total amount of solvency margin	108,785	102,535
(B)Total amount of risks	38,780	38,780
(C)Solvency margin ratio [(A)/{(B)×1/2}]	**561.0%**	**528.8%**

Assumed that the solvency margin is reduced by 6.3 billion dollars and the amount of risks stays at the same level.

Issues (1): CAT risk management

- This time, there was little serious impact on the SM ratio of the Japanese insurance companies.

  CAT risk still accounts for large part of “The total amount of risks ”.

  - The amount of CAT risk accounts for 30% of “The total amount of risks”.

  * By the amount of risks of major five companies in FY2010 based on the calculation method of the solvency margin system.

- In case big earthquakes occur successively, it would be much larger impacts on insurance companies’ financial status.
- It is presumed that the cover ratio of EQ risk in the stricken area was not high this time.

  ⇔However, the demand for the insurance coverage for EQ risks including automobile insurance has been expanded.

Issues(2): The calculation of CAT risk in SM system

- "Earthquake risk" and "Typhoon risk" are calculated and the larger one is taken as the amount of CAT risk.
- The calculation method of EQ risk for fire insurance (not including residential EQ)
  - Based on the theoretical distribution model or engineering model
  - The return period: 200 years return
- The present model cannot take tsunami into consideration.
- The technique is used industry-wide.
  - ⇒ It is desirable to develop the following models:
    - ・Exploiting CAT risk models using engineering technique
    - ・Building internal models with more reflection of the portfolio of each company

Summary

- The financial impact caused is limited by the following reasons.
  - The EQ insurance system and its reserve functioned.
  - Other than residential EQ , most of losses are covered by reinsurance.
  - Tohoku is the area where the cover ratio was not high
- Meanwhile, the following issues were raised.
  - The demand for insurance coverage for earthquake risk is expanded.
  - We are anxious about a next larger event.
  - SM ratio went down by certain points and reinsurance rate hike is expected.

⇒It is called for that we develop the more efficient risk-measurement techniques and meet the demands for earthquake coverage.