AIG総研

# "Society 5.0" and parametric insurance clearing a path to "risk transfer" for catastrophic disasters

Kazuya Hattori, Executive Fellow, AIG Institute

*NOTICE: This represents an English translation of an original report released in Japanese by the AIG Institute on September 28, 2018. In the event that there are any inconsistencies between the Japanese version and the English one, the Japanese version shall control and supersede the substance of the English translated version.*

Parametric insurance is highlighted outside Japan in relation to the sophistication of micro-insurance or advanced risk models in developing countries as a part of the United Nations' Sustainable Development Goals (SDGs). By reviewing this insurance from the perspectives of "Society 5.0", an initiative run by the Japanese Government, and "risk transfer" categorized based on the financial regulation structure by function or by cross-function described in the interim report of the Financial Service Agency's Financial System Council (June, 2018), a new path of risk transfer to help ourselves to be prepared for catastrophic disasters such as the Nankai Trough earthquake or the Tokyo near-field earthquake will become more visible.

(See https://ig.ft.com/sites/japan-tsunami/ for the Nankai Trough earthquake)

## I Overview and trend of parametric insurance

In parametric insurance, claims will be paid based on indexes such as rainfall or seismic intensity measured by independent organizations. This insurance schema does not directly aim at compensation for losses which is a function of the traditional general insurance business. There is a strong resemblance between this insurance and weather derivatives developed in the 1990s. The table below shows a comparison between parametric insurance and conventional insurance, referring to agricultural insurance as an example.

Parametric insurance does not require an onsite loss assessment, which can largely reduce the length of time required for the claim payment to be made. This is also regarded as a contribution to the resolution of common challenges around insurance such as moral hazard, asymmetry of information, and adverse selection, for example. For the claim payment process, concerns with non-payment of claims payable can be drastically mitigated. Therefore, transparency between insurance companies and their policyholders can be enhanced.

AIG総研

| | Conventional insurance | Parametric insurance |
|---|---|---|
| Covered risks | Multiple perils such as hail, storm, etc. (except for excluded perils) | Only risks specified in insurance policy |
| Underwriting information | Crop loss history, locations, planted area | Historical weather data / crop loss history / production, observation stations for data collection |
| Criteria for claim payment | Actual loss amount | Weather data |
| Adverse selection | High | Low |
| Moral hazard | High | Low |
| Basis risk | Nothing to low | Mid to high |
| Transparency of risk from perspectives of investors such as shareholders | Risks underwritten by insurance companies must be understood. | Risks are easily understood due to high transparency and objectivity |

Fig. 1 Comparison between conventional insurance and parametric insurance[1]

※ "Parametric insurance" is referred to as a general name, but it is not intended to be positioned as insurance products domestically offered by insurance companies.

Also, due to the uniqueness of this insurance, the possibility of leveraging the payment for disaster-preparedness or loss prevention has been suggested lately. However, in parametric insurance, a claim will be paid based on criteria such as rainfall or seismic intensity, and therefore, gaps will be formed between actual loss amounts and paid amounts. This gap is called a basis risk, and either overpayment or underpayment would be possible. Considering this, the interrelation between the index and losses should be examined to design better insurance with lowered basis risk. This point will be a significant challenge from the viewpoint of policyholder protection, and the basis risk should be fully explained to policyholders in order to obtain their agreement. In the particular case of potential underpayment of a claim, it will be another important point to propose methodologies for risk mitigation/business continuity and to encourage policyholders to engage themselves.

The International Association of Insurance Supervisors (IAIS) published a report on parametric insurance in June, 2018[2]. The report identifies challenges for an insurance supervising organization to protect consumers and considerations for pilot projects based on differences of functions and roles between parametric insurance and conventional insurance. In the same month, the Association of Insurance and Risk Managers in Industry and Commerce (AIRMIC) also released a report for risk managers in enterprises[3]. Insurance companies are very active in developing products. For example, Syndicates or Coverholders (companies or partnerships authorized by a

Managing Agent to enter into insurance contracts to be underwritten by the members of a syndicate) of Lloyd's of London started offering parametric insurance to cover damage caused by unusual weather. In the United States, it has been reported that sales of parametric insurance started in Florida. According to an article about the Southeast Asia Disaster Risk Insurance Facility (SEADRIF) reported by Nikkei Newspaper in May this year, it is implied that parametric type of financing for initiatives to provide funds for disaster recovery is under review.[4]

With this as a background, I now would like to share my view on parametric insurance from the perspective of "reinforced functions for resilient disaster prevention and mitigation" as indicated in the Cross-ministerial Strategic Innovation Promotion Program (SIP) by the Japanese Government advocating "Society 5.0" for anti-disaster preparation.

## Ⅱ "Society 5.0" and earthquake risk in Japan

In the initiative for "Reinforced functions for resilient disaster prevention and mitigation", a framework to share estimated damage caused by earthquakes with both public and private sectors in real-time is under development. The estimation will be made on a level of individual streets and buildings, and it is targeted to be completed by the end of 2018. The Real-time Earthquake and Disaster Information Consortium has organized the Hazard Risk Experiment Consortium to reflect the achievement in public use.

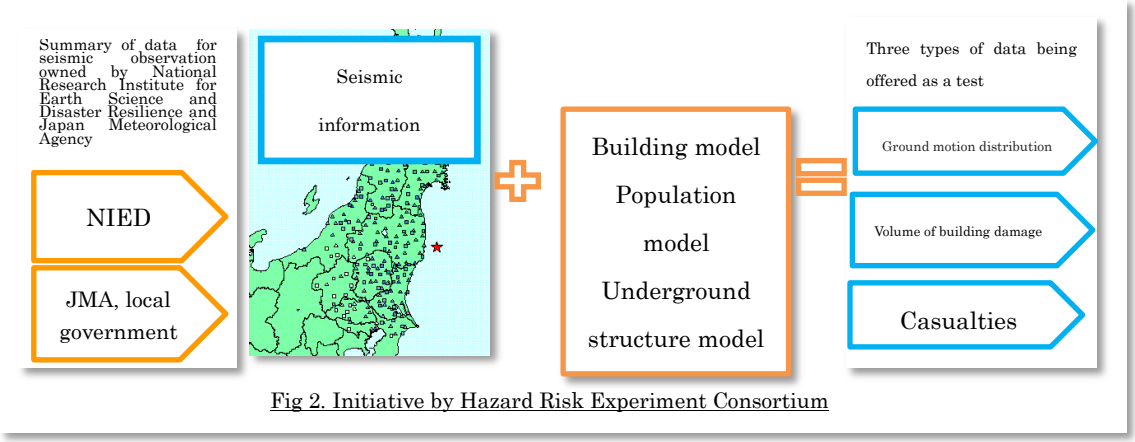


Fig 2. Initiative by Hazard Risk Experiment Consortium

A network of around 1,700 observation sites that the National Research Institute for Earth Science and Disaster Resilience (NIED) has all over Japan, and the observation networks of the Japan Meteorological Agency (JMA) and local governments are utilized for seismic observation, and the consortium provides detailed data on the city/town/village level or by 250 square meters to companies that participate in the

AIG総研

proof-of-concept test so that they can understand seismic motion distribution, damage to buildings, casualties, and so on.

At 07:58 a.m. on June 18, 2018, an earthquake occurred in the northern area of Osaka prefecture, and at 08:10 a.m., twelve minutes after the earthquake, the estimated damage was reported to the consortium. Fig. 3 shows the estimated seismic intensity map which was provided at that time. Fig. 4 compares the number of buildings fully- and half-destroyed as indicated by one of the damage functions and the number of damaged buildings announced by Osaka prefecture on August 8. In the SIP, eight damage functions were used, and the estimates were significantly different from function to function. Fig. 4, again, shows a comparison between the data of a function that estimated the damage closest to the actual results and the number of damaged buildings published so far. The SIP is trying to break down their damage estimation into the building level, and if this data can be incorporated into parametric insurance, then, as stated in the section I, basis risk can be mitigated.

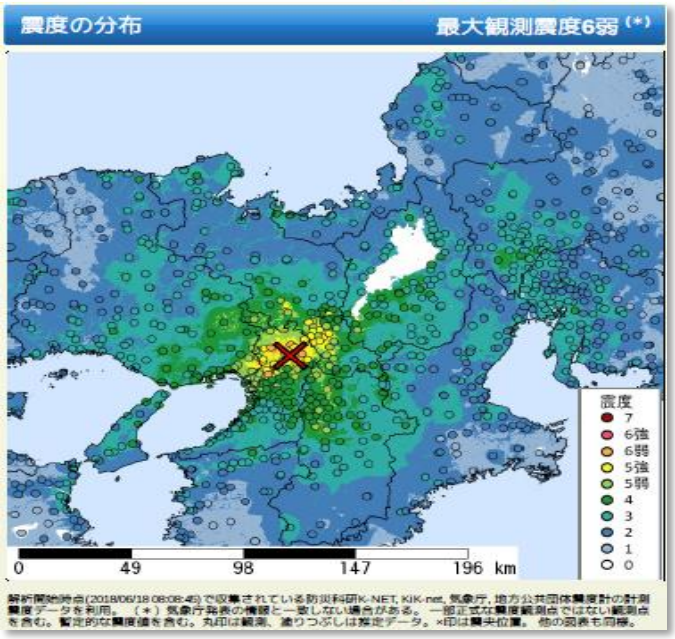


Fig. 3 Seismic intensity map of Northern Osaka Earthquake[5]

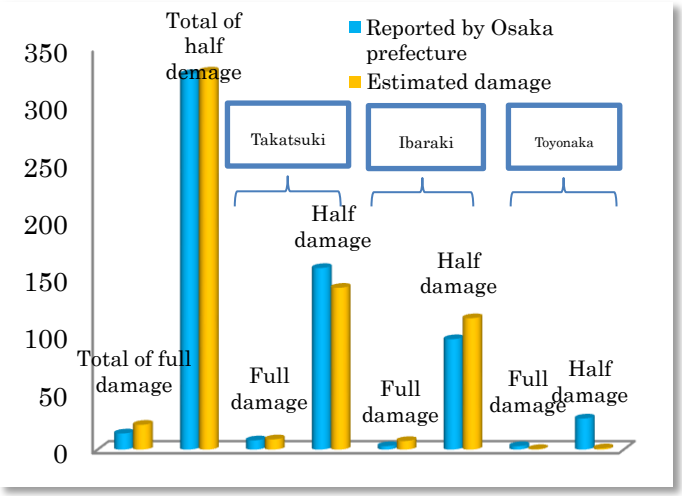


Fig. 4 Comparison between estimated damage and actual damage announced by Osaka

## Ⅲ Mitigation of basis risk in parametric insurance, acceleration of restoration

Thus far, a parametric-type of earthquake risk transfer has been focusing on cases with triggers of the magnitude or the seismic intensity only. In the case of a CAT bond for Oriental Land Co., Ltd. that operates and manages the Tokyo Disney Resort (Fig. 5), which is categorized as an EQ derivative, the magnitude is defined as a trigger, and the

AIG総研

distance from Tokyo Disneyland to the epicenter as well as the magnitude were used to set the rate of fall below par. The objective of a CAT bond is to compensate revenue lost due to an earthquake, but, therein lies a basis risk in the difference between the principal loss and the actual revenue loss. Enterprises like Oriental Land could tolerate a certain level of basis risk, but, it would be hard for individuals to follow the same approach.

The current residential earthquake insurance categorizes losses as complete destruction (up to 50% of the fair value of damaged properties to indemnify), major destruction (do. up to 30%), minor destruction (do. up to 15%), and partial destruction (do. up to 2.5%), and based on onsite loss assessment, the claims are paid in accordance with the level of damage. Therefore, a basis risk already exists between the actual damage and a claim amount to be paid. If you leverage the deliverable from the SIP, you will be able to estimate damages on more granular level than when you use the current four categories, and a basis risk for the residential earthquake insurance will potentially be further reduced.

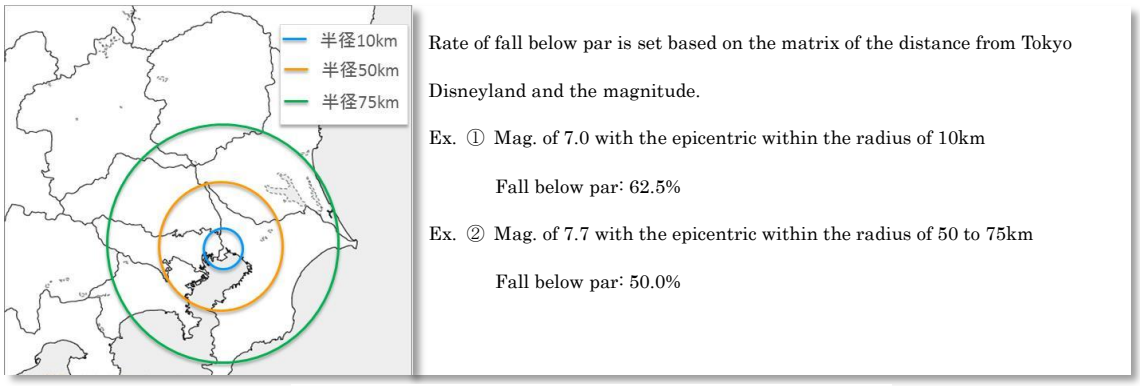


Fig. 5 CAT bond for Oriental Land[7]

Furthermore, another advantage of parametric insurance is that no loss assessment would be required, which enables timely claim payment. When a large-scale earthquake occurs, it is anticipated that a few or several months would be required for the loss assessment, resulting in delayed claim payments, which may hinder recovery from disasters. With parametric insurance, immediate claim payment would be possible, and restoration could be initiated on the following date after an earthquake.

## Ⅳ. Feasibility to enhance resilience and mitigate burden to the suffered

According to the Cabinet Office, it is estimated as the worst-case scenario that 2.4 million residential buildings would be fully damaged (including burned-down) in the Nankai Trough earthquake and 610 thousand would be fully damaged in the Tokyo

near-field earthquake. Adding half- or partially-damaged ones would require a huge number of buildings to get assessed on site. If parametric insurance utilizing the deliverable from the SIP is introduced instead of the onsite assessment of such a huge number of afflicted buildings, smooth and extremely timely claim payment will be possible with the secondary disaster being avoided, and it is expected that the resilience of the Japanese economy can be reinforced through the reconstruction of the lives of those impacted. The report released in June, 2015 by "the project team for the earthquake insurance program" operated by the Ministry of Finance includes discussions around "simplified loss assessment" assuming the Nankai Trough earthquake or the Tokyo near-field earthquake and concludes that the acceleration of loss assessment with technological innovation should be reviewed as a solution to the challenge in the future.

Also, in order to issue a disaster victim certificate which is required for requesting payment of support grants for reconstructing the livelihoods of disaster victims, their disaster situations need to be confirmed, which inflicts procedural burdens on those affected. Utilization of the derivable from the SIP can mitigate such burdens, which could result in a socially significant impact.

## Ⅴ. Necessary resilient disaster risk finance

At the AIG Institute forum, "Preparation for the Nankai Trough Earthquake - Disaster Management from a fiscal risk perspective" in January, 2018, subject-matter experts discussed various approaches for disaster prevention with consideration of financial risks. (http://www-154.aig.com/about-us/event-report/event-report-archive/20180312)

Financial risks are also addressed in the report, "Recommendations for restoration" which was released by the Reconstruction Design Council in response to the Great East Japan Earthquake, and initiatives to enhance self-support with awareness of financial risks have been discussed in many occasions. In this section, the limitation of insurance and risk transfer with the use of the capital market as a tool to supplement such shortcomings will be explained.

### 1. Limit of rescue and assistance by public bodies; necessary reinforcement of self-support

"The panel for promotion of disaster-preparation by insurance/mutual aid" organized by the Cabinet Office, discussed disaster risk finance for the Nankai Trough earthquake and the Tokyo near-field earthquake, noting that the public assistance would be limited at the time of a catastrophic disaster. [8] Likewise, in the discussions by the Japanese government about support grants for reconstructing the livelihoods of disaster victims,

it was stated that an extremely difficult situation could be predicted for the government to bear the financial burden since a huge effort would be required to reconstruct infrastructure after catastrophic disasters[9].

If public support is limited, then self-help should be enhanced. According to research comparing gaps between an economic loss caused by earthquakes and recovery by insurance (Protection Gap as it is called in some cases) across multiple nations[10], Japan shows a lower rate of compensation. Compared to other nations, in Japan, self-help such as deposits and savings, mutual aid such as donations, and more pubic support including support grants for reconstructing livelihoods of disaster victims are applied instead of insurance claims payment.

## 2. Raising attachment rate of earthquake insurance

According to Article 1 of the Earthquake Insurance Act, earthquake insurance is defined as expense insurance to supply funds for the "contribution to stable living of those affected"; it is not aimed at the restoration of residential houses. It is impossible to state the "contribution to the restoration of residential houses" presumably because of a basis risk deriving from the claim payment only made in accordance with the above-mentioned four categories and of the fact that the maximum attachment ratio (coverage ratio for a loss) is limited to 50%. Considering the limit of public assistance for catastrophic disasters, more effort has to be made to educate people about the importance of earthquake insurance, and moreover, ways to raise the current attachment rate hovering at 50% should be reviewed[11].

## 3. Limit of insurance – limit of insurance market size and limit of risk pooling

The Cabinet Office released materials comparing the estimated damage by the Nankai Trough earthquake and the size of the insurance market, and Fig. 6 shows an excerpt [12]. While the estimated maximum amount of damage is 215 trillion yen, the earthquake/storm/flood insurance market size in Japan is just 3.7 trillion yen, which indicates extreme vulnerability. The arrangement of reinsurance for earthquake insurance only engages the Japanese Government, and no commercial reinsurance market has been utilized. Considering the limit of public support, it would be meaningful to discuss how to raise the attachment rate of earthquake insurance through leveraging commercial reinsurance, but, looking at 60.3 trillion yen as the total capital of global reinsurers, the current reinsurance market size cannot be recognized as a way of offering enough security. The estimated amount of damage caused by the Nankai Trough earthquake in Fig. 6 includes 75.6 trillion yen as the estimated

maximum amount of damage caused to residential houses[13]. If all houses are renovated for 100% earthquake resistance, it is estimated that 80% of the houses will not collapse. Therefore, if the residual risk is targeted after that 100% resistance rate is achieved , then more practical discussions around how to raise the attachment rate can be invoked[14].

On the other hand, for regionally concentrated earthquakes or floods, some experts consider that risk pooling available in insurance will not function. This implies the limit of using the insurance market for catastrophic disasters. From such a perspective as well, it has been said that risk transfer with the use of a larger capital market will be required for catastrophic disasters. Fig. 6 shows 3,780 trillion yen as the size of the capital market.

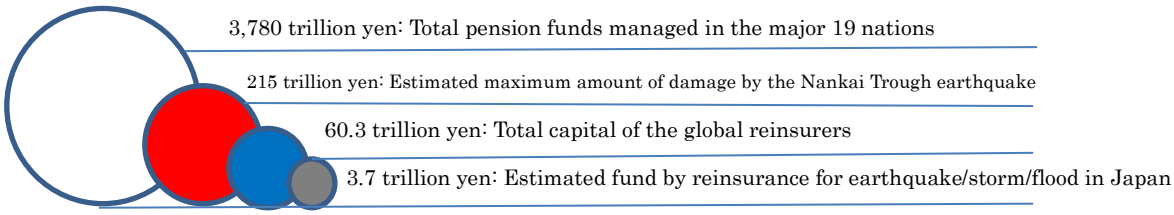


Fig 6. Capital market, Nankai Trough earthquake, Insurance market

In 2011, the OECD released a report, "Risk Awareness, Capital Markets and Catastrophic Risks". In the time when a risk transfer utilizing the capital market started emerging, the report addressed such a trend and identified challenges for governments to develop risk transfer function in the capital market. This report also pointed out the limit of risk pooling by way of insurance.

## 4. Catastrophic disaster risk transfer with use of capital market

As a way of risk transfer with the capital market, a CAT bond or ILS (Insurance Linked Securities) is mainly used as ART (Alternative Risk Transfer) in the broad sense. Even before the financial crisis, the activation and expansion of the ILS market was perceived.

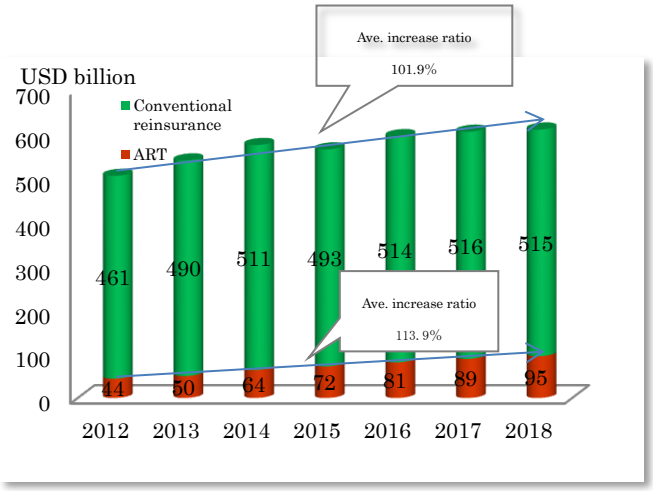


Fig. 7 Comparison between conventional reinsurance and ART [15]

Investors show their strong interest because of the high dividend and the diversifiable portfolio derived from less correlation with other investment products.

One of the recently debated topics around the ILS market is about the increased inflow of capital. Last year in the United States, multiple large-scale hurricanes caused a record claim payment, but, because of the inflow of funds from the capital market to the risk transfer market, it is said that the reinsurance premium rate was not increased. Fig. 7 shows a comparison of the capital amount between in the conventional reinsurance market and in the ART market. Also, Fig. 8 shows the annual issue and the outstanding balance of the CAT bond. Both are increasing linearly. Recent news has reported that the National Flood Insurance Program (U.S.A.) transferred a risk of around 50 billion yen to the capital market. Also, earthquake insurance in California, storm insurance in Florida, fire insurance run by Louisiana and Massachusetts have all started to leverage the capital market.

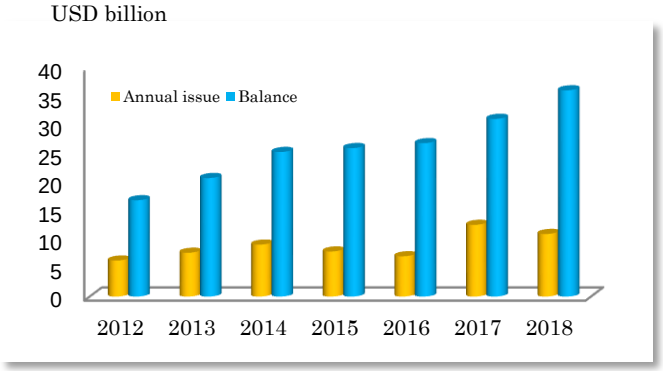


Fig. 8 Annual issue and balance of CAT bond [16]

Risk transfer to the capital market has been more activated in other nations. In February, 2018, the World Bank formulated a CAT bond with the participation of several nations in Latin America, and its record-breaking amount exceeded 1 billion USD at face value. In Japan, the National Mutual Insurance Federation of Agricultural Cooperatives (JA Kyosai) represents one of the largest CAT bond sponsors in the world[17]. The JA Kyosai arranged the CAT bond as self-help because its earthquake insurance is not incorporated into the government-operated earthquake reinsurance program.

On the other hand, the earthquake reinsurance is arranged by the Japanese Government only without leveraging any commercial reinsurance market or capital market. The government-operated earthquake reinsurance program is to make claim payments up to 11.3 trillion yen per earthquake, while it held a reserve fund of 1.66 trillion yen as of the end of March, 2017[18]. If a catastrophic disaster occurred now, the gap of around 10 trillion yen would be likely to be filled by a public fund for a post-disaster reconstruction. As for The Great East Japan Earthquake, a special national income tax and a local residential tax are to be collected for twenty-five years and for ten years, respectively to secure the fund of 8.1 trillion yen. To secure the funds

for earthquake insurance, an equally large amount of tax income revenue would be required, which also implies the limit of public support.

With reference to recent case studies about risk transfer in other nations or the trend of the ILS market, more resilient self-help—considering the limit of public-support, as well as the increased attachment ratio of residential earthquake insurance based on leverage of the commercial reinsurance market and the capital market—should be immediately reviewed and discussed.

## Ⅵ Parametric insurance as a tool to attract capital

When investors invest in insurance risks, on top of their investment in insurers, they can also invest in the risk transfer market through the ILS as mentioned in the previous section. As addressed in Fig. 1, the parametric insurance allows investors to easily enter the risk transfer market because of its high transparency.

### 1. Objectivity and transparency of parametric insurance

The previously mentioned OECD, "Risk Awareness, Capital Markets and Catastrophic Risks", identifies prerequisites, driving forces, and hurdles related to the expansion of the ILS market. It also suggests that the parametric insurance using indexes such as seismic intensity will contribute to the driving force, referring to an example of index-type products that had led the expansion of the credit risk securitization market. This is because the underwritten risks and the structure of parametric insurance are so objective and transparent that investors can easily understand them. In regular insurance, risks are taken on based on underwriting information, but, the information is largely asymmetric and a claim payment depends on terms of liability/non-liability or deductible, and loss assessment criteria, which make the investment target unclear for investors.

### 2. Integration of capital market and insurance market

In the 1990s, when the securitization of insurance risks was initiated, an integration of the capital market and the insurance market also started getting attention. Since the insurance market needs further diversification of risks because of the larger impact from recent natural disasters, such an integration is further accelerated in an environment marked by advanced risk models using IT and increased need for diversified investment under the lower global interest rates.

The World Economic Forum released a report, 'The Future of Financial Services 2015", and predicted the impact that innovation would have on financial functions. According to the report, financial services are categorized into six functions such

as ”Payment”, ”Insurance” and others. For ”Insurance”, it shares a view that the ILS would be leveraged for hedge funds or investment banks to actively drive themselves into insurance risks. Also, it suggests that big data or risk models utilizing IT enables a securitization of insurance to offer new markets to investors.

In the UK and Singapore, the governments have launched initiatives to expand the ILS market. The British government enforced regulations to enable the domestic issuance of ILS at the end of last year[19]. The Government of the Republic of Singapore announced that they would use government grants to expand the ILS market, and it was reported that they were having discussions with a Chinese reinsurance public corporation[20].

In FSA, the Financial System Council's "Study Group on the financial system" discussed how financial guidance should be for the next generation's individual financial functions[21], including "Settlement", "Financing", "Asset Management", and "Risk Transfer". Like the World Economic Forum, the Council categorizes the financial domain by function, and mainly discusses the impacts of IT on the financial business and how it should be supervised. For "Risk Transfer", the ILS was not addressed, but discussions focusing not on business types, but on functions suggest the possible and inevitable integration of individual businesses in "Risk Transfer" without borders among banks, securities, and insurance. Discussions around the integration of insurance and other financial businesses have started from this perspective, as well.

Discussions around the utilization of parametric insurance match Society 5.0 led by the Japanese Government. They address the future of the insurance industry in Japan for risk transfer, and at the same time, they offer opportunities to prepare risk finance for unprecedented catastrophic disasters, which can be evaluated as significantly meaningful actions for the Japanese society. It is expected to see more activated discussions, including a review of accounting or legal frameworks across the borders of industries, government, and schools.

Note

1 Excerpted from World Banks' "Risk Modeling for Appraising Named Peril Index Insurance Products"

2 "Issues Paper on Index Based Insurances, Particularly in Inclusive Insurance Markets"

3 "Whitepaper: Parametric solutions"

4 Nikkei Newspaper: "CAT insurance in South East Asia: Japan-ASEAN framework for timely funding for restoration", April 27, 2018

5 Quoted from J-RiSQ Earthquake Newsflash www.j-risq.bosai.go.jp/report/

6 Created based on data for individual damage functions provided by the Real-time Earthquake and Disaster Information Consortium. In SIP, eight types of damage functions are used as a trial, and the assumed information shows differences because of the attributes of the individual damage functions. For the Osaka Earthquake, the number of fully damaged buildings varies from 0 to 1,494,

AIG総研

and the number of half-damaged buildings varies from 329 to 16,426. In this report, the damage function, M7, is referred to. (Mr. Midorikawa and others, 2011). Also, only cities such as Takatsuki, Ibaraki, and Toyonaka with fully damaged buildings are addressed in this report. No other cities with half-damaged buildings are addressed.

7 Created based on "Insurance derivative: Challenge of new risk hedge solution" authored by Kaoru Tsuchikata

8 Report from the same council (March, 2017)

9 Intermediate report from "the Review meeting about best assistance offered by the Japanese Government to those affected" organized by the Cabinet Office: "In principle, support grants for reconstructing livelihoods of disaster victims should be offered by mutual aid of prefectures, while more support from the government should be considered for catastrophic disasters, but it is also predicted that additional grants from the national treasury could be extremely difficult."

10 According to a publication from the World Bank, "Learning from Megadisaster", a comparison of coverage by insurance to compensate economic damage from earthquakes is conducted among The Great East Japan Earthquake, and damages caused by the earthquakes in New Zealand and Chile. The insurance coverage rate is 16% in Japan, 80% in New Zealand, and 40% in Chile.

11 The reason why the earthquake insurance attachment ratio is suppressed up to 50% is for stable management of such an insurance program, but, according to the publication from the World Bank, "Learning from Megadisaster", it is proposed that forced insurance or increased insurance attachment ratio should be considered for increasing the number of insurance policyholders.

12 Quoted from the second review meeting, "Current state and challenges of disaster risk underwriting market" of the "Risk Finance Committee about more devastating catastrophic natural disasters" hosted by the Cabinet Office

13 The secondary report of the Nankai Trough Large Earthquake Countermeasure Review Working Group of the Central Disaster Prevention Conference organized by the Cabinet Office (March, 2013)

14 Estimated damages of Nankai Trough Large Earthquake (primary report) (released on August 29, 2012)

15 Aon Benfield "Reinsurance Market Outlook" June and July 2018

16 Artemis Deal Directory (As of August, 2018)

17 According to "Catastrophe bonds & ILS outstanding by sponsor or cedant" of Artemis, the outstanding balance of CAT bond issue amount exceeded 200 billion yen as of August 10, which was ranked as the second by sponsor.
www.artemis.bm/deal_directory/cat_bonds_ils_by_sponsor.html

18 "Earthquake Reinsurance Business" from Ministry of Finance
www.mof.go.jp/about_mof/mof_budget/review/2017/280053shiryo.pdf

19 Risk Transformation Regulations 2017 and Risk Transformation (Tax) Regulations 2017

20 Artemis's "China Re & Singapore discuss ILS and cat bond cooperation", June 12, 2018

21 Intermediate report, "For functional and comprehensive financial statutory structure", of the Financial System Council's "Study Group on the financial system"