

# Natural Catastrophe Insurance Programs: Comparisons and Implications

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## **Abstract:**

Natural hazards adversely affect many thousands of people worldwide each year and cause extensive property and other damages. Many countries and areas have built natural catastrophe insurance programs. Based on the comparisons of these catastrophe insurance programs, some implications have been given to the building of Chinese catastrophe insurance system.

**Key words: natural catastrophe insurance comparison implication**

## **1. Introduction:**

Natural hazards adversely affect thousands of people worldwide each year and cause extensive property and other damages. In 2010, a year that was not considered an exceptional one for natural hazards, natural hazards still caused an estimated \$222 billion in property losses and only \$36 billion of the property losses has been covered. In this case, existing policies or approaches that are used in other countries or areas to reduce natural catastrophe losses can help theories and practices of Chinese catastrophe insurance system.

This report contains three main parts as follow:

(1) A brief introduction of seven typical natural catastrophe insurance programs in the world. These certain selected foreign countries or areas are the United States, Japan, France, Australia, the United Kingdoms, China Taiwan and New Zealand. This paper describes the policies or approaches used by these countries to reduce natural catastrophe losses.

(2) A targeted comparative analysis of those different natural catastrophe insurance programs. In order to make the comparison more clearly, this paper forms a comparative table.

(3) Some conclusions and implications have been given according to the above analysis: At first, the government should play a crucial role in dealing with catastrophe risk. The Governmental financial support is needed to reduce the cost of private insurance; Secondly, programs that integrate variable premiums and limitations on benefits best mirror the private sector efforts to control moral hazard; Thirdly, there should be some steps taken to accomplish the dual purpose of providing a comprehensive plan that protects the public, while simultaneously providing reinsurances to the insurance industry when the catastrophe events occur; In addition, international cooperative efforts may provide instructive examples of risk management and disaster reduction.

## **2. Related reviews**

Natural catastrophe insurance programs are widely discussed all over the world especially among the developed countries. United States Government Accountability Office (2005) provides an outline of the insurance industry's current capacity to cover natural catastrophic risk and discusses the impacts of the 2004 hurricanes, the potential of catastrophe bonds, and the approaches that six European countries have taken to address natural and terrorist catastrophe risk,

including whether these countries permit insurers to use tax-deductible reserves for such events. Hiroaki Tsubokawa(2005) presents an overview of the events of Hurricane Katrina and discuss the lessons to be learned in Japan. The author describes natural disasters and problems of public insurance systems, analyzes the debate on the accuracy of claims settlement models, and finally discusses the role of insurance in societies where inequalities exist. Mario Jametti, Thomas von Ungern-Sternberg (2007) argue that risk selection, a situation where the public partner insures the majority of high risk agents, is potentially an important issue. They build a simple model that characterizes the French system, show that risk selection is a likely equilibrium outcome and discuss the policy options available. Asian Development Bank(2008) presents that dealing with natural hazard risk requires attention at several levels: from frequent disasters of limited reach to rare events of catastrophic proportions, from general economic considerations to specific project-level applications, from insurance and risk transfer to disaster response and contingency planning, and from remote rural areas and small island nations to densely populated urban centers. The Ministry of Finance of Japan met with ADB in October 2007 to follow up on the recommendations of the technical assistance on Development of Catastrophe Risk Insurance Mechanisms. Erwann O. Michel-Kerjan(2010) presents an overview of the forty years of operation of the National Flood Insurance Program, analyzes the financial balance of the NFIP between 1969 and 2008 and presents some of the challenges the NFIP nowadays.

The issues of natural catastrophe insurance programs in developing countries also caught people's attention. Joanne Linnerooth-Bayer, Reinhard Mechler(2008) examines the recent experience with insurance and other risk-financing instruments in developing countries. They describe specific examples of public-private insurance, highlight their limitations, and then investigate arguments about donor and public involvement in provision of subsidized insurance in developing countries. Sonia Akter, Roy Brouwer, Saria Chowdhury and Salina Aziz (2008) presents empirical evidence of the determinants of catastrophe insurance participation in one of the poorest and most disaster prone countries in the world. Their study suggests that low participation rates for catastrophe insurance in a developing country can be explained by high rates of illiteracy and limited access to credit. It is still a controversial topic.

Previous natural catastrophe insurance programs are mostly based on single catastrophe, however, the governments and researchers began to pay attention to comprehensive plans recently. United States Government Accountability Office (2008) give an evaluation to this potential combined federal insurance program with coverage for both wind and flood damage which would be created by H.R. 3121, the Flood Insurance Reform and Modernization Act of 2007. In its report, GAO discusses the resources and processes that the Federal Emergency Management Agency (FEMA) would need to implement the program, the steps that FEMA would need to take to determine premium rates that adequately reflected all expected costs; and the possible effects of the program on policyholders, insurance market participants, and the federal government. National Association of Insurance Commissioners (2008) drafts out a report, outlines steps that regulators believe must be taken to accomplish the dual purpose of providing a comprehensive plan that protects the public, while simultaneously providing reinsurance to the insurance industry when catastrophe events occur.

Different countries have different plans or programs, and therefore a lot of comparisons have existed. Richard Roth Sr.(1999) describe earthquake insurance programs in certain selected foreign countries based on information contained in SCOR Reassurance Company's 1996 SCORTECH

Report. Six of the foreign countries are Australia, France, Italy, Japan, New Zealand, and Spain. The seventh is the United States, but only the state of California. GAO (2008) selected six countries in the review: Australia, France, Germany, Japan, New Zealand, and Switzerland. They analyzed various studies and reports and interviewed U.S. agency and foreign officials and individuals from academia, reinsurance companies, and relevant organizations. They also interviewed written material from knowledgeable individuals from the six countries they selected. They chose different countries or area and maybe have their own thoughts. This paper will choose seven typical natural catastrophe insurance programs and give comparisons and implications.

### **3.the brief outline of natural catastrophe insurance programmes**

#### **3.1 America's National Flood Insurance Program**

The National Flood Insurance Program (NFIP) was created by the Congress of the United States in 1968 through the National Flood Insurance Act of 1968. The program enables property owners in participating communities to purchase insurance protection from the government against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. As of April 2010, the program insured about 5.5 million homes, the majority of which were in Texas and Florida.

Homeowners with mortgages from federally regulated lenders on property in communities identified to be in special high-risk flood hazard areas are required to purchase flood insurance on their dwellings. Optional, lower-cost coverage is also available under the NFIP to protect homes in areas of low to moderate risk. Premium amounts vary according to the amount of coverage purchased and the location and characteristics of the property to be insured.

Nearly 20,000 communities across the United States and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary.

The main goal of the NFIP was to provide flood insurance to many more people, with the understanding that there might still be truly exceptional events for which the program would have to borrow money from the federal government. The program was structured to subsidize the cost of flood insurance on existing homes, in order to maintain property values, while charging actuarially fair rates on new construction.

In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the Nation's floodplains. Mapping flood hazards creates broad-based awareness of the flood hazards and provides the data needed for floodplain management programs and to actuarially rate new construction for flood insurance.

The intent was to reduce future flood damage through community floodplain management ordinances and provide protection for property owners against potential losses through an insurance mechanism that requires a premium to be paid for the protection. The NFIP is meant to be self-supporting, though in 2004 Congress found that repetitive-loss properties cost the taxpayer about \$200 million annually. Congress originally intended that operating expenses and flood insurance claims be paid for through the premiums collected for flood insurance policies. NFIP borrows from the U.S. Treasury for times when losses are heavy, and these loans are paid back

with interest.

The National Flood Insurance Program has grown significantly since its inception in 1968 to cover \$1.23 trillion of insured assets in 2010. It provides financial protection against flood to residents across the nation, but more than two thirds of its policies are located in just five coastal states. Homeowners are charged a relatively low price; that continues to be true even in flood-prone states such as Louisiana, Florida, and Texas, which suffered major flood losses due to the 2004, 2005, and 2008 hurricane seasons.

Since the enactment of the National Flood Insurance Program, flood insurance in the United States has been provided mainly by the government. But private insurance companies have played a large role in selling and servicing policies. Also, there is some private flood insurance covering claim amounts above the residential cap for flood losses and under certain special commercial insurance policies, even though this represents only a small portion of the market today.

### **3.2 Japan's earthquake insurance program**

Earthquake risk involves the potential for large-scale natural disasters throughout Japan, so it is necessary for the national government to provide support in the form of reinsurance.

The government of Japan created the "Japanese Earthquake Reinsurance" (JER)scheme in 1966, and the scheme has been revised several times since. Homeowners may buy earthquake insurance from an insurance company as an optional rider to a fire insurance policy. Insurers enrolled in the JER scheme who have to pay earthquake claims to homeowners share the risk among themselves and also the government, through the JER. The government pays a much larger proportion of the claims if a single earthquake causes aggregate damage of over about 1 trillion yen (about US \$8.75 billion). The maximum payout in a single year to all JER insurance claim filers is 4.5 trillion yen (about US \$39.4 billion); if claims exceed this amount, then the claims are pro-rated among all claimants. Japan's earthquake insurance consists only of damage insurance and does not cover any incidental expenses.

JER is administered by private sector and national government. The private insurance firms undertake sales and primary insurance. All primary insurance policies are ceded to the Japan Earthquake Reinsurance Co (JERC) for reinsurance. JERC is a specialized reinsurance company for earthquake insurance. It was established with a mission to serve as the core mechanism of a system unifying the property-and-casualty insurance industry with respect to the earthquake reinsurance system. JERC's functions include pooling all earthquake insurance policies underwritten by private companies and accumulating private company contingency reserves. The national government provides reinsurance(excess of loss reinsurance) too.

Until March 2005, 9.32 million insurance policies were existed. There are six premium rate categories: four zones nationwide, plus two classifications based on building structure (wood or other). Depending on the building's earthquake resistance and year of construction, discounts of up to 30% are available. The participation rate varies somewhat by region. Nationwide, 37.4% of fire insurance policy holders also had earthquake insurance in 2004. Study is underway concerning introduction of a system to discount insurance premiums for existing buildings as well, reflecting the results of earthquake resistance evaluation by local governments and the like. Income tax deductions for earthquake insurance premiums are also being considered as a way to promote adoption of earthquake insurance.

But the existing earthquake insurance system has its Problems. Firstly, lower insurance system premiums. People have clamored for lower premiums since the system's inception. Reducing

premiums would require the government to shoulder more of the risk, or other such measures. Secondly, improved indemnification. Although the indemnification system has been improved a number of times, the underwriting limits and coverage rate limitations conflict with the need for complete indemnification. Continued improvements in indemnification remain an issue. Thirdly, simplifying insurance system and coverage. The increasing complexity of the insurance system and coverage produces misunderstanding or incomplete understanding among policyholders. Some of these misunderstandings may become apparent only after a disaster occurs. For the sake of convenience, demands for separate insurance coverage have been voiced. For the moment, this is a matter for future discussion.

### **3.3 France's Catastrophes Naturelles program**

Following the serious flooding which occurred at the end of 1981, the French Parliament voted a law, issued on July 13, 1982, which instituted a new compensation system for natural disasters, for damages occurring from August 14, 1982 onwards. There have been four major changes to the system since its creation in 1982. Currently, natural disaster insurance system in France is mainly based on bill *The French Nat System* mended in 2002.

Briefly, the system can be defined as follows: Cover for wind damage (storms, cyclones, and hurricanes) is compulsory. It must be included in any insurance policy covering fire damage. Each company is free to set conditions relative to storm damage. Similarly, all insurance companies offering property insurance in a specific area are obliged to include protection against natural disasters. Premium rates are defined as a percentage of other property insurance premiums, while excesses are fixed per contract and per event.

France uses a government approach to insurance, which involves a mandatory extension to property insurance policies provided by the private sector. Policyholders pay an additional cost of 12 percent of the property insurance premium for coverage against natural hazards. The French government must declare a state of natural disaster for coverage to take effect. According to agency officials, 90 to 95% of homes have property insurance and therefore have coverage against natural hazards. French insurance companies can purchase reinsurance from private companies or from a government reinsurance agency.

An important institutional feature of the system is the existence of a publicly owned reinsurance company, the Caisse Centrale de Réassurance (CCR). Reinsurance is not compulsory, and insurers are free to contract with other, private, reinsurance companies. Reinsurance with the state reinsurance company is, however, potentially attractive, both because the reinsurance premiums charged are low and because it can offer unlimited cover (it is covered by a state guarantee). Insurance companies that decide to reinsure with the public reinsurer are offered two types of contracts: proportional contracts (for a given percentage of premium income the reinsurance company covers a given percentage of claims) and stop-loss contracts (the reinsurance company covers all claims that exceed a given multiple of annual premium income). CCR offers unlimited reinsurance coverage that is guaranteed by the French government in the event that CCR exhausts its resources. However, a CCR official noted that insurance companies must transfer half of their natural catastrophe risk to CCR in order to be covered under the state guarantee. According to one insurance broker and a French Treasury official, most insurers in France reinsure their natural catastrophe risk through CCR to obtain the state guarantee coverage.

Under the French program, the government must declare that an event qualifies as a natural disaster. According to information from the French government and a CCR official, the program is

set up so that insurers manage policyholders' claims because they have the best claims-paying experience and expertise. Coverage from CCR takes effect after insureds pay a certain deductible. Since the program was started in 1982, France has declared 110,000 natural disasters and paid €6.4 billion (about \$8.6 billion) in compensation, over half of which was for floods. In 2001, the government introduced a program to encourage cities to implement loss prevention measures by increasing deductibles in the event of repeated natural disasters, such as floods, for cities without a prevention plan.

### **3.4 UK's flood insurance program**

In UK the main natural hazards covered by insurance is earthquake risk. In the meantime, many areas of the UK are, and have been, regularly exposed to flooding. The regulation of flood protection is therefore a historical phenomenon that can be traced back to 1531 when the first legal regulations concerning protective measures against floods were issued.

In the UK, flood insurance is provided through the private market. It is one of the few countries where private insurance schemes against flooding have already existed for more than half a century. The vast majority of properties in the UK are therefore covered by flood insurance, including properties in areas which are considered to have a significant risk of flooding.

England developed a private flood insurance scheme about half a century ago. This scheme can be described as a 'Gentlemen's Agreement' between Government and the insurance industry. From the 1960s, the Gentlemen's Agreement had survived without trouble, and the historical success of it cannot be questioned. The substantial core of the Gentlemen's Agreement is the protection of all house-owners against all flood related risks. The Agreement optimizes the risk spreading across all property owners and in that way establishes a sound economic basis for insurance activities without burdening the state. To reach the goal, flood insurance in England is a bundled and compulsory system. This bundled, compulsory system works, but with declining marginal revenue as "moral hazard" systematically undermines protection. In the attempt to mitigate and control moral hazard, the Agreement differentiated premiums according to levels of exposure. Fortunately, unlike the high moral hazard, the level of adverse selection in UK is low.

In the light of rising flood risks insurers are calling for better risk management practices to keep these risks insurable. The Association of British Insurers (ABI) wants to ensure that flood risk is managed effectively and that as many people and businesses as possible can continue to obtain competitively priced home and business flood insurance to protect themselves from the financial cost of flooding. A new approach is needed. The ABI have been working closely with the Government to lay the foundations for a long-term solution to managing flood risk in the UK. The Government has agreed that insurance is just part of the solution, and that responsibility needs to be shared between Government, consumers and insurers.

The main signal for insurance is costs. The costs pressure from natural hazards grew rapidly over the last decade. While the insured loss of the UK floods of Easter 1998 was estimated at £500-700 million, the insured losses for the floods of 2000 exceeded the psychologically upper bound of £1 billion. Costs are the signals that make climate change a relevant threat for the insurance industry. The increased costs for insurance coverage are not sufficiently reflected in premiums. Now in UK the premium rate for residential housing and commercial housing is 0.09% and 0.25% respectively.

### **3.5 China Taiwan's earthquake insurance program**

In China Taiwan, the residential earthquake insurance market is a public-private shared market.

The main field of private insurance firms is sales and primary insurance while for the district government it is reinsurance, especially the excess of loss reinsurance. For the residential earthquake insurance, the risk based rate is 0.4‰-5‰, the specific premium rate depends on the location and building type.

On July 9, 2001, China Taiwan revised and enlarged the Taiwan Insurance Law. On November 30, 2001, the competent authority announced the “Taiwan Residential Earthquake Insurance Fund Articles of Incorporation”, and “Regulations Governing the Taiwan Residential Earthquake Insurance Fund”, laying a legal foundation for the establishment of Taiwan Residential Earthquake Insurance Fund (TREIF). TREIF was established in January 2002 and turned to be the core insurance agency in Taiwan.

Since April 1, 2002, Taiwan launched the Taiwan Residential Earthquake Insurance Program (so called “TREIP”), the residential earthquake insurance business has grown steadily. Up to the end of 2009, insurance policies in force amounted to 2.17 million, representing 27.45% of the total national households of 7.9 million, growing by 6.9% when compared with 2008. For the purpose of strengthening the scheme and increasing the take-up rate, the goal of the TREIF is to continue its effort to optimize the statutory function of residential earthquake insurance by finding ways to quickly and effectively indemnify the public’s losses after an earthquake.

Considering that the residential earthquake insurance is a statutory insurance in Taiwan, it ought to be managed by a non-profit organization to avoid the possible credit risks that private insurers or reinsurers face, which could hinder the implementation of the scheme and sabotage policyholders’ rights. In 2009, under the leadership of former Chairman Tsan-Ming Shih, the TREIF integrated resources from the private, public and academic sector to form task forces to probe into important issues related to residential earthquake insurance, including risk spreading and premium rate, underwriting, claims and regulations as well as information technology, statistics, and educational promotion.

As of the end of 2009, the TREIF’s cumulative special reserve was NT\$9.58 billion, reserve adjustment was NT\$174 million, and credit risk reserve was NT\$59 million. Total reserves reached NT\$9.81 billion, an increase of 22.89% compared with NT\$7.98 billion in 2008.

Besides earthquake, in China Taiwan the main natural hazards covered are tidal wave, floods, volcanic eruptions, hurricanes, terrorism, rebellion, insurrection and riots.

### **3.6 Australia’s earthquake insurance program**

In Australia, regional governments have improved standards beyond those required under the national building code maintained by the Australian Building Codes Board to make structures more resistant to hazards such as cyclones and earthquakes. Insurance against earthquakes is provided by private insurance companies. There is disaster relief which is provided by the government, but it is not an insurance program, and it is not pre-funded.

The Australasian Fire and Emergency Services Authorities Council has established a joint fire management. Mutually reinforcing or joint strategies are adopted. Insurance companies may provide coverage for action of the sea, earthquake, erosion, flood, high water, landslide, storm, subsidence, tempest, tsunami.

Earthquake insurance is usually included in residential, commercial, and industrial fire insurance policies. The private insurance market will take on any risks it considers insurable. The State authorities and Commonwealth also provide relief through the Natural Disaster Relief Arrangements (NDRA) and the Rural Assistance Authority (RAA). The property insured are

dwellings, commercial and industrial structures. Perils covered are earthquake, fire following earthquakes, tsunamis. And it covers all of Australia. Considerable seismic activity has been recorded in the West (Darling fault) and South (Adelaide geo-system and Lincoln fault). Private insurance companies establish Premiums, handle Claims and decide deductibles. There are no financial incentives for insurance companies to increase their reserves for major disasters. Any reserves are not tax-exempt. Australian insurance companies make heavy use of the worldwide insurance market. Australia is the third largest purchaser of catastrophe reinsurance behind the United States and the United Kingdom.

The Australian Prudential Regulation Authority: oversees banks, building societies, insurance companies, and other entities. Some of the functions of some of these agencies include authorizing insurance companies to do business, assessing solvency, and determining whether insurance companies comply with regulations. Australia have private sector-only approaches to insurance, and government involvement in pricing insurance is limited. States and local communities have key roles in developing and establishing mitigation priorities.

### **3.7 New Zealand's Earthquake insurance program**

In New Zealand, The Earthquake Commission Act (1993) came into effect on January 1, 1994, and replaced the Earthquake and War Damage Act (1944). The Act provides for a board of five to nine members, appointed by the Government. There are currently six Board members.

A mandatory government program has been applied to every residential fire insurance policy written by private insurance companies. Local governments are primarily responsible for implementing policies for risk assessment and mitigation. A natural disaster insurance cover, called EQCover, is added automatically to each home or contents fire insurance policy. The premium paid to the private insurance company includes the premium for EQCover. The private insurance company then transmits the EQCover premium to the Earthquake Commission (EQC). Dwellings are covered on a replacement value basis. Personal property is issued on the same terms as it is in a household insurance policy. Some retaining walls are covered but on a cash value basis.

Property Insured are dwellings (self-contained premises used as a home, including apartments) and most personal property but excluding some types (e.g. motor vehicles and art) Perils covered include earthquake, natural landslip, volcanic eruption, hydrothermal activity, tsunami. All of New Zealand is covered. The cost of cover is 5 cents a year for every \$100 value of property insured. Claims are handled directly by the Earthquake Commission through independent claims assessors and adjusters. Claims must be made within 30 days from the date of damage. NZ\$200 (\$191) is deducted for property claims NZ\$20,000 (\$19,106) or less. Claims over NZ\$20,000 are paid 99 percent of the total amount. Land claims have NZ\$500 deducted for each claim \$5000 or less. Claims over NZ\$5000 are paid 90 percent of the total amount except that the maximum amount that may be deducted is NZ\$5000. All premiums are paid into the Natural Disaster Fund and claims are paid from it. It is exempt from the payment of income taxes.

If the Natural Disaster Fund is exhausted, the Government steps in to pay the remaining claims. The fund is invested primarily in New Zealand Government securities with about half of the sum through the Reserve Bank in Foreign Bond Linked Notes. A substantial amount of catastrophe insurance is carried with some 150 separate entities. The total amount of reinsurance protection is NZ\$1.5 billion (\$1.43 billion) once the total claims from a single event exceeds NZ\$750 million (\$716 million).



#### **4.the comprison of natural catastrophe insurance programs**

Natural hazards adversely affect many thousands of people worldwide each year and cause extensive property and other damages. Many countries face significant risks associated with natural catastrophes have developed a range of approaches to enhance insurers' capacity to address catastrophic risks. For example, the six countries and a region we studied—Australia, England, France, Japan, New Zealand, the United States and China Taiwan—have developed various approaches to insure natural hazard risk and regulate insurers.

Natural hazard insurance generally involves both government and the private sector, through that they usually play different roles in different countries. In five countries that have government insurance approaches, and two of them are totally government-led. In USA's NFIP, private insurance firm just plays a role of sales, while in New Zealand it is the reinsurer. There are five countries with private insurance approaches on the other hand, and three of them chose a mix of government and private-sector approaches to covering natural catastrophe risk except UK and Australia. Six countries have centralized agencies that regulate the insurance industry. Certainly, there are lots of other differences among those six countries and a region, you can see them clearly in the following table(see Table 1).

	USA(NFIP)	Japan	France	UK	China Taiwan	New Zealand	Australia
Year created	1968	1966	1982	1954	2000	N/A	N/A
Type of program	Government-led, Semi-compulsory	Public-private shared, voluntary	Public-private shared, Compulsory	Private insurance , Compulsory	Public-private shared, Compulsory	Government -led, Compulsory	Private, voluntary
role of private insurance firms	Sales	Sales and primary insurance	Sales and primary insurance	primary insurance and Reinsurer	Sales and primary insurance Reinsurer	Reinsurer	primary insurance
role of national government	Insurer	Reinsurer (excess of loss reinsurance)	Authorize CCR as Reinsurer	Establish effective system for disaster	(excess of loss reinsurance)	Primary insurance	provide relief and Assistance
Legal Construction	1968, The National Flood Insurance Law	1966, The Earthquake Insurance Law	1982; The French Nat System	1960s, 'Gentlemen's Agreement'	2001, Taiwan Insurance Law	1993, The Earthquake Commission Act	N/A
Core agencies	FIA(Federal Insurance Administration)	JER(Japan Earthquake Reinsurance Company)	CCR(Caisse Centrale de Réassurance)	ABI(Association of British Insurers)	TREIF(Taiwan Residential Earthquake Insurance Fund)	EQ(Earthquake Commission)	N/A
Main natural hazards covered	Flood	Tsunami, volcanic eruption	Includes floods, mud slides, landslides, drought, earthquakes, tidal waves, and Avalanches	Earthquake	earthquake, tidal wave, floods, volcanic eruptions, hurricanes, terrorism, rebellion, insurrection, riots	Earthquake, Natural Landslip, Volcanic Eruption, Hydrothermal Activity, Tsunami	Earthquake, fire following earthquakes, tsunamis
Premium rate	Risk-based rate, 0.08%~5.00%, depends on altitude, construction's date and flood zone	Risk-based rate, 0.5%~3.55% , depends on location and Building type	Fixed rate	Fixed rate Residential Housing:0.09%; Commercial housing: 0.025%	Risk-based rate 0.4%~5% , depends on location and Building type	Fixed rate, 5%	Risk-based rate
Insurance Approach	main risks	additional risks	N/A	One kind of responsibility of the property policy	N/A	additional risks	N/A
moral hazard adverse selection	High	Low	High	High	High	High	Low
loss potential	Low	High	Low	Low	Low	Low	High
subsidy	High	Medium	High	High	High	High	Medium
Cost of insurance	High	Low	High	Medium	Medium	Medium	Low
insurance	Low	high	low	Medium	Medium	Medium	high

Table 1: the comparision of typical natural catastrophe insurance systems

## 5.conclusion

The aim of the study presented in this paper is to give a comparison of natural catastrophe insurance programs, and thus will provide some useful suggestions to the building of Chinese catrastrophe insurance system.

As we can see in the above analysis, there are five countries or areas have government insurance approaches. Moreover, in the other two countries or areas, their governments have also taken some effective measures to facilitate the operation of the natural catastrophe insurance program respectively. Catastrophe risk is a highly correlated risk. The pooling of correlated risk

increases the variability of risk. As a result, the natural advantage of private insurance is lost. Private Insurance Industry is limited in its ability to finance catastrophe risk. Insurance is best suited to cope with independent non-correlated risk. The larger the pool of independent risks in an insurance pool, the lower the variability of risk. So the government should play a role in dealing with catastrophe risk. The Governmental financial support is needed to reduce the cost of private insurance through credit loans, reserves, taxes aspects and so on.

But government's participation in the catastrophe risk has some problems, either. All government insurance programs suffer from severe problems of moral hazard. Moral hazard increases the cost of risk that becomes reflected in escalating costs of the catastrophe insurance program. If governments bear the costs of catastrophes, their citizens are unlikely to reduce the risk of their behavior, which is moral hazard. While private insurance limits moral hazard by restricting benefits. Two common techniques are co-pays and deductibles. So government insurance and private insurance should join together. In the countries mentioned above, government natural hazard insurance programs take two forms: government acting as insurer and government acting as reinsurer. Both approaches tend to rely on private sector to provide needed administrative support. The private sector is paid a commission or fee for providing needed administration.

When it comes to China, existing policies or approaches that are used in other countries or areas to reduce natural catastrophe loss can help the theories and practices of Chinese catastrophe insurance system. Chinese government should participate in the catastrophe risk, and commercial insurance company should play an important role too. While access to governmental financial resources is critical in coping with large-scale covariant risk, the problem of moral hazard must be a key element in the planning process. Control of moral hazard is extremely difficult for governments. Reinsurance schemes seem to provide the best access to a country's treasury with the least risk of moral hazard. Programs that integrate variable premiums and limitations on benefits best mirror the private sector efforts to control moral hazard.

At the same time, each catastrophe insurance program is based on relevant laws. For examples, the National Flood Insurance Program (NFIP) was created by the Congress of the United States in 1968 through the National Flood Insurance Act of 1968, France's Catastrophes Naturelles (CatNat) program was introduced in France in 1982 after the bill *The French Nat System* was built. Therefore relevant legal construction is very important. As for China, it does not establish relevant catastrophe insurance system, so the legal construction should be paid more attention right now.

Previous natural catastrophe insurance programs are mostly based on single catastrophe, however, the government and researchers began to pay attention to comprehensive plans recently. The insurance industry cannot be expected to provide comprehensive catastrophe coverage without adequate financial supports for the most extreme events. There should be some steps taken to accomplish the dual purpose of providing a comprehensive plan that protects the public, while simultaneously providing reinsurances to the insurance industry when the catastrophe events occur.

Finally, given the ongoing challenges facing the world, international cooperative efforts may provide instructive examples of risk management and disaster reduction. In a word, catastrophe risk must be scattered as broadly as possible in the world through all kinds of methods or measures.

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