



Flood insurance in China: recommendations based on a comparative analysis of flood insurance in developed countries

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Abstract

Flooding is a serious natural disaster that has caused massive economic losses in China. The development of an effective flood disaster relief mechanism is of increasing significance, and some argue that flood insurance is an optimal solution. Currently, China uses post-disaster government aid as its main disaster relief policy, which is considerably less efficient than insurance. Thus, it is critical for China to establish a rational flood insurance system. As flood insurance is common among developed countries, a wealth of experience has been accumulated that can provide rich references for the construction of a Chinese flood insurance system. Hence, this paper will comparatively analyze the flood insurance systems of four representative developed countries and provide insight into the applicability of British and American insurance systems to China. Subsequently, suggestions will be made regarding the establishment of a Chinese flood insurance system, which include issuing legislation, establishing compulsory commercial insurance and securitizing flood insurance.

Keywords Flood risk · Flood insurance · Flood disaster relief mechanism

Introduction

China is a country frequently suffering various natural disasters, of which flood disasters cause the most serious losses. In China, the area under threat of flooding covers to 10% of the national territory, 40% of the population, 30% of cultivated lands, 70% of the total value of agricultural output and over 100 large and medium-sized cities (Wang et al. 1999). Relevant statistical data show that, from 1990 to 2006, flood disasters caused annual direct economic losses of 113.67 billion yuan, which accounted for 60% of annual losses due to natural disasters in China (Xu and Liu 2005). In addition, with rapid economic growth and global climate change, economic losses generated by flood disasters have been increasing (Mi and Long 2007). In China, government

aid has been the main disaster relief policy in past couple decades. However, government aid is seen as social welfare that is free of charge and can make people dependent on after-disaster governmental relief, negatively impacting their willingness to proactively engage in disaster reduction and loss prevention.

Therefore, it is crucial for China to establish an effective flood disaster relief mechanism. Among the options, flood insurance has drawn the most attention from academics and the Chinese government. Insurance is a charged mechanism that facilitates the benign circulation of right-obligation relations among market subjects. Relevant research indicates that insurance either cannot satisfy or can barely satisfy all the needs of disaster victims, but it is still the most effective and rational way to provide disaster relief (Singer 1990). Flood insurance targets frequently flooded areas and allows flood victims, governments and other involved parties to jointly share flood risks. The insurers maintain steady operation by determining their ability to pay according to their capital scale and transfer risks. Through flood insurance, the insurers accumulate benefits before a disaster and guarantee reconstruction after a disaster, compensating losses in suffering areas with insurance funds from areas that did not suffer disasters, which aids social stability and economic

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sustainability. Hence, it is urgent that China establishes a flood insurance system.

Flood insurance is a complicated social system project. Since the early 1980s when the insurance industry was revived in China, sympathetic research on flood insurance has been conducted, and attempts have been made to transform the governmental relief system to the commercial insurance system. According to the previous exploration, the government would provide national capital guarantees and citizens would pay a portion of the capital by purchasing common commercial insurance, forming a contractual relation between the government and the public. Subsequently, guarantee rate, timeliness and other indicators could be discerned, and a rational system can be formed. However, these forays into insurance failed due to contradictions in practice, the most significant problems including imperfect legal policies (Ningbo Civil Affairs Bureau 2016). In 2015, China released the Ten Action Plans for the Prevention and Control of Water Pollution, outlining a disaster insurance system, though practical methods of implementation were still absent.¹ Overall, there is currently no developed flood insurance system in China.

Most countries lack a proper flood insurance legal system and are still exploring this issue, so information on the effective management of such programs is scarce. Studies on flood insurance and relevant legal systems in developed countries have ranked the world's most effective insurance systems, from which developing countries can learn. Hence, many scholars believe that referring to foreign flood insurance systems will best impel the rapid development of the Chinese flood insurance system and its relevant legal policies. Ren (2012) argued that China should refer to the flood insurance system in America. Likewise, Huang and Jiang (2009) compared relevant elements of flood insurance in China and America and claimed that it was necessary to refer to the American system in building a flood insurance system suitable to China. In addition, Surminski and Eldridge (2017) claim that the British flood insurance system is unique and advanced, while Zhang and Shao (2010) demonstrated the possibility of basing China's insurance system on the Japanese system.

However, current research on this topic is deficient in the following aspects: first, comparative analysis of the systems of developed countries such as America and Britain are insufficient; second, there is a lack of adequate analysis on the applicability of British and American insurance systems to China. These deficiencies lead to imbalances in our knowledge of different countries' flood insurance systems and will influence reference choices. Thus, this paper will

focus on a comparative analysis of the flood insurance systems of four developed countries and conduct further analysis on the applicability of British and American insurance systems to China. Finally, the paper will advance relevant suggestions for developing an appropriate legal system of Chinese flood insurance.

Research status of Chinese flood insurance

As early as the late 1980s and early 1990s, Chinese civil administration departments were preparing to convert government aid to commercial insurance, which ultimately failed. For example, in 1997, the Ministry of Civil Affairs and State Flood Prevention General Command Office visited America to investigate the implementation of flood insurance. In 2015, a catastrophe insurance system was described in Ten Action Plans for the Prevention and Control of Water Pollution,² released by the State Council. For the first time, rules were established for flood insurance. In the same year, Shenzhen became the pilot city—the first in China to implement the catastrophe insurance system—followed 4 months later by Ningbo, which has a relatively developed insurance industry. In the first year of the pilot project, the Ningbo government spent 38 million yuan buying catastrophe insurance for 10 million residents. In 2015, the typhoons “Canhong” and “Dujuan” caused flooding in most areas of Ningbo, and the insurance industry there eventually suffered over 60 million yuan in losses. Hence, although China has attempted reform and innovation in flood insurance and its related legal systems, many problems still exist in practice.

First, the current flood disaster relief system, which mainly relies on government aid, is deficient and lacks operability. Every year, the central government allocates disaster relief funds, but the amount is insufficient to cover the losses of flood disasters and fulfill the needs of disaster victims (Ren 2012). Hence, it is not feasible for the government alone to provide disaster relief. In addition, Chinese government aid also faces a dilemma, namely how to dissolve the contradiction between the uncertain resources needed for disaster relief and government expenditure decisions. Government budget procedures are very strict, with the scope and amount of expenditures determined in advance, but disaster losses cannot be easily predicted.

Second, there is no special law or regulation for flood insurance in China, and flood insurance is only rarely and obliquely addressed in general. Practical implementation methods and systems are absent. Moreover, China lacks a developed flood insurance system at present. The Law for

¹ See The Ten Action Plans for the Prevention and Control of Water Pollution, 2015.

² See The Ten Action Plans for the Prevention and Control of Water Pollution, 2015.

Flood Prevention issued in August 1997 only mentioned that “The state encourages and supports the implementation of flood insurance”,³ while Article 41 of the Regulations for Flood Prevention, revised by the State Council in 2005, stipulates “The Flood insurance system shall be established gradually in stagnated flood areas.⁴ Specific methods will be formulated separately”. The Notification of Opinions for Enhancing Construction and Management in Stagnated Flood Areas⁵ issued by the General Office of the State Council states that: “It is necessary to positively conduct research on insurance of flood disaster losses and set up an effective insurance system for flood disaster losses”. The Opinions for Reform and Development in the Insurance Industry released by the State Council in June 2006 pointed out that it is necessary to establish a catastrophe insurance system supported by national finances.⁶ Unfortunately, these laws, regulations and policies fail to give any specific stipulations about the nature, legal status, functions of flood insurance or the obligations of the government. They also fail to clarify the insurers and insured, or other parties. Hence, there is no direct and operable legal basis for the practical implementation of flood insurance.

Third, insurance companies have no insurance specifically for flooding. Instead, they calculate flood risks by considering them an element of property loss insurance. At present, China has not formulated a scientific and rational flood insurance rate based on flood disaster loss data. Flood risks are included in all-risk enterprise property insurance and family property insurance, while basic enterprise property insurance incorporates flood risks into exclusions. Furthermore, the flood insurance rate is influenced by other risks such as fire. This implementation completely contradicts the pricing principles of insured commodities (Ren 2012).

Analysis of flood insurance systems in developed countries

Developed countries implemented flood insurance systems early and have accumulated abundant experience. This section analyzes and evaluates the flood insurance systems in America and Britain, which have typical flood insurance systems and are of great significance to China. Like other catastrophe risks, such as earthquake, tsunami and typhoon, flooding has a very low occurrence frequency but can cause huge losses when it happens. Hence, countermeasures to

mitigate flood disaster risks have much in common with those of other catastrophes. Thus, this chapter also discusses catastrophe insurance systems in Japan and France.

America

Due to various climate conditions,⁷ flood disasters occur frequently in America, making it one of the worst-suffering countries in the world. For example, in 1927, the most serious flood in American history occurred in the Mississippi River, causing huge economic losses and bankrupting insurance companies.⁸ Since then, legislators have gradually realized the importance of flood insurance and started building such a system through legislation. In 1968, the United States Congress passed the National Flood Insurance Act (NFIA),⁹ formulated the National Flood Insurance Plan (NFIP) (Alexandros 2010) and established the National Flood Insurance Fund to compensate for the lack of a flood insurance market (King 2012). The legislative goals of NFIA include providing flood insurance nationwide and instituting proper policies for land use in flooded areas¹⁰ to emphasize “flood insurance” as an important economic method of promoting flood management and controlling losses due to flooding (Silvis 2017). More recently, towards the end of 1973, the United States Congress passed the Flood Disaster Prevention Law,¹¹ compelling all flood-threatened communities to join the NFIP as a precondition for receiving federal disaster relief.

In 1982, the Federal Insurance Administration (FIA) cooperated with private insurance companies to establish a new NFIP and proposed “Write Your Own Plan” (WYO Plan), wherein the federal government serves as the guarantor and the reinsurer. Private insurance companies that join the WYO Plan sell flood insurance for the NFIP in their own names but do not bear the risk of compensation, as all the insurance policies are transferred to the FIA. Private insurance companies receive commissions according to the number of insurance policies sold. The FIA is responsible for settling claims, managing the flood insurance fund and operating capital. When short on funds, the FIA can borrow money from the Treasury Department but must pay it back with interest. By October 1986, over 200 private insurance

³ See The Law for Flood Prevention, 1997.

⁴ See The Regulations for Flood Prevention, 2005.

⁵ See The Notification of Opinions for Enhancing Construction and Management in Stagnated Flood Areas, 2006.

⁶ See The Insurance Industry, 2006.

⁷ See Long-Term Fluctuations in Thunderstorm Activity in the United States, Changnon SA, Changnon D. 2001.

⁸ See Technical Report “A chronology of major events affecting the National Flood Insurance Program beginning with the year 1824 through January 2006”, FEMA, 2005.

⁹ See The National Flood Insurance Act, 1968.

¹⁰ See 42 U. S. Code Sect.~ 4001 (d)–(e) (2000) (declaring the purpose of national flood insurance), available at <https://www.law.cornell.edu/uscode/text/42/4001>.

¹¹ See The Flood Disaster Prevention Law, 1973.

companies had joined the WYO Plan. The new operating management system not only embodies the dominant role played by the FIA in the NFIP and ensures the nationwide application of NFIP funds, but also makes full use of service networks of private insurance companies (Huang and Jiang 2009). Since the end of nineteenth century, the United States federal and state governments have been focusing on preventing floods from spreading and providing after-disaster relief.¹² With over 40 years' experience, the flood insurance legal system has played an increasingly significant role in normalizing land use in American flood-prone areas, enhancing awareness of flood prevention among the public and reducing the government burden of after-disaster relief.

The flood insurance system in America is characterized by the following aspects: first, the NFIP not only provides insurance, but also engages in risk recognition and disaster reduction (National Research Council 2015). One important reason that private insurance companies cannot provide flood insurance is that they cannot accurately measure the risk of flood losses or determine flood insurance rates. Initially, the NFIP was designed to investigate and formulate "flood insurance rate maps" and underwrite insurance. However, formulating insurance rate maps is a slow process. Therefore, the United States Congress formulated emergency plans in 1969 that allowed the provision of limited amounts of flood insurance based on estimated insurance rates prior to the formulation of the flood disaster insurance rate maps.

In addition, the insurance provided by the NFIP is associated with disaster reduction. Only the communities that meet the NFIP's flood prevention and disaster reduction requirements can participate in the program. The disaster reduction policy adopted by the NFIP is based on non-project disaster zone management and aims to cooperate with the federal government's flood prevention projects. The management of a flooded zone requires labor division and cooperation between the federal government and local governments. The federal government is responsible for formulating provisions concerning land development and construction standards. The NFIP signs agreements with local governments who promise that they will assume responsibility for the daily management of lands and buildings in flooded areas and reduce flood losses by issuing construction licenses and otherwise regulating construction in flooded areas. The Federal Administration for Emergency Affairs and state governments supervise and monitor the implementation of disaster reduction policies conducted by local governments. If a local

government fails to perform its management obligations, the flood insurance expense of this area will increase until termination of the insurance. To incentivize local governments' implementation of disaster reduction measures, the FIA established the "community rating system" in 1990, which local communities can voluntarily join. If the management performance of these communities in flood prevention exceeds the lowest standard of the NFIP, they can be eligible to pay lower insurance rates (Zhou 2012).

Second, the American flood insurance system is featured with "administrative styles". American flood insurance is compulsory to a certain extent. In 1973, the United States Congress passed the Flood Disaster Protection Act (Myers 1976). According to the Act, the NFIP shall identify areas at risk of serious flood disaster losses and inform local residents that they must join the flood insurance program or forfeit specific types of federal aid.

On the other hand, the American government serves as the "final insurer" in the flood insurance system. American commercial insurance companies sell flood insurance policies as agencies. Insurance fees are uniformly paid to the FIA, while insurance companies only receive a commission and do not bear responsibility for insurance compensation. Generally, the NFIP is self-sufficient, using insurance fees to pay for their costs of operation, but when losses exceed their historical average, the NFIP is entitled to borrow up to 1.5 billion USD from the Treasury Department or appeal for a special appropriation from Congress. At present, the NFIP is the second-largest federal insurance plan, ranking next to only the pension insurance plan.¹³ Statistical data show that from 2005 to 2010, the insurance income of NFIP was 17.3 billion USD, while the total compensation expenditure was 24 billion USD. Due to insurance compensation, the disaster aid expenditure of the American government is annually reduced by one-third, effectively remedying victims' property losses and serving as an important source of funds for after-disaster reconstruction.

Britain

Flooding occurs frequently in Britain and is considered one of the costliest types of natural disaster (Harries 2013). Flood insurance in Britain differs from that of other countries by being based on a "gentlemen's agreement" concluded between the British government and private insurance companies in 1961. According to the agreement, the government assumes responsibility for flood prevention, as well as regulating land use and real estate development and

¹² See U.S. Govt Accountability Office [Gao], National Flood Insurance Program: Greater Transparency and Oversight of Wind and Flood Damage Determinations are Needed 9 (2007), available at <http://www.gao.gov/new.items/d0828.pdf>.

¹³ See Flood Relief and Absence of Flood Insurance, Wang Yi News, 2016 available at <http://news.163.com/16/0707/02/BRBBATR0014AED.html>.

providing flood warnings, while insurance companies promise the government that they will provide flood insurance for residential properties through the market, in which the government promises not to intervene. British flood insurance is a type of private insurance, but it is almost compulsory in practice, as insurance for floods and other natural disasters are bundled in the same policy and homeowners are generally required to buy flood insurance when applying for mortgage loans (Surminski and Eldridge 2017).

After 1961, flood losses were transferred to insurance companies, so the British government was less proactive in flood prevention. In 1998 and 2000, flood disasters occurred once per year in Britain, exceeding the predicted losses of insurance companies. Hence, the gentlemen's agreement was suspended for 2 years. In 2002, the government and insurance companies signed a new gentlemen's agreement. According to the agreement, the government would reform land use planning and enlarge investment in flood prevention, while insurance companies would continue bearing flood insurance responsibility, but would also reform the conditions of coverage and insurance rates. When the flood insurance system was first established, insurance companies set no conditions and insured all who applied, but after the reform, insurance companies could reassess the insurability of insured properties and add additional conditions. To get flood insurance, the insured must obey government regulations concerning disaster prevention, and the insurance companies began charging different insurance rates for different insured persons to relieve the problem of adverse selection (Zhou 2012).

The most important trait of British flood insurance is that it is completely market oriented, meaning that commercial insurance companies follow the principles of commercial operation, act autonomously, bear their own benefits and losses and undertake risks. Commercial insurance companies determine the underwriting scope at will and determine insurance rates according to the actual risks of underwritten subjects. Moreover, these companies are responsible for managing their operations, including the sale of insurance policies and provision of relevant services. Insurance risks are completely borne by commercial insurance companies, who receive materials concerning flood risks (i.e., risk assessments, flood early warnings and climate research) from the government. In this way, commercial insurance companies can control flood risks, making them commercially insurable.

France

In 1981, a severe flood disaster occurred in France, and the French Parliament passed the Insurance Compensation

System for Natural Disasters.¹⁴ The law passing symbolized the formal establishment of a comprehensive catastrophe insurance system involving cooperation between commercial insurance companies and the government. The French catastrophe insurance system includes reinsurance service provision (i.e., sale of reinsurance policies for catastrophe insurance) by the state-owned Central Reinsurance Company. The main characteristic of this system is that the government provides the guarantee and accrues a "balanced reserve fund". The balance reserve fund is dedicated to providing catastrophe insurance services and is thereby different from general technical reserve funds such as the non-due liability reserve fund and the undetermined compensation reserve fund.

The French catastrophe insurance system comprises three steps. First, common commercial insurance companies sell policies to underwrite the insurance. Second, reinsurance service activities are implemented by the common insurance companies and the Central Reinsurance Company signing insurance contracts to underwrite the operating risks of insurance companies. Third, when insurance claims arise, the catastrophe reinsurance mechanism transfers and scatters the liabilities to the Central Reinsurance Company. French catastrophe insurance is a semi-compulsory comprehensive insurance system. When property insurance is purchased, catastrophe insurance will be automatically attached and cover floods, earthquakes, debris flow, snow slides, etc. The laws relating to catastrophe insurance also stipulate provisions for supervision: The responsibility of supervision falls to different government departments led by the Ministry of Finance. Since 1982, when the French catastrophe insurance system was established, all compensations have been paid by same-year insurance income and the reserve funds of the Central Reinsurance Company, with the government bearing no burden (Guo 2015).

Japan

Japan is located on a plate junction in the Pacific Rim earthquake zone, which accounts for an average of 10% of the world's earthquakes each year. Hence, developed through prolonged earthquake prevention processes, an effective earthquake insurance system has been in place since the nineteenth century. In 1966, the Earthquake Insurance Law was passed,¹⁵ which marks the point at which commercial insurance companies began providing earthquake insurance services and building the earthquake insurance system in cooperation with the government (He 2013). After this date,

¹⁴ See The Insurance Compensation System for Natural Disasters, 1981.

¹⁵ See The Earthquake Insurance Law, 1966.

many laws and regulations on catastrophe insurance, such as the Relevant Laws of Earthquake Insurance,¹⁶ were passed in quick succession to list natural disasters that could be underwritten for public residences, such as earthquakes, volcanic eruptions and tsunamis. In Japan, catastrophe insurance mainly involves earthquake insurance, with fire insurance as one of its prerequisites. Nevertheless, earthquake insurance is not compulsory, and it only underwrites family residences and other family properties and is not applicable to commercial buildings. Insurance rates are determined separately according to factors such as the type of structures, years of construction, materials and anti-seismic properties. Insurance policies last from 1 to 5 years and must be renewed when the duration exceeds 5 years.

The catastrophe risk insurance system in Japan creates a secondary reinsurance system in which the government and commercial reinsurance companies co-operate catastrophe insurance services and co-bear risks. Specifically, after underwriting catastrophe risks in the market, commercial insurance companies provide reinsurance to the Japanese reinsurance company. The reinsurance company divides the earthquake reinsurances into three categories. Some return to buy second-grade reinsurances from original insurance companies; some buy second-grade reinsurances from the Japanese government; and the rest reserve shares to be borne by themselves. Through these layers of reinsurances, the original insurance companies, the reinsurance company and the Japanese government become the final subjects sharing earthquake insurance risks. In addition, Japanese law divides compensation for catastrophe insurance into three grades and, according to different compensation limits, into four levels as well. On each level, insurers bears responsibility for different proportions of compensations that exceed the total limit. In this way, risks underwritten by the insurers are scattered.

Data analysis

Comparative analysis of systems in four countries

According to the above information, this study will analyze and compare the flood and/or catastrophe insurance systems in America, Britain, France and Japan regarding their risk-bearing subjects, characteristics and mechanisms. The main characteristics of these four systems can be represented as follows (Zhao 2009):

Country	Risk-bearing subject	Characteristics	Mechanism
America	Government bears actual risks within the limit	Independently run by the government	Within the limit, commercial insurance companies underwrite insurances and transfer them to the government or insurance organizations established by the government, while commercial insurances can be instituted at will for the exceeding part; after the insurance release, all the compensation responsibilities within the limit are borne by the government, while compensation responsibilities exceeding the limit are borne by commercial insurance companies
Britain	Commercial insurance companies are actual risk-bearing subjects	Independently operated by commercial insurance organizations	Commercial insurance companies directly underwrite insurances and transfer risks to commercial reinsurance companies
France	Commercial insurance companies are actual risk-bearing subjects but are subsidized by the government	Operated by commercial insurance companies and subsidized by the government	Commercial insurance companies underwrite insurances and scatter risks to the commercial reinsurance company or reinsurance organizations authorized by the government

¹⁶ See The Relevant Laws of Earthquake Insurance, 1966.

Country	Risk-bearing subject	Characteristics	Mechanism
Japan	Commercial insurance companies are actual risk-bearing subjects; the government is the actual risk-bearing subject within the limit	Co-run by the government and commercial insurance organizations	Within the limit, commercial insurance companies underwrite insurances directly and transfer all the risks to special reinsurance organizations, who spread the risks to commercial insurance companies and the government in the form of reinsurance for compensation exceeding the limit, and commercial insurances can be purchased at will for the exceeding part; after the insurance release, for the respective limits borne, the special reinsurance organization of the commercial insurance company and the government are responsible for compensation

The above analysis indicates that the four countries have quite different insurance systems and operating mechanisms. In Britain, the flood insurance system is dominated by the market, which brings advantages such as high flexibility and professionalism. Based on market indicators, the system could recognize disasters and analyze flood risk in a timely and comprehensive manner. Furthermore, commercial insurance companies have very strong professional and technological advantages, which can ensure service quality and satisfy the diversity requirement of flood insurance. With a powerful national economy and the world's third-largest non-life reinsurance market, insurance companies in Britain are wholly capable of providing insurance against flood risk.

In contrast, the American flood insurance system is dominated by the government. Based on effective and numerous flood insurance laws, the government uniformly plans flood insurances and provides insurance fee subsidies, allowing even low-income individuals to purchase plans and permitting flood insurance rates to be increased. Hence, a large-scale effect is realized in checking and claiming flood risks.

Compared to commercial insurance companies, the government commands more resources, such as public finance, so it has stronger competence and a larger credit line for the payment of disaster insurances. When disasters occur, the government can immediately execute its legal functions and power, exercising its legal compulsory force and ensuring a steady supply of flood compensation.

Differing from the single-subject modes in American and Britain, the catastrophe insurance systems in France and Japan involve both the government and commercial insurance companies. The French catastrophe insurance system is operated by commercial insurance companies and subsidized by the government. It is similar to the British system, except that the government and commercial insurance organizations jointly bear the insurance risk. The Japanese system is more similar to the American system, except that commercial insurance companies can participate as direct risk-bearing subjects, though the government still acts as the overriding loss-compensation subject when catastrophes occur.

On the other hand, the four countries are different in their risk dispersion mechanisms. Flood risk in Britain is underwritten only by insurance companies, with the government bearing no responsibility. The risk dispersion completely depends on insurance companies and reinsurance companies, who transfer the risks to the international market via reinsurance. France also transfers risks using the reinsurance market, but in contrast to Britain, the French government bears infinite guarantee responsibility and acts the subject of risk scattering. The risk dispersion mechanism in Japan is chiefly characterized by its utilization of a layered risk transfer mode and its secondary reinsurance market, which mean that limited risks are co-borne by insurance companies, reinsurance companies and the government.

Although the flood insurance systems of the four countries differ, they also have commonalities. First, the occurrence of catastrophic natural disasters directly promoted the development of catastrophe insurance law and its insurance system. The occurrence of catastrophes led to huge imbalances in the supply and demand of catastrophe insurance in the insurance market, drawing the attention of the government and directly promoting the establishment of a catastrophe insurance system in each country. Second, the "legislation first" principle was always obeyed in formulating the catastrophe insurance systems and their corresponding legal frameworks. Using laws and regulations as the basis of insurance systems effectively guaranteed the success and stability of catastrophe insurance systems and markets. Third, effective systems are one reason for the successful implementation of catastrophe insurances in four countries. Government-dominated countries such as America have well-developed and effective catastrophe insurance laws and regulations and powerful economies; countries dominated

by commercial insurance companies such as Britain have well-developed reinsurance markets; countries with joint participation of the government and commercial insurance companies generally find success through government transfer and the scattering of catastrophe risks (Li 2014). Despite their different systems, all the countries have established relatively effective catastrophe insurance systems that have developed diversified risk scattering mechanisms by dictating laws, leveraging the reinsurance market, establishing catastrophe insurance funds or applying other derived products of the capital market. Finally, these countries have established productive, responsible organizations to deal with matters concerning catastrophe insurance. Their names and specific functions may differ, but division of labor is explicit in each organization, allowing them to rapidly respond and give appropriate solutions to disasters.

Analysis of the applicability of American and British flood insurance systems to China

After summarizing four catastrophe insurance systems, the author finds that the American and British flood insurance systems are of greater referential significance to China for the following reasons: first, since the nineteenth century, the Chinese government has sent specialists to investigate the flood insurance system in America, preliminarily indicating a policy tendency (Zhang and Shao 2010). Hence, subsequent work on the development of the American flood insurance system can enhance the policy continuity of similar Chinese government research. Second, the Chinese government has worked on catastrophe insurance system before. As previously mentioned, China has established a catastrophe insurance system pilot project in Ningbo that failed during the 2015 flooding due to flawed insurance rules (Ningbo Civil Affairs Bureau 2016). Hence, rather than catastrophe insurance system, the authors believe that China should establish a dedicated and detailed flood insurance system, so this paper will further analyze and evaluate flood insurance system systems in America and Britain and their applicability to China.

The American flood insurance system has experienced many successes, aided by the fact that it not only provides insurance, but also engages in risk recognition and disaster reduction. The government has independent control of the insurance system, which is characterized by compulsoriness. However, this model has obvious deficiencies. As the risk-bearing subject, the government concentrates all the underwriting risks on itself, so it bears excessive risks and suffers higher stress to its financial budgets, while commercial insurance companies are only responsible for underwriting and compensating catastrophe insurance services and do not bear any risk responsibility. In the absence of substantial constraints, it is impossible to make commercial

insurance companies exercise due diligence in underwriting, compensating and consciously maintaining the government's interests. In 2004 and 2005, America experienced many hurricanes, hugely impacting national flood insurance and other catastrophe projects. This emphasizes the fact that the American flood insurance system is still deficient in risk assessment, rate confirmation, risk sharing, etc. and needs to be further improved (Gu 2012).

The British flood insurance system is wholly commercial, with flood risks being underwritten according to commercial principles (meaning the independent operation of and independent bearing of benefits and losses by the insurers), which appeals to the common interest of all participants (Surminski and Eldridge 2017). Britain managed to realize this commercial flood insurance system for two reasons. First, the country has an efficient insurance industry with a long history, according it powerful underwriting strength and abundant underwriting experience, as well as professional insurance expertise and a well-developed reinsurance market. In addition, insurance market competition provides the necessary guarantee for the successful operation of market-oriented flood insurance. On the other hand, the British government has set up an effective disaster prevention system, reducing the flood risks to a degree acceptable to commercial insurance companies. The British insurance industry believes that underwriting flood risks in standard insurance policies can facilitate risk scattering in broader insurance sets. In this way, and facilitated by sufficient insurance market competition, insurance costs can be kept as low as possible. Hence, commercial insurance companies are willing to provide flood insurance.

Based on China's national situation, the authors believe that it should not adopt a government insurance system like the one seen in America. First, the mechanism of catastrophe loss compensation in China is currently centered on governmental relief, which makes people dependent on the government. An American-style system cannot relieve people's sense of dependence or enhance people's awareness of the benefits of insurance. Second, it will pose huge challenges to China's financial sustainability. Due to government budget constraints, the trade-off effect may be amplified by government-financed flood insurance. Subsequently, such a program may worsen the government deficit. In addition, scholars have raised doubts about the financial problems caused by the existing flood insurance system in America. Third, the government-centered system cannot utilize the power of the market and lacks sustainable constraints on commercial insurance companies.

On the other hand, China cannot adopt the independently operating market-oriented system seen in Britain either. First, the Chinese insurance market is still in a state of preliminary development, and there is no developed engineering system for disaster prevention and loss reduction in

China. Hence, China lacks the basic preconditions of the commercial insurance model. Second, a market-oriented system cannot force people to buy flood insurance or regulate insurance rates. In addition, the public lacks familiarity with catastrophe risks, and there is little demand for flood insurance. People living in areas with better flood-resisting measures or lower risk are not willing to buy insurances, while there is stronger demand for insurance in middle and western areas and rural areas with relatively frequent flooding, but the residents cannot afford it.

Although neither American nor British flood insurance systems can be directly applied in China, some commonalities of both countries' systems are of great significance. First, flood insurances in Britain and America restrain the scope of underwriting. Residents and small entrepreneurs with weaker risk-bearing abilities are taken as the guarantee subjects. Second, insurance fees based on risk are established in both countries. Insurance rates are unit prices of insurance products. These rates should not only embody the principles of fairness and rationality, but also ensure that insurers have sufficient payment ability. In addition, insurance rates promote disaster prevention, loss reduction and the prevention of adverse selection. Flood insurance rates in both America and Britain are determined according to risk and the type of property under consideration, including the costs and uses of buildings. Third, both the British and American governments implement engineering measures for disaster prevention and loss reduction, including constructing anti-disaster infrastructures and providing insurance companies with relevant information, such as flood disaster risk assessments and early warning and climate research materials. Both countries can provide necessary disaster relief to the poor or those suffering multiple.

Suggestions

Based on the analysis above, the American flood insurance system may bring excessive risks and financial burdens to the government, while the British flood insurance system depends too much on markets and obfuscates the role of the government. Since the Chinese insurance market is underdeveloped, it cannot independently handle the operation of flood insurance. Hence, China cannot directly adopt existing flood insurance systems, though it is necessary to refer to existing practices to optimize and customize the flood insurance system according to China's national situation. Consequently, the following suggestions are proposed:

1. Issue special laws for flood insurance

The above analysis indicates that flood insurance is the most effective and rational way to provide disaster aid.

Internationally, a "legislation first" approach has been widely adopted in different countries. The national legislation on flood insurance should include specific guidelines for the operation and management of the insurance system and detail the rights and obligations of subjects involved therein to ensure the system's smooth implementation. Initially, legislating a flood insurance system will provide guidance for later practice, avoiding the awkward situation of a "lack of laws". Hence, effective flood insurance legislation is an important guarantee of a successful flood insurance system and a stable flood insurance market.

China has long suffered frequent natural disasters, but its insurance market is underdeveloped and cannot handle comprehensive risks of different types. Hence, China can refer to the successful single-item legislative model of America and formulate a dedicated flood insurance law. Guiding documents, including mid-term and long-term plans for accelerating the development of flood insurance, should be issued. The flood insurance law should also define the insurance system's general goals, main tasks, operation systems and its participants' functions, as well as national measures for encouraging and supporting flood insurance. Since the regional distribution of flood disaster risks is obvious in China, areas with high flood risk can be discerned from historical data. Moreover, the empirical research suggests that Chinese residents, especially those living in coastal areas with high-frequency flooding, are not all willing to accept flood insurance (Wang et al. 2012). Thus, insurance should be compulsory in such areas. If the laws and rules are only policy-oriented and not compulsory, social fairness will not be realized, and the authority of the laws will be reduced.

2. Establish a flood insurance system dominated by the government and supplemented by the market

Chinese flood insurance should be a compulsory commercial insurance based on legislative policy. China lacks a reinsurance market as developed as that in Britain. It is impossible for the commercial insurance mechanism alone to scatter risks and compensate losses. China also lacks the strong government financial support seen in America. If the losses caused by sudden catastrophes rely on national expenditures for restitution, the income-expenditure framework set by the financial departments will be broken, and the development of the national and social economy will be affected. Hence, both the market-dominated and government-dominated systems are not suitable in China. Instead, it is necessary to set up through legislation a flood-risk dispersion mechanism that is dominated by the government but supported by the commercial insurance system and supplemented by national relief, charitable donation and non-governmental relief.

At first, it will be necessary to emphasize the government's leading role in flood insurance development, formulating and perfecting the legal rules of flood insurance and defining and refining issues, such as the underwriting principles of flood insurance and the standards of insurance rates, loss settlements and compensation and reinsurance. During the program's implementation, the government should give proper insurance fee subsidies. For example, positive actions of the insured and the insurer should be incentivized through insurance fee subsidies, disaster relief funds, tax excitation, exceeding loss sharing, etc. In addition, flood risks will be rationally shared by individuals, the government and insurance companies, eliminating problems such as excessive financial stress on the government. In addition, underwriting the stress of insurance companies should be considered (for example, flood losses generated in Britain during 1998 and 2000 exceeded the predictions of insurance companies). Hence, in the flood insurance system in China, insurance companies should serve as direct operating subjects and bear certain percentages or shares of risk responsibility, while the government should provide policyholders with proper insurance fee subsidies and serve as a reinsurer for limited exceeding losses.

Second, based on the experience of British commercial flood insurance, the authors find that the Chinese insurance system should pay close attention to the roles played by the market-oriented operation mechanism. When promoting flood insurance, it is necessary to make full use of the market-oriented mechanism to motivate private insurers and policyholders. For example, insurance rates should be determined by the risks where market can accurately reflect actual risk of properties. The market competition mechanism should also be introduced in the formulation of flood risk maps, loss assessments, etc. to reduce the occurrence of speculation or moral hazards. Various market-oriented excitation mechanisms can be used to encourage policyholders engage in disaster and loss prevention.

3. Carrying forward securitization of flood insurance

Insurance securitization refers to a process of protecting against an uncertain event over a certain period, with the underwriting risks being transferred to the nationwide or even the worldwide capital market through sales of a corresponding securitized financial product (Wang and Huang 2016). Some developed countries such as America, and developing countries such as Mexico, have nearly 20 years of practical experience in investment dispersion and catastrophe risk transfer to capital markets using insurance-derived tools. As a country that frequently suffers flood disasters, China can impel flood insurance securitization while establishing its flood insurance system. At first, the Chinese catastrophe insurance market will develop continuously,

while the guarantee degrees of insurance and reinsurance markets for catastrophe risks will be limited. The securitization of catastrophe insurance risks will compensate for the deficiencies of reinsurance and can more effectively scatter catastrophe insurance risks. Second, foreign capital markets can provide more guarantees than the domestic market in market scale, investor quantity, perfectness of market systems, etc. Domestic investors have limited bearing capacity for risks, but the Chinese capital market possess some basic conditions required to securitize catastrophe insurance risks. In the earlier stages, foreign mature capital markets can be utilized, while China can later expand the securitization of flood insurance risks in the domestic capital market (Yang and Hu 2016). In the end, the successful use of catastrophe bonds abroad provides reference for the securitization of flood insurance risks in China. China can issue catastrophe bonds in pilot areas as a preliminary step to securitizing flood insurance.

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References

- Alexandros et al (2010) Urbanization, climate change and flood policy in the United States. *Clim Change* 103(3–4):597–616
- Gu MS (2012) Enlightenment of flood insurance system between Britain and the United States to China. *J Liaoning Univ (Philos Soc Sci)* 40(05):87–92
- Guo CQ (2015) On the construction of China's catastrophe insurance system: extraterritorial legislation experience and its reference. *Law Bus Res* 32(02):175–183
- Harries T (2013) Responding to flood risk in the UK. In: Rossetto T, Joffe H, Adams J (eds) *Cities at risk: living with perils in the 21st century*. Springer, Dordrecht, pp 45–72
- He L (2013) The progress and enlightenment of catastrophe insurance in Japan. *Disaster Sci* 28(02):127–130
- Huang YJ, Jiang XX (2009) Framework design and institutional innovation of China's flood insurance system—also on the development of domestic and foreign flood insurance. *J Jiangxi Univ FinanceEcon* 02:35–41
- King RO (2012) National flood insurance program: background, challenges, and financial status. Congressional Research Service, Washington, D.C.
- Li JY (2014) Construction of China's catastrophe insurance legal system. *Acad Exch* 04:56–60
- Mi JH, Long Y (2007) Research on catastrophe insurance in developed countries—based on the experiences of Britain, the United States, and Japan. *J Anhui Agric Sci* 21:6609–6610
- Myers BL (1976) The flood disaster protection act of 1973. *Am Bus Law J* 13(3):315–333
- National Research Council (2015) Affordability of national flood insurance program premiums: report 1. The National Academies Press, Washington, D.C.
- Ningbo Civil Affairs Bureau (2016) Ningbo catastrophe insurance: covering a wide range of public service models. *China Civ Aff* 10:21–23

- Ren ZL (2012) Research on the legal system of flood insurance in the United States—with an eye to the enlightenment of its transformation on China. *Tsinghua Law* 6(01):122–135
- Silvis VG (2017) Flooding by design: a look at the national flood insurance program. *Risk Hazards Crisis Public Policy* 9(1)
- Singer SJ (1990) Flooding the fifth amendment: the national flood insurance program and the “takings” clause. *Boston Coll Environ Aff Law Rev* 2:323
- Surminski S, Eldridge J (2017) Flood insurance in England—an assessment of the current and newly proposed insurance scheme in the context of rising flood risk. *J Flood Risk Manag* 10:415–435
- Wang LP, Huang DQ (2016) Analysis of the development of insurance securitization and its enlightenment to China. *Shanghai Insur* 12:41–46
- Wang WH, Wu SY, Chen XY (1999) Discussion on assessment methods of coastal erosion disasters. *J Nat Disasters* 01:71–77
- Wang M et al (2012) Are people willing to buy natural disaster insurance in China? Risk awareness, insurance acceptance, and willingness to pay. *Risk Anal* 32(10):1717–1740
- Xu L, Liu ZH (2005) Research on the relationship between bank and insurance in the financial symbiosis theory. *J Xinjiang Financ Econ Coll* 04:61–65
- Yang LP, Hu WH (2016) Experience and inspiration of foreign catastrophe insurance risk securitization. *Shanghai Insur* 08:46–49
- Zhang L, Shao YQ (2010) Discussion on establishing mode of flood insurance in China. *Insur Res* 8:68–73
- Zhao YD (2009) Comparative analysis and evaluation of flood insurance systems between UK and USA. *Manag Rev* 16:32–36
- Zhou XF (2012) Comparative study of catastrophe insurance system and its inspiration to China. *J Beijing Univ Aeronaut Astronaut (Soc Sci Ed)* 25(03):46–55

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