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Natural disaster insurance: public-private sector partnership[1]

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Abstract
The public sector should intervene in the natural disaster insurance market in order to increase economic efficiency and social welfare. However the governments should not put at risk the sustainability of public finance by undertaking excessive financial risks. Therefore, public-private sector partnership practices in natural disaster insurance are on the agenda. Public-private partnerships can incorporate some of the advantages of both public insurance systems and private insurance systems. In such insurance systems, government guarantees, fiscal incentives, regulations and private sector expertise come together. The insurance systems established in public-private partnership sectors should be designed appropriately to ensure sustainability. A sustainable public-private insurance system should include mandatory participation, risk-based premiums, encouraging risk-mitigation activities, risk transfer mechanisms. NFIP, CEA, CATNAT, TCIP, CCS, JER are successful examples of public-private sector partnership. However, these insurance systems do not have all the features that a good insurance system should have.

Keywords: Natural disaster insurance, public-private partnerships, mandatory participation, risk-based premiums, risk-mitigation, risk transfer mechanisms.

1. Introduction

In addition human repercussions, natural disasters have the potential to cause significant economic and fiscal damage. Damage-prevention investments seeking to mitigate risks made prior to disasters' occurrence are significantly more cost effective than paying out compensation after they have struck. Yet, since it is still impossible to prevent all losses incurred by disasters regardless of the precautions taken, both individuals and the public sector are obliged to take measures to distribute risk. Governments, for example, may develop a wide variety of financing tools to protect budgets from the fiscal costs incurred by natural disasters. Among those measures to be taken prior to disasters are an emergency fund, budget reserve, conditional credit, insurance tools, reinsurance or its derivatives, and capital market tools. Measures that may be sought following disasters include tax increases, redistributing the budget, credit, and external relief. Individuals, for their part, can distribute risk using insurance tools, savings and credit, government relief, and both third-party aid

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and donations (Linnerooth-Bayer et al., 2019). Natural disaster insurance emerges as one important risk distribution tool equally available to the public sector and individuals. Yet, supply and demand deficits may render natural disaster insurance coverage to be insufficient. Noy et al. (2017) list the basic reasons underlying insurance supply and demand deficits as follows:

Reasons for Demand Deficits

- Unpredicted risks
- Low financial literacy
- Government relief
- Underestimating risks

Reasons for Supply Deficits

- Ethical dangers and adverse selection problems caused by asymmetric information
- Limited technical expertise
- Limited fiscal capacity
- Limited access to the reinsurance market
- Lack of necessary data to perform risk management
- Uncertainty of risk
- Size of risk

The above reasons cited by Noy et al. (2017) illustrate that both market failures and behavioral biases may be found in natural disaster insurance. To complicate matters further, behavioral economists assert that humans do not behavior rationally during events that, despite having a low probability of occurring, have far-reaching repercussions, like natural disasters. In addition to insurance market ineffectiveness, (Kunreuther, Meyer, & Michel-Kerjan, 2013; Kuntreuther & Pauly, 2014; Kunreuther, 2015; 2016), systematic prejudices (Kahneman & Tversky, 1979; Laibson, 1997; Johnson et al., 1993; Tversky & Shafir, 1992; Kahneman, 2003), social comparisons (Friedl, Lima de Miranda, & Schmidt, 2014), and other similar behaviors lead to insurance supply and demand deficits. Furthermore, affordability problems stemming from an inequitable distribution of income may lead to insufficient insurance demand. All of these reasons necessitate that the public sector enlarge the insurance market to include natural disaster insurance. When, however, the fiscal risk to be shouldered by the government is considered, the number of voices calling for more effective public-private sector partnership increases. Furthermore, the guarantees and fiscal incentives able to be offered and the regulations able to be instituted by the government intersect with the public sector's expertise in public-private sector partnership.

In this study, the importance of natural disaster insurance established in public private partnership is examined. In this context, a descriptive analysis was performed on the theoretical/empirical literature and country examples. In the following section, the reasons and advantages of public private partnership in the natural disaster insurance are presented. In section 3, the characteristics of National Flood Insurance (NFIP), California Earthquake Authority (CEA), Catastrophes Naturelles (CATNAT), Turkish Natural Catastrophe Insurance Pool (TCIP), Consorcio de Compensacion de Seguros (CCS) which are important public private natural disaster insurance examples in the world are examined. In section 4, important details in public-private sector partnerships are discussed. These include mandatory participation, risk-based premiums, encouraging risk-mitigation activities, risk transfer mechanisms. Section 5 is the results.

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2. Reasons and Advantages of Public-Private Sector Partnership

While all types of natural disaster insurance are offered by the private sector in some countries, they are offered solely by the public sector in others. Public-private partnership in natural disaster insurance has witnessed an increase in recent years. The most fundamental reason for this is that private insurance companies have by and large exited the market after facing severe risks and uncertainties. For example, private insurance companies in the United States of America decided to leave the flood insurance market following the Great Mississippi Flood of 1927. After providing disaster relief for several subsequent decades, the government eventually established the National Flood Insurance Program (NFIP) in 1968 (Atreya, 2015). In 1992, Hurricane Iniki caused Hawaii's largest insurance company to declare bankruptcy, which in turn provoked several companies to depart from high risk areas like the hurricane-prone Caribbean and Pacific (Pelling et al., 2002). A large number of private insurance companies withdrew from the market following the 1994 earthquake Northridge that occurred in California, USA. As a result, the public-administrated California Earthquake Authority (CEA) was founded in 1996 (CEA, 2019). Following the 1999 Turkey-Kocaeli earthquake, insurance companies either refused to offer insurance to buildings that were not earthquake resistant or would only do so after being paid high premiums. The initiation of a general insurance plan was subsequently deemed necessary (Özerdem, 2000), leading to the establishment of the Natural Disaster Insurance Institutions (TCIP).

Public-private sector partnership in natural disaster insurance[4] offers several solutions to market failures, behavioral biases, income distribution, and other similar problems. For example:

- The government, by acting as a guarantor, is able to offer extreme risk insurance,
- Coverage may be expanded by making insurance mandatory,
- An economy of scale may be achieved,
- Awareness may be raised by conducting educational programs,
- Databases and risk models may be constructed through research programs,
- Premiums may be reduced through cheaper access to capital, and
- Affordability issues may be resolved through premium subsidies.

In their analysis conducted in China, Ma, and Jiang (2018) concluded that public-private sector partnerships were Pareto efficient in mitigating and distributing natural disaster risks. The risk management model that they developed revealed that in a competitive system based on public-private sector partnership, insurance companies were able to set reasonable premiums. In order to set appropriate insurance premiums and to ensure insurance demand, governments can devise policies that effectively distribute natural disaster risk. In other words, it is still necessary to enlarge the insurance market in order to protect the state budget from fiscal risks even in cases where post-disaster government relief is more Pareto efficient than insurance (Jaffe & Russell, 2013).

3. Examples of Public-Private Sector Partnership

Various countries whose natural disaster insurance systems are managed through public-private sector partnerships may be cited. Depending on the country in question, different motivations exist for governments creating insurance systems based on public-private sector partnerships to deal with the dangers caused by natural disasters. In some countries, disaster risk is shared through a solidarist understanding, in others, precautions are taken to protect against the fiscal risks that the government may face, and in even others, preemptive interventions are taken against market failures. While coverage for nearly all natural disaster risks is offered in some countries, frequently occurring disasters are excluded from coverage in others.

[4] Systems where private and public sector admistrative infrastructures are used in conjuction and in which tax exemptions, government guarantees, government reinsurance, financial and fiscal incentive mechanisms, mandatory insurance, and other similar programs are implemented are defined as public-private partnerships.

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3.1. National Flood Insurance (NFIP)

In the USA, the aforementioned NFIP and CEA are two well-known natural disaster insurance programs in which public-private sector partnership prevails. Founded in 1968, the NFIP is a federal program that controls the flood insurance market throughout the country. The most essential factor underlying the NFIP's foundation is the desire to limit federal disaster relief. Insurance companies act as financial tools in the provision of insurance policies. The Federal Emergency Management Agency (FEMA) is responsible for the NFIP's administration. Mortgage owners supported by the Federal Loaning Institution are required to participate in the NFIP (FEMA; McAneney et al., 2016; Paudel, 2012). In addition to premium payments, the NFIP's financial resources include credit provided by the federal government. In NFIP policies, differences in premiums primarily reflect the degree of risk of a specific area. This way, the program seeks to finance itself. However, it has become apparent that this is not possible in practice. Before devising flood insurance maps, a high percentage of owners of old buildings are offered subsidies. Premiums represent only 35-50% of actual risk. The NFIP does not have a risk protection mechanism in the private reinsurance market (Paudel, 2012). Offering deductions to those households that accepted flood management standards (McAneney et al., 2016), the Flood Mitigation Assistance program was founded in 1994 so that owners of NFIP policies could make investments to mitigate flood risks (Kousky, 2017). This encouraged NFIP policy owners to take risk-mitigating actions necessary to sustain a high-quality insurance system. However, there are several negative characteristics of the program, namely that (i) the NFIP's equalization reserves are not tax exempt, (ii) mandatory participation is limited, (iii) premiums are heavily subsidized, and (iv) it is impossible to reinsure risk. Limited mandatory participation has greatly restricted flood insurance from making deep penetrations into the market. Moreover, a small risk pool only serves to increase financial risks and just as high subsidies increase the government's fiscal burden, so too does the inability to reinsure in the private sector increase the government's overall fiscal risk.

3.2. California Earthquake Authority (CEA)

Since the 1980s, insurance companies selling home insurance have been legally required to offer earthquake insurance in California. In addition to this, the vast majority (95%) of private insurance companies left the market following the Northridge earthquake. The CEA, a nonprofit, public-run, private sector-financed earthquake insurance agency, was subsequently founded in 1996. Covering only residential dwellings, the CEA provides two-thirds of all residential earthquake insurance in California (CEA, 2019). In 2016, new regulations were laid out by the CEA in which coverage limits, coverage, and deductions were diversified. The CEA used 5% of the income collected from investments in risk-mitigation activities, even offering financial relief to homeowners who make efforts to reduce their risk. A risk-reducing incentive scheme is run through the Earthquake Brace+Bolt Program established under the joint authority of the CEA and the California Governor's Office of Emergency Services. Homeowners who partake in risk-mitigation activities are offered up to a 3,000 USD grant (CEA, 2018). Like a tripod, the CEA model stands on three legs. Autonomy in their activities encourages freedom in participation, on the one hand, and both financial and actuarial robustness under public guidance, on the other. The members of the CEA's administrative board are composed of public servants. Since participation in insurance policies is not mandatory and premiums are determined in such a way that reflects risk, taxpayers' money is not used. In addition to this, the CEA does not pay federal income tax (Marshall, 2017). CEA premium rates are calculated based on the type of building, the year it was built, and the area's risk of an earthquake occurring. However, high premium rates have led to homeowners' decreased participation in the CEA (Noy et al., 2017).

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3.3. Catastrophes Naturelles (CATNAT)

Catastrophes Naturelles (CATNAT) was established in France in 1982 following several floods that occurred in Southwest France. Realized by expanding property and accident insurance coverage, CATNAT is a mandatory insurance system founded on the notion of national solidarity in which 90-98% of the population is covered. Private insurance companies are responsible for compensating for disaster risks, premiums for insurance policies are determined by the Central Tariffs Office, and insurance companies collect premiums, manage policies, and pay out compensations. Whereas premiums were initially set at 2.5%, they have subsequently increased to 12% for home and business insurance and 6% for automobile insurance. Since its founding, CATNAT has offered wide-range coverage and compensation for catastrophic events when states of emergency are declared. Both equalization and technical reserves need to be created in order to minimize fluctuations in loss ratios for insurance companies and reinsurers. These reserves are exempt from taxation up to a certain limit. Insurance companies can obtain reinsurance from either the private market or from the Caisse Centrale de Reassurance (CCR), a state-supported and legally-authorized company. Insurance companies can also opt to reinsure risk through the CCR. In the event that the CCR's reserves are depleted, the French government offers unlimited reinsurance security (Paudel, 2012; GAO, 2005, 33-34; OECD, 2017, 165-166). Paudel (2012) asserts that problems of adverse selection emerge as a result of good risk's being privately reinsured and bad risk's being reinsured by the CCR. Paudel further states that problems of adverse selection do not occur in Spain's CCS system (Consorcio de Compensacion de Seguros) because both good and bad risk is covered by the public sector. The fact that premiums do not reflect risk levels and that individuals partaking in risk-mitigation activities receive no premium discounts under CATNAT further discourages risk-mitigation investments and causes moral hazard problems.

3.4. Turkish Natural Catastrophe Insurance Pool (TCIP)

Occurring on August 17, 1999 and causing severe loss of life and property, the Marmara Earthquake led to the creation of the non-profit Turkish Natural Catastrophe Insurance Pool (TCIP) in the year 2000. This mandatory earthquake insurance pool seeks to reduce damages caused by earthquakes. Being a public-private sector partnership, its 7-member administrative board is composed of five public servants, one private sector official, and one university representative. The TCIP offers reinsurance through the private sector. Whereas residential dwellings are covered by the TCIP, commercial and industrial buildings, public buildings, buildings in rural areas, and buildings constructed in conflict with regulations are not covered. Premiums are determined based on three criteria: (i) risk zone (5 classes), (ii) building type (3 classes), and (iii) buildings' gross square footage. Relatedly, Turkey's seismic hazard map was revised in 2018 and will be used in determining new risk premiums beginning in 2020. The TCIP has stated that it seeks to maintain premium amounts at an affordable level for all citizens. Discounts are offered in the event that the following criteria are met: (i) insurance policies are renewed annually, (ii) the building's construction permit was issued in 2007 or later, and (iii) all residences within the building/complex are insured. In an attempt to increase the number of residential dwellings covered by the TCIP, Turkish legal regulations require that households seeking to enter into electric and water contracts, to take out residential loans, or to perform title deed transactions have an earthquake insurance policy. Despite these efforts, however, only 51.70% of residential dwellings are covered (TCIP, 2019; TCIP, 2018). Since households are offered no discounts for partaking in risk-mitigation activities under the TCIP, there is no incentive to engage in them. This notwithstanding, the TCIP does take precautionary measures and also organizes informational programs to increase awareness of the risks posed by earthquakes and to reduce their potential damage. Additionally, the TCIP provides support for the creation of an earthquake risk map.

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3.5. Consorcio de Compensacion de Seguros (CCS)

Following Spain's 1941 civil war, the Consorcio de Compensacion de Seguros (CCS) was established to organize Spain's insurance companies to deal with claims related to natural disasters and other unforeseeable events. Covering all insurance policies related to fire, natural disasters, motorized vehicle damage, property damage, and personal accidents, the CCS evolved into a public-private partnership in 1945. Not bound to any government budget, the CCS has private legal status and its own assets. Whereas seven of the 14 total members of its administrative board are senior administrators of private insurance companies, the remaining seven are composed of public servants (CCS, 2019; McAneney et al., 2016). While private insurance companies devise mandatory insurance policies for natural disaster damages, the public sector is responsible for ensuring that risks are covered and that insurance policyholders' demands for compensation are satisfied. The government provides unlimited guarantee to the CCS. Insurance premiums are determined by the CCS based on the property type insured. Private insurance companies, however, are responsible for collecting premiums. Insurance policyholders who do not partake in risk-mitigation activities receive no discounts or risk-based premiums (Paudel, 2012).

4. Important Details in Public-Private Sector Partnerships

Because private insurance companies face great risks and uncertainties, they often opt either to leave the natural disaster insurance market entirely or to demand that a high premium be paid for insurance policies. The government, however, is able to offer public insurance programs as an alternative to private sector insurance. For example, insurance is provided by the public sector in Switzerland, Romania, and New Zealand. However, high transactional and fiscal costs of public insurance (Noy et al., 2017), providing low premium insurance for high-risk properties from public insurance pools (McAneney et al., 2016), an excessively high demand for subsidized insurance, an increased tax burden of subsidized insurance for subsequent generations (Smetters, 2004), and other similar issues constitute important points of contention against public sector insurance. This causes there to be insufficient premiums in the insurance pool. In the event that a natural disaster strikes, the public budget is therefore forced to compensate for losses, which in turn increases taxpayers' burden. In fact, it may even be the case that families with both high incomes and high risk are subsidized by low-income earning taxpayers, a phenomenon that prevents private insurance companies from entering the market.

That said, the aforementioned problems related to public insurance also exist in public-private sector partnerships. Giving the Florida Keys as an example, Perrow (2007, 31) states that the government taxed the poorer segments of the population in order not only to improve the infrastructure of at-risk regions but also to subsidize insurance payments. Government guarantees and public reinsurance may create burdens with undisclosed conditions for the government while also burdening taxpayers with significant costs (Noy et al., 2017). On the one hand, public-private insurance partnerships are necessary to solve affordability problems resulting from market failures, behavioral biases, and problems in income distribution. In such partnerships, the government takes on several responsibilities, including subsidizing premiums, providing reinsurance, and acting as a guarantor. On the other hand, however, the government must also bear in mind potential fiscal crises resulting from a major disaster without increasing taxpayers' burden. As such, it is an absolute must that public-private sector partnerships be appropriately designed.

A well-designed insurance program should have a financial risk transfer mechanism that is cost-effective and financially sustainable, that fulfills damage post-disaster damage demands, and whose market penetration is high (Noy et al., 2017; Skees & Barnett, 1999). Paudel (2012) delineates nine main areas of particular note in natural disaster insurance, these being:

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- Mandatory participation,
- Creating efficient implementation and follow-up mechanisms,
- The government's shouldering of a portion of extreme risks in order to ensure financial feasibility and offer appropriate premiums,
- Private insurance companies' participation in public-private insurance plans,
- The integration of risk transfer mechanisms,
- Using tax exemptions to encourage increases in insurance reserves,
- The integration of risk-mitigation policies into the insurance system,
- Detailed assessments and risk mapping, and
- Offering financial incentives to insurance policyholders that encourage them to take part in risk-mitigation activities.

The above list consists of characteristics deemed necessary for a good insurance system. Certain aspects become more prominent when they are evaluated in a public-private sector partnership context. Private sector technical expertise and market experience should be exploited and a competitive structure should be maintained in public-private sector partnerships. Just as the government should not incite moral hazard in their use of tax incentives and subsidies, risk-mitigating activities should be encouraged through regulations. In order to increase market penetration, legal, financial, and fiscal arrangements should be made. Moreover, the government should conduct scientific studies, create risk maps, and develop zoning standards in order to construct a viable infrastructure to support the insurance system. These issues are evaluated below in their own main subheadings.

4.1. Mandatory Participation

In insurance systems were participation is voluntary, the problem of adverse selection is very frequently observed. While high-risk individuals prefer to purchase insurance, low-risk individuals are reluctant to pay insurance premiums. For this reason, creating a suitable risk pool is improbable in volunteer-based insurance systems, thereby causing premiums to increase and, over time, leading low-risk individuals to exit the market completely. Moreover, natural disaster insurance has specific characteristics that differentiate it from other types of insurance. One of these is the amount of damage claims faced by insurance companies in the event that a natural disaster occurs compared to other types of damage claims. Since the risk pool is insufficient in such a scenario, it may be impossible for insurance companies to compensate for all losses.

Behaviors biases constitute a separate problem, as they hinder claimants from making rational decisions and cause the number of insured residences to remain insufficient. Kousky and Kunreuther (2018) found that families prefer to purchase insurance against disaster risks common in their own regions and not to purchase insurance for more frequently occurring dangers in other regions of the country. Consequently, insurance companies have difficulty diversifying disaster risks.

In the event of a natural disaster, political conditions may cause implicit contingent liabilities to emerge. Both families incurring damage and the labor market might depend on government relief. This called the charity hazard problem in the literature (Raschy & Weck-Hannemann, 2007) and the charity hazard may cause insurance demand to remain low. Mandatory participation is an appropriate method to enlarge and diversify the risk pool, as it serves to increase the total number of policyholders participating in the pool. An increase in the number of insured properties reduces risk for insurance companies, the need for government relief, and the burden on taxpayers.

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4.2. Risk-Based Premiums

Premiums in private sector natural disaster insurance are generally set high. Advanced prediction models are necessary to predict the location, frequency, duration, and size of potential catastrophic events. One of the reasons for this is the inability to accurately determine risks. When the market is small, insurance companies may not find it profitable to invest in technologies with high fixed costs. In the absence of dependable risk assessment predictions, insurance companies may opt to set premiums near those of developed countries (Auffret, 2003). Furthermore, premiums generally tend to be high when insurance companies are unable to differentiate between risk zones and households' degree of risk (Auffret, 2003). Consequently, low-risk households are observed to be used to subsidize high-risk households. In public insurance, however, premiums may be set low and governments may greatly subsidize premiums either for political reasons or to solve affordability problems. Doing so, however, may result in high-risk households being subsidized by general taxpayers. That said, severely subsidized premiums cause moral hazard problems in both scenarios. In natural disaster insurance offered by public-private sector partnerships, it is essential that premiums reflect real risk instead of simply being arbitrarily high or low, as doing so affords many benefits. One of the most salient benefits is that the problem of moral hazard is eliminated, which allows communal resources to be used more efficiently and equitably. This particular public-private setup also increases the insurance system's financial sustainability. Severely subsidized premiums may cause insurance companies to exhaust their resources in the event that damage is incurred by a natural disaster. The public sector can support or conduct high fixed-cost research to encourage the creation of risk prediction models so that premiums may be determined using risk maps. However, it is still possible that high-risk individuals with low incomes are unable to afford high premiums in this scenario. Stating that low-income households' general taxpayer revenue or insurance policyholders' income from taxes may be subsidized, Kousky and Kunreuther (2019) and Kunreuther (2016) emphasize that this subsidization must be implemented for individuals residing in at-risk areas. In a similar vein, the premiums of individuals deciding to settle in potential hazard zones should not be subsidized, even if they earn a low income because settling in high-risk areas should be discouraged. There are several advantages in setting premiums that reflect real risk and that are maintained at an affordable level in public-private insurance partnerships. Administrative costs are high in pure public insurance, and private sector insurance can help decrease these administrative costs by benefiting from its experience in the insurance market. Furthermore, mandatory insurance allows economy of scale advantages to be exploited by increasing the number of insured households.

4.3. Encouraging Risk-Mitigation Activities

As stated by Noy et al. (2017) and McAneney et al. (2016), disaster insurance deals first and foremost with the accurate pricing of risks and risk transfer and is not, by itself, a risk-mitigating mechanism or social policy tool. Since insurance does not directly save lives and since it indirectly increases human welfare, it is more important that risk be reduced in the first place. That said, insurance, by causing moral hazard (Stiglitz, 1983), can actually reduce risk-mitigation activities. But Hudson et al. (2017) do state that moral hazard may not necessarily emerge in disaster insurance. Based on their econometric analyses performed in Germany and the USA, they found insurance and risk-mitigation activities to serve a complementary function. Likewise, Botzen et al. (2017) found that moral hazard did not always appear in disaster insurance. Petrolia et al. (2015) concluded that, contrary to economic theory predictions, purchasing natural disaster insurance reduced risk-mitigation activities. Hanger et al. (2018) found that appropriately designed insurance systems may encourage risk-mitigation activities, with premiums constituting just one component of appropriately designed systems. Kleindorfer et al. (2012) and Poussin et al. (2014) state that incentives like insurance premium discounts are an appropriate tool for encouraging risk-mitigation activities. Governments may offer tax deductions or other incentives to companies and households that invest in risk mitigation (Dayton-Johnson, 2004, 34). Mol, Botzen, and Blasch (2018) state that

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because of behavioral characteristics (e.g., risk avoidance, effectiveness of perceived safeguards, apprehension toward disasters), premium discounts may increase investments made toward damage mitigation. Not only do financial and fiscal incentives offered to reduce damage risk afford benefits for policyholders and insurers, they also decrease the costs of public-private insurance systems in the long term. Additionally, because the benefits afforded through risk mitigation cannot be fully obtained by insurers in a competitive market (Paudel, 2012), the public sector is responsible for the majority of risk mitigation policies. Consequently, the government needs to make regulations so that risk mitigation activities may be integrated into the insurance system. Likewise, devising building codes and land regulations, conducting educational campaigns to increase community awareness of natural disasters, creating early warning systems, producing risk maps, and other similar activities are the responsibility of the public sector.

4.4. Risk Transfer Mechanisms

Insurance companies may find themselves completely depleted of reserves following a natural disaster. One safeguard to this is to transfer risk through reinsurance. However, purchasing reinsurance from the private market increases costs and causes premiums to exceed actuarial values (Paudel, 2012). Government provision of reinsurance is frequently encountered in public-private insurance partnerships. This way, risk may be transferred at low costs, which not only affects premiums but also increases insurance affordability. However, governments may offer limited or unlimited guarantees in public-private sector insurance systems. Government guarantees eliminate the prospect of private insurance companies' extreme risk reserves from being depleted. Moreover, there are doubts as to whether the public sector will be able to use public-private partnerships in order to benefit from government support (Noy et al., 2017). While unlimited government guarantee and public reinsurance reduces private sector costs, risk may consequently fall unto the shoulders of the public sector. Like in the example of CATNAT, individuals may prefer to reinsure bad, as opposed to good risk. Moreover, both public reinsurance and government guarantees cause the total amount of risk to increase within the country, which in turn leads to an increased burden on both the government budget and taxpayers. Since fiscal crises may emerge when extremely high-risk events occur, the degree of coverage offered by public reinsurance and government guarantees is an essential component in public-private sector partnerships. Governments may give limited guarantees for insurance compensation claims, and disaster bonds may be used to transfer a portion of risk may to the international capital market in public reinsurance. In addition to insurance companies' technical reserves, regulations may be devised for the creation of tax-exempt equalization reserves.

5. Conclusion

Natural disaster insurance is an appropriate tool to distribute natural disaster risks. However, private natural disaster insurance coverage remains insufficient because of market failures, behavioral biases, and income distribution problems. Consequently, the number of countries entering into public-private sector partnerships for natural disaster insurance has witnessed an increase in recent years. Public-private sector partnerships are able to benefit from several advantages offered by both public and private insurance systems. In addition to this, it is necessary for insurance systems based on public-private sector partnership to be appropriate designed so that they may be sustainable. It is essential that participation be mandatory, that premiums reflect real risks, that risk-mitigation activities be encouraged, and that the system have a risk transfer mechanism in a sustainable public-private insurance system. Mandatory participation enlarges the risk pool by increasing overall insurance coverage and risks are able to be diversified. An increase in the number of insured households reduces the need of public relief. Moreover, since moral hazard is decreased when premiums are determined based on the degree of risk, low-risk individuals are not financed by high-risk individuals. The burden on taxpayers does not increase when premiums are based on risk instead of being severely subsidized. Since the total amount of

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reserves in the insurance system increases, the danger of reserves being depleted is also eliminated. Insurance systems encouraging risk-mitigation activities offer long-term benefits to households, insurance companies, and the public sector. The number of compensation claims also decrease because the amount of damage caused by natural disasters is reduced. Public reinsurance, government guarantees, and equalization reserves may be used as risk transfer mechanisms. Public reinsurance and unlimited government guarantee may also cause risk to intensify in a country. Since risks may be transferred from the private sector to the public sector, it is necessary to approach unlimited government guarantees with caution. In public reinsurance, however, appropriate mechanisms must be developed so that risk may be transferred to the international capital market.

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