Optimal Nuclear Liability Insurance

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Despite their low probability of occurrence, nuclear catastrophes are very tangible threats. The Fukushima-Daiichi disaster that occurred in March 2011 for instance, led the Japanese authorities to evacuate 150 000 people up to 20 kilometers around the damaged power plant. Solely for the purpose of decontamination, indemnification and decommissioning, the Japanese government now expects a cost of 177 billion euros, three times higher than its 2013 estimate, and some believe that this is still a too conservative assessment. Confronted with such potential damages, States are liable to organize the prevention, protection and indemnification of citizens. Adequate indemnification is achieved by setting liability rules that determine how potential victims are compensated, and who bears the costs of these compensations. Taking as given the prevention and protection behaviors of the States, we focus attention on the design of an optimal liability scheme, from risk sharing perspective. On the one hand, a high level of liability reduces the risk of potentially dramatic and un-insured losses, hence mitigating the adverse consequences of a catastrophe for risk averse citizens. On the other hand, low probability—high severity risks, such as large-scale nuclear accidents, are systemic and therefore they cannot be covered through usual insurance mechanisms. Designing a liability scheme for those risks therefore entails the use of innovative risk transfer mechanisms such as cat bonds, in addition to the more traditional issuance of sovereign debt. These instruments may be efficient to handle risks such as nuclear accidents, but their cost is bound to be passed-on, at least partially, to the final energy consumers and/or to taxpayers. In this context, we show that the optimal mechanism provides the same deductible insurance contract to all individuals, whatever their distance from the source of risk. Our model also allows us to characterize the optimal apportionment of the total liability between the State and the nuclear operator, which entails two tiers of liability. A first tier is born by the operator, while a second tier is supported (almost fully) by the State, in accordance with the prescriptions of nuclear international, such as the Paris and Vienna conventions. A numerical calibration of the model allows us to study the optimal liability level for nuclear risk in France, a country that produces over 70 % of its electricity through nuclear power plants. Using Probabilistic Safety Assessments of a nuclear reactor and considering various loss scenarios, we characterize the risk exposure of French citizens. Thanks to a new cat bond market database, as well as a simple modelling of the cost of sovereign debt, we assess the cost of setting up such an optimal liability scheme. Considering the most likely accident scenarios, we find that the French liability law could be significantly improved, by providing higher level of risk coverage.

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