Auctions for new and undiversifiable risks

Catherine Bobtcheff, Carole Haritchabalet and David Alary

This project develops an explanatory model for the insurance of undiversifiable and new risks. Certain large unconventional risks such as terrorism, nuclear power production, environmental protection or pandemic risks cannot be borne by a single insurance company. Indeed, when the amounts of claims are very high, they exceed the financial capacity of insurers, equity and reinsurance included. In addition, the regulation of insurance companies requires a minimum level of capital and a target capital to absorb such risks (Solvability II in the European Union for instance): a single insurer can hardly fulfill this condition. Finally, these so-called unconventional risks are often poorly understood, the claim history being limited or even non-existent. All these characteristics explain the difficulty of their coverage by a standard insurance mechanism. A widespread practice in the insurance industry to achieve co-insurance is to set up “ad-hoc co-insurance agreements”. Ad-hoc co-insurance agreements are developed in the market, facilitated and negotiated by a broker. Such cooperations not only directly and significantly increases the financial capacity of participating insurers, but also allow to organize information sharing on the nature and intensity of the risks insured. The latter characteristic is crucial for the insurance of unknown and new risks since the sources of information are often dispersed, moving and heterogeneous.

We propose to develop a unified theoretical model using auction theory to analyze these ad-hoc co-insurance agreements. Our theoretical model builds on a simplified representation of insurers’ interactions based on empirical findings of a report commissioned by the European Commission (2014). Even if some country-specific differences exist, they share some common features. The prevalent procedure for the conclusion of an ad-hoc co-insurance agreement is broker-led within a two-stage auction, defining a leading insurer and following ones. The leader’s selection process may combine the following factors: capacity, premium, insurer’s expertise or reputation, terms and conditions of the offer. As European Commission (2014) note, “*the followers are usually invited to either accept or decline or take a share of the risk on the same terms and conditions as the lead insurer*”. Based on this, we propose to study a simplified scenario where ad-hoc agreements operate as a uniform price auction with an “exit/re-entry” option and in which a leading insurer is selected on the basis of the more competitive bid premium.

Following the observations drawn up, we incorporate several key ingredients to our modelling strategy. First, the undiversifiable nature of the risks causes a shortage of insurance capacity so that a single insurance company cannot insure such risks. These capacity constraints may come either from legal solvency regulation constraints and capital requisites that are imposed to prevent from insurers' bankruptcy or from the characteristics of the risk itself. Second, when contemplating insuring new risks whose knowledge is limited, insurers use their own expertise to evaluate them. Each insurer has its own learning on the occurrence probability of the risk. At the industry level, this creates informational asymmetries not only between insurers and insureds, but also between insurers. The contracts' terms will not only depend on insurers' beliefs on the probability of the risk, but also on the functioning rules of the coinsurance agreement. Third, we will deal with the most general case in which the insurance of such risk

is not mandatory. Policyholders may remain uninsured or partially insured if insurance is too costly (see Kousky and Cooke (2014) for instance). In terms of modelling, we will assume that insureds have a reserve price.

The game we consider is then a particular auction of a common value divisible good between capacity constrained agents who have private information in presence of a reserve price. We refer this particular auction as the "Flexible Uniform auction" (FU auction). We characterize the equilibrium risk premium of this auction and the resulting insurance capacity offered. We then compare the outcome of the FU auction to a discriminatory auction (in which each insurer offers its own conditions (capacity and premium)), an auction format also prevalent in the insurance sector. This leads us to compare different auction pricing rules and to understand the role of the exit/re-entry option. These auction formats are compared with respect to premiums and coverage, taking into account the impact of different markets and characteristics (intensity of competition and risk aversion via the reserve price). We then provide two kinds of results: some results directly help the insurance industry and other complete the auction literature.

Let us first discuss the outcome of the FU auction. We determine the unique equilibrium in symmetric and strictly increasing bidding strategies. Conditional on bidding, the equilibrium strategy completely reveals the signal an insurer observed. The reserve price implies the existence of a maximum signal determining the participation to the first stage of the auction. The equilibrium then exhibits both a complete market failure (no insurance) when both insurers have private pessimistic evaluations (above the threshold) and a partial market failure (partial insurance) when only one insurer is pessimistic about the risk. The re-entry option impacts these market failures in two ways: insurers refrain from bidding ex-ante (increasing the no-insurance region) but an insurer always has the possibility to re-enter the auction ex-post if he discovers that his opponent received a good signal (increasing the full insurance region). All these market failure regions are affected by the parameters of the model: intensity of the capacity constraints and reserve price. Increasing competition has two opposite effects on coverage: partial coverage is more likely but the proportion of uninsured risks decreased. A larger reserve price unambiguously increases insurance coverage: full coverage is more likely, and in case this latter is not achieved, partial coverage occurs more often when the reserve price increases.

Let us now turn to the discriminatory auction. We show that the equilibrium in symmetric and strictly increasing bidding strategies is semi-separating or separating and also involves some complete and partial market failure regions. The nature of the equilibrium and the maximum signal determining the participation depend on the parameters: intensity of competition and reserve price. The more intense the competition (weak capacity constraints), the smaller the bidding regions. Similarly, the smaller the reserve price, the smaller the bidding region. Also, the bidding regions in the discriminatory auctions are always larger than in the FU one. However, we may observe full insurance with the FU auction and partial insurance in the discriminatory auction when the leader is optimistic enough about the risk occurrence and re-enters. The follower's position is essential to understand the efficiency of a given auction format. In the FU auction, the follower does not take any risk, but only enjoys relatively low profits (because of uniform pricing). On the contrary, in the discriminatory auction, the potential negative profit of

the follower is counterbalanced by higher premiums. It must be noted that the comparison of the equilibrium bidding strategies differs from the comparison of the premiums. If pricing is uniform in the FU auction, the leader and the follower offers different premiums in the discriminatory auction, the follower's premium being larger. The difficult comparison of the equilibrium bidding strategies makes the comparison between the premiums quite involved.

Both auction formats then lead to different coverage/premium tradeoffs and the analysis shows that ex-ante there is no clear dominance of one auction format. When we compare these two auctions ex-post (for any possible realization of the two insurers' signals), we show that if at least one insurer provides an optimistic expertise about the risk, the FU auction offers higher coverage. At the opposite, if all insurers receive pessimistic information, the discriminatory auction offers a better coverage. If insurers agree about the ex-post evaluation of risk, the FU option has less scope so that the size of the bidding region is key to determine the insurance coverage. The discriminatory auction therefore offers more coverage. On the contrary, if insurers receive opposite evaluations, the exercise of the re-entry option allows to increase insurance coverage.

We provide some results about the ex-ante comparison of auctions for the case of completely new risks (insurers' signals are therefore independent). We show that a regulator aiming at maximizing the expected coverage should promote the FU auction when the reserve price is low enough or when competition is high enough. Indeed, in these two cases, the bidding regions of the two auction formats converge to the same region. As a result, the FU auction allows to increase insurance coverage.