Proposal Applying for 2009 Russell Ackoff Doctoral Student Fellowships

Applicant: Chieh Ou-Yang (Wharton, Insurance and Risk Management)

1. Project title and descriptive summary:

Parimutuel Insurance for Hedging against Catastrophic Risks

Pari-mutuels have been extensively used in various betting markets, especially horse races. Nowadays, they are also applied for trading derivatives in financial markets by investment banks[1]. In October, 2008, Weather Risk Solutions, LLC (WRS) invents Hurricane Risk Landfall Options (HuRLOs)[2], an innovative commodity option that applies pari-mutuels. Both hedgers and speculators can trade HuRLOs on the hurricane risk among Gulf of Mexico and East Coasts of the U.S. The trigger event is one of the covered regions being first hit by a hurricane during a year.

A comparison of pari-mutuels with traditional insurances in terms of policyholder's cash flows indicates that if the probability of the hurricane's occurrence is high enough such that the traditional insurance premium is greater than the loss minus the net indemnity, pari-mutuels dominates traditional insurances across all outcomes.

This paper uses the case of hedging against catastrophic risks as an example and applies pari-mutuels to insurance contracts. We construct two models where a risk-averse individual make decision on the pari-mutuel stakes to hedge against potential catastrophes. In the first model, an optimal stake choice is obtained when total stakes on the target area placed by other participants and total stakes outside the target area are exogenous given. The optimal stake can be obtained by equating marginal cost of a net payoff with the ratio of the expected marginal utilities in the payoff state and the no payoff state. When the odds and the conditional probability of a hurricane hitting the target areas are available, we can derive the dynamic optimal hedge rule based on the

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[1] Deutsche Bank and Goldman Sachs introduced the first Pari-mutuel Derivative Call Auctions of options on economic data releases, including employment, industrial production, economic growth, and inflection, etc.

[2] In 2008, HuRLOs trade via the WRS electronic trading platform on the Chicago Mercantile Exchange Alternative Marketplace, Inc.'s (CME AM) exempt board of trade (EXBOT) and clear by the CME. Their prices are determined first based on a historical hurricane risk database and then interact dynamically by trading decisions made by all participants via a mathematical adaptive control algorithm that adjusts in a way that makes the selected outcome in the last trade more expensive and other outcomes less expensive. Detailed procedures of the algorithm are presented in Meyer et al. (2008).

above equation. In the next model, the equilibrium of the pari-mutuel stake is derived based on a representative agent's optimal choice. Without transaction fee and tax, the pari-mutuel insurance intrinsically leading to underinsurance due to basis risks, a result that is inconsistent with the traditional insurance[3]. Furthermore, the sensitivities of the equilibrium of the pari-mutuel stake with respect to the potential loss caused by a hurricane, the conditional probability of the hurricane hitting the target area given that it occurs, and the conditional probability of the individual's asset being destroyed given the hurricane hits the target area, are all positive. However, the sensitivity of the equilibrium of the pari-mutuel stake with respect to the initial wealth is ambiguous.

As a novel tool for hedging against catastrophic risks, the pari-mutuel has both advantages and disadvantages. The main advantage of the pari-mutuel insurance is that insurers bear no underlying risks. Other advantages include: better liquidity, less default risk, potential basis gain for participants, cost reduction for insurers, more flexible in contracts, and ameliorating adverse selection and moral hazard. Except for the key shortcoming, pari-mutuel insurance policyholders being underinsured, those disadvantages are as follows: uncertain price in trading, not suitable for hedging information-sensitive risk, the potential less cash flow, and the trigger event having to be mutually exclusive.

In this study, the pari-mutuel market is analyzed with only hedgers. However, the market may have both hedgers and speculators. Empirical anomalies, such as the favorite-longshot bias, may result from the participation of speculators. Taking speculators into consideration may affect the optimal stake choice for investors. Moreover, in practice, in horseracing and lottery games that utilize pari-mutuels, the track take generally ranges from 15% to 25%, which is not trivial and deviates from our assumptions. Accounting for the transaction fees and taxes, our results could alter sharply.

2. Name of primary faculty member with whom the student is working:
Professor Neil Doherty

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[3] Based on Mossin's theorem, if proportional insurance is available at a fair price, without loading factor and default risk, full insurance is optimal for a risk-averse individual.