Prediction Markets and Risk Management

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Outline

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  - What are prediction markets?
  - How do they work?
- Properties of prediction markets
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  - Returns
- Uses in risk assessment and management
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- Management
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  - Resource Allocation
- Concluding Remarks
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- Appendix
  - Some prediction markets of interest for risk assessment and management

Introduction
What are Risks?

- “Global Risks” 2007, Global Risk Network Report identifies:
  - Economic
  - Environmental
  - Geopolitical
  - Societal
  - Technological

What Are Prediction Markets?

- Futures and options markets with
  - Payoffs tied to events of interest
  - Designed specifically to
    - Aggregate information and
    - Forecast
- Example: The Iowa Electronic Markets (IEM)
  - www.biz.uiowa.edu/iem

2008 IEM Presidential Markets

- Tied to Election Outcomes
- “Vote-Share” Market
  - UDEM08_VS
    - Pays $1 x Democratic % of 2-party vote
  - UREP08_VS
    - Pays $1 x Republican % of 2-party vote
- “Winner-Takes-All” (Binary Option) Market
  - DEM08_WTA
    - Pays $1 if Democratic % of 2-party vote > 50%
  - REP08_WTA
    - Pays $1 if Republican % of 2-party vote > 50%
How do Prediction Markets Work?
Mechanics

- Traders
  - Open account and
  - Place orders through the internet

- Exchange
  - Accepts orders in a time and price ordered queues
  - Clears trades when orders cross or are accepted

- IEM allows traders to create contracts
  - Unit portfolios (1 of each contract) can be purchased from or sold to exchange at any time

How do Prediction Markets Work?
Theory: Re-Insurance Pricing

- Borch K.
  - “The Safety Loading of Reinsurance Premiums,”

- Contingent claim prices reflect
  1. Relative state probabilities and
  2. Relative endowments in states

- Unit portfolios ⇒ constant endowments
  ⇒ Contingent claim prices ONLY reflect state probabilities
  ⇒ Prices = Expected Values!

How do Prediction Markets Work?
Theory: Modern Option Pricing

- Brealey, Myers and Allen, 8th Ed., pg. 568

\[
Pr(Dem) = \frac{r - (-1)}{1 - P_{Dem}} = (1 + r)P_{Dem} = Pr(Dem) = \frac{Pr(Dem)}{1 + r}
\]

- Unit portfolio ⇒ 1 = \frac{Pr(Rep)}{1 + r} \Rightarrow Pr(Rep) = Pr(Dem) \Rightarrow r = 0

⇒ \( P_{Dem} = Pr(Dem); P_{Rep} = Pr(Rep) \)
How do Prediction Markets Work?

Practice

- Current laboratory and field work suggests the following avenues:
  - Information sharing
  - Information aggregation
  - Information production
  - Dynamic feedback
  - Trader self-selection
  - Trader role selection

Prediction Markets and Risk Management

Properties of Prediction Markets

IEM Vote Share Accuracy

IEM Vote Share Accuracy

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<th>Item</th>
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<td>72%</td>
<td>87%</td>
<td>76%</td>
<td>70%</td>
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<td>49</td>
<td>30</td>
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<td>129</td>
<td>268</td>
</tr>
<tr>
<td></td>
<td>% market</td>
<td>93%</td>
<td>71%</td>
<td>91%</td>
<td>96%</td>
<td>66%</td>
<td>74%</td>
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</table>

- Returns appear to follow efficient (Bayesian) random walk

Sources:

IEM WTA Price Dynamics

Content removed because of journal publishing requirements


IEM WTA Price Dynamics: Modified Binomial Tree

Content removed because of journal publishing requirements

IEM WTA Price Dynamics: Modified Binomial Tree

Content removed because of journal publishing requirements


Prediction Markets and Risk Management

Uses in Risk Assessment and Management

- Assessment
  - Assessment of known risks
  - Identification of unknown risks
    - “Other” contracts
    - Trader proposed contracts
- Management
  - Hedging
  - Resource Allocation
Assessment Example: Influenza Markets


Identification of Unknown Risks: 2008 Republican Convention

Source: Data from www.biz.uiowa.edu/iem
Identification of Unknown Risks:
2008 Republican Convention

Fred Thompson

Source: Data from www.biz.uiowa.edu/iem

Identification of Unknown Risks:
Trader Proposed Contracts

- Forsight Exchange
  - www.ideosphere.com
  - Traders propose and judge contracts
- DARPA
  - Proposal for traders to propose contracts
- Some corporate interest

Hedging Example
Chicago Mercantile Exchange

- Heating Degree Days
- Cooling Degree Days
- Cumulative Average Temperature
- Frost Days
- Snowfall
- Hurricane
  - Landfall x Carvill
  - Hurricane Index

Note: IEM in its third year of trading small scale hurricane markets
Resource Allocation Example:
IEM Influenza markets

- 2 weeks warning is enough time to:
  - Reschedule elective surgeries
  - Ship saline
  - Cancel vacations and leaves of medical personnel
  - Recommend alternative work arrangements and other preventive measures

Prediction Markets and Risk Management

Concluding Remarks

Strengths

- Anonymity
- Allows a common language
- Incentives for Information Production
- True information AGGREGATION
- Speed
- Flexible Design
Weaknesses

- Legal issues
- Public relations issues
- Information issues
- Manipulation(?)
- Trader Heuristics and Biases
- Self invalidation

What About Trader Biases and Heuristics?
Marginal Traders and Rationality

Action Classification by Role


An Issue: Self-Invalidation
Example from “Company X”

- Two processes “A” and “B” create vulnerabilities for Company X
- Company X want to assess relative likelihood of loss from the two vulnerabilities
- Contracts:
  - “ALoss” will pay $1 if loss occurs from process A first
  - “BLoss” will pay $1 if loss occurs from process B first
- Company X will devote loss prevention resources based on this market
An Issue: Self-Invalidation
Example from “Company X”

- The contracts are self-invalidating
- Why?
- What is the outcome?
- How could they fix this problem?
  - A: Conditional Contracts
    - Run loss contracts conditional on allocation of resources across A and B
  - For conditional contract description and uses see:

Prediction Markets and Risk Management

The KEY Issue: Contract Design

For more information:
IEM:  www.biz.uiowa.edu/iem
Vaughan Institute:  http://www.biz.uiowa.edu/insurance/
Personal Webpage:  http://www.biz.uiowa.edu/faculty/rietz/
E-mail: Thomas-Rietz@uiowa.edu
Appendix

Some Prediction Markets of Interest for Global Risk Assessment and Management

Some Prediction Markets and Markets with Prediction Style Contracts

- Iowa Electronic Markets
  - [www.biz.uiowa.edu/iem](http://www.biz.uiowa.edu/iem)
- Hedge Street
  - [www.hedgestreet.com](http://www.hedgestreet.com)
- Chicago Board of Trade
  - [www.cbot.com](http://www.cbot.com)
- Chicago Mercantile Exchange
  - [www.cme.com](http://www.cme.com)
- InTrade
  - [www.intrade.com](http://www.intrade.com)
- Cantor Fitzgerald / Hollywood Stock Exchange
- ForeSight Exchange
  - [www.ideosphere.com](http://www.ideosphere.com)

Markets of Interest: Core Global Economic Risks

- IEM
  - Federal Funds Rates
  - Has rights to economic indicator markets
  - In the past ran on unemployment and inflation
  - Proposed: Run on “misery” index.
- Chicago Board of Trade
  - Federal Funds Rates
- HedgeStreet
  - Federal Funds Rates
  - CPI
  - Crude Oil and Natural Gas
  - Housing Prices
- InTrade and Foresight Exchange
  - Range of contracts
  - Financial outcomes well covered by “regular” financial markets
Markets of Interest:
Core Global Environmental Risks

- IEM
  - Hurricane Landfall
  - Proposed: EPA global warming market
- Foresight Exchange
  - Big West Coast quake by 2010
  - Atlantic tropical storms
  - CO2 level 2030
- InTrade
  - Hurricane
  - Global warming

- Chicago Mercantile Exchange:
  - Event (Landfall) Markets based on Carvill Hurricane Index (CHI)
  - Heating/Cooling Degree Days
  - Cumulative Average Temperature
  - Snowfall and Frost

Markets of Interest:
Core Global Geopolitical Risks

- DARPA
  - “Terrorism” Markets
  - Outcomes of strategies
- InTrade
  - US/Israeli air strike against Iran
  - US Military action against Korea
  - EU act of terror before 2010

Markets of Interest:
Core Global Societal Risks

- IEM Health Markets
  - Influenza, Mumps and Avian Flu
- Foresight exchange
  - Smallpox returns<2010
  - flu-pandemic before 2010
  - Cancer cured by 2010
  - Eventual Collapse of Universe
- InTrade
  - Bird Flu
Markets of Interest:
Core Global Technological Risks

- Foresight Exchange
  - Numerous technological markets
- InTrade
  - Numerous technological markets