Designing Information Markets for Decision Making

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Objectives

- Define a decision market
- Preview main results
- Propose a model of a decision market
- Explain key results
- Conclude
Two Definitions

• An *information market* is a market for contracts that yield payments based on the outcome of an uncertain future event
  – *e.g.*, an election outcome, East Anglia rainfall, *etc.*

• A *decision market* is an information market with a decision linked to the equilibrium price
  – Provides *new* incentives for agents to trade
    • *e.g.*, the decision maker and “manipulators” may trade
Preview of Main Results

• The decision maker will choose to trade (at a loss) in a decision market
  – When the market is illiquid
  – When information is more important for her decision

• The decision maker’s liquidity subsidy
  – Enhances the informational efficiency of the market price and the linked decision
  – Reduces the influence of other interested parties
Motivating Decision Markets

• Better information can improve decisions
  – Experts have information about others’ decisions
• Asset markets aggregate information naturally
  – Markets are often quite informationally efficient
• Various decision markets have been proposed
  – *e.g.*, to choose the best election candidates, the best fiscal, monetary and regulatory policies, *etc.*
Current Decision Market Research

• Researchers address three primary issues
  – Decision markets may be illiquid or uninformative
  – Decision markets may be manipulated
  – Decision market prices may be biased predictors

• But we lack formal models of *decision* markets
  – In information market models, the DM is missing
  – We could model the DM as an optimizing agent
A Decision Market Model

• Has the potential to address all three questions
• Traders *and the decision maker* maximize their total profits (and/or other sources of utility)
• All variables of interest arise endogenously
  – Liquidity, manipulation and price informativeness
Illustrative Example

• Consider a market for local rainfall
• A local farmer’s total profits depend on his crop production and his trading gains/losses
• This farmer decides how much seed to plant
• Another (uninformed) farmer’s profits also depend on the amount of seed planted
• Optimal amount of seed depends on rainfall
• An expert can observe a signal about rainfall
Timeline for a Decision Market

• Rainfall market clears in a batch auction
  – Expert and farmer #2 submit market orders
  – Market maker sets a price based on sum of orders
• Farmer #1 chooses a seed quantity based on the clearing price of rainfall
• Actual rainfall is realized
  – Profits from production are realized
  – Trading profits are realized
Important Assumptions

• Rainfall is contractible
  – Different from the mechanism design literature

• Rainfall is independent of seed planted
  – This is reasonable for rainfall
  – But this assumption fails for causal effects
    • Example: impact of investment on firm value
    • Clever IV and/or random policy mitigate this problem
Equilibrium Pricing and Decisions

• The market price depends on both experts’ signals and manipulation
• The decision depends on this market price
• Interested experts foresee this decision rule
  – They trade to try to influence the decision
  – Only their unexpected trades have any impact
Will the Decision Maker Intervene?

• Some market intervention is optimal
  – When the market is illiquid
    • *i.e.*, there is little random manipulation (or noise)
  – When information is important for the decision
    • *e.g.*, rainfall is important for production

• Intervention increases market liquidity
  – Decreases the DM’s trading profits, and
  – Increases the DM’s production profits
Interpretation and Intuition

• The DM can subsidize market liquidity in two ways
  – (Direct) market maker role or (indirect) trader role
  – The two mechanisms are sometimes equivalent

• The liquidity subsidy has (at least) three effects
  – Increases the expert’s trading (and total) profits
  – Reduces the decision influence of the manipulator
    • By increasing the cost of distorting the price
  – By construction, increases the *total* profits of the DM
Variation in the Liquidity Subsidy

• Liquidity supplied by the manipulator and the decision maker are substitutes

• Other features of the liquidity subsidy
  – The subsidy is necessary only in illiquid markets
  – The decision maker always sets liquidity greater than a competitive market maker
  – The decision maker sometimes trades when there would otherwise be no trade
Price Sensitivity vs. Manipulation Uncertainty

Decision Market Maker's Price Sensitivity to Order Flow (Inverse Liquidity)

Uncertainty in Manipulator Objectives

- \( \lambda^* (c = 0.5) \)
- \( \lambda c (c = 0.5) \)
- \( \lambda^* (c = 1.0) \)
- \( \lambda c (c = 1.0) \)
- \( \lambda^* (c = 2.0) \)
- \( \lambda c (c = 2.0) \)
Traders’ Profits vs. Degree of Manipulation

![Graph showing the relationship between trader profits and uncertainty in manipulator objectives. The graph has two lines: one representing an informed trader and the other a manipulator. The legend indicates different types of traders: Informed Trader, Manipulator, and Decision Maker.](image)
Liquidity Subsidy vs. Degree of Manipulation

![Graph showing the relationship between decision maker trading profits and uncertainty in manipulator objectives for different values of c.]
Conclusions

• Linking a decision to the price in an information market changes the equilibrium
  – Decision makers sometimes trade at a loss
  – Manipulators will trade in decision markets

• Decision maker liquidity subsidies can
  – Enhance the informational efficiency of market prices and the linked decisions
  – Reduce manipulative influence