Using information markets in grantmaking.
An assessment of the issues involved and an application to Italian banking foundations

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Outline

- The idea behind
- Problems in large-scale grantmaking
- Types of information markets
- Why do they work?
- A proposal
- Mechanism design issues
- Conclusions

The idea behind

- On Jan. 28th 1986, the space shuttle Challenger lifted off from its launch pad at Cape Canaveral. Seventy-four seconds later, it blew up.
- Within minutes, traders started dumping the stocks of the four major contractors who had participated in the Challenger launch:
  - *Rockwell International*, which built the shuttle and its main engines;
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- Immediately after, trading in Thiokol was suspended. By the end of the day, the stock was down almost 12%.
- By contrast, the stocks of the three other firms fell a little but soon started to move back up. By the end of the day they had fallen only around 3%.
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The idea behind

- Useful information is dispersed.
- Markets bundle the collective knowledge of individuals and aggregate available information to produce best estimate, not least because those who know and are best able to process the information invest the most.
- Information markets share a common structure with betting, but differ for the purpose to which they are put.
- Information markets are tools explicitly designed to extract and gather information which can inform business and policy decisions.

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Problems in large-scale grantmaking

- **High-impact philanthropy**. Transformative solutions on a large scale (*€100 million problems*). Endowed foundations in a right position to act as social innovators.
- **Biases in deliberation**. Informational (deference) and social (fear of sanctions) pressures may prevent the disclosure of private information.
- **Board members' expertise**. The knowledge of the people in charge of granting funds may be incomplete, especially on game-changing projects or on geographic contexts far from those in which they usually operate.

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Prices transmit information

- Three future (mutually incompatible) events (*A*, *B*, *C*).
- Members of a group N (= $N_1 + N_2$) try to predict the event.

- Suppose the subset N_1 knows with certainty that A will not occur …
- … while the subset N_2 knows with certainty that B will not occur.

- If the two groups could share their private pieces of information, all of them would know that the event C will occur for sure.

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Prices transmit information

- Introduce a market with three securities such that:
  - Security α will pay €1 if A occurs, and 0 otherwise;
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Types of information markets

- **Winner-take-all contracts**
  - A contract pays €1 if an event occurs, and €0 otherwise.
  - Price interpretation: market's probability the event will occur.

- *Example*
  - A contract pays €1 if Janet Yellen is appointed as the new FED Governor, and €0 otherwise.
  - Current price = € 0.89.
  - Interpretation: 89% chance that Ms. Yellen will be the next FED Governor.

Types of information markets

- **Index contracts**
  - A contract pays a payoff comprised between €0 and €1, depending on the outcome of an underlying event.
  - Price interpretation: market's expected value of the event.

- *Example*
  - A contract pays €0.01 for any percentage point of the estimated €70 billion capital shortfall EU banks will plug by the end of 2014.
  - Current price = €0.62.
  - Interpretation: market's forecast of new capital raised by EU banks by the end of 2014 is €43,4 billion.

Types of information markets

- **Spread contracts**
  - A contract pays a predetermined payoff if an indicator is above a spread value *y*.
  - Price interpretation: median value of a given event.

- *Example*
  - A contract pays even money if the unemployment rate in Nov. 2013 is higher than 12%.
  - Market trades based on *y*% (I'll buy 10 units at *y* = 12).
  - Interpretation: the median value of the unemployment rate *y* next month (this is a fair bet if the payoff is as likely to occur as not).

Types of information markets

- **More complicated contracts**
  - Carefully constructed markets can reveal information about the distribution of an uncertain future event.
    - An index contract a pays x^2.
    - An index contract b pays x.
  - Market prices reveal $E[x^2]$ and $E[x]$.
  - In general, contracts can be constructed to provide any desired order statistic about distributions.

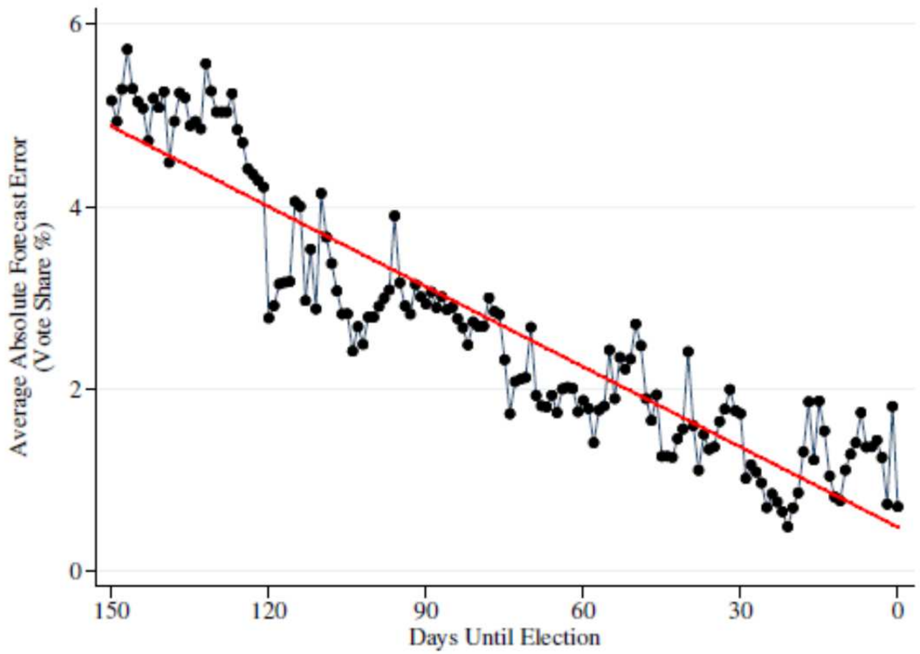
Types of information markets

- **Contingent markets**
  - The contract pays if an event will occur, conditional on a second event.
  - Price interpretation: conditional expected value of an event.

- *Example*
  - A contract pays €1 if the FED starts *taper* by the end of the 2014-Q1 conditional on Janet Yellen being the FED chair, and €0 otherwise.
  - Current price = €0.48.
  - Interpretation: the market expects the FED will cut its stimulus in the next 6 months if J. Yellen is the new Governor.

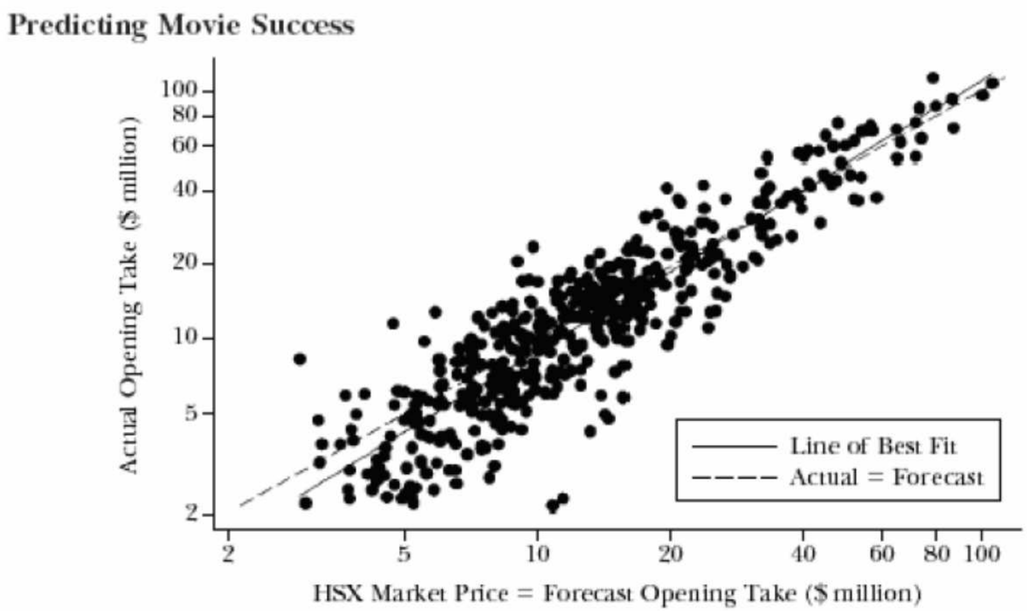
Do IMs work?

- <u>Presidential elections</u>
  - Absolute error: 1.5% compared to 2.1% error of polls



Do IMs work?

- <u>Box office revenues</u>
  - Very close forecast throughout 489 movies

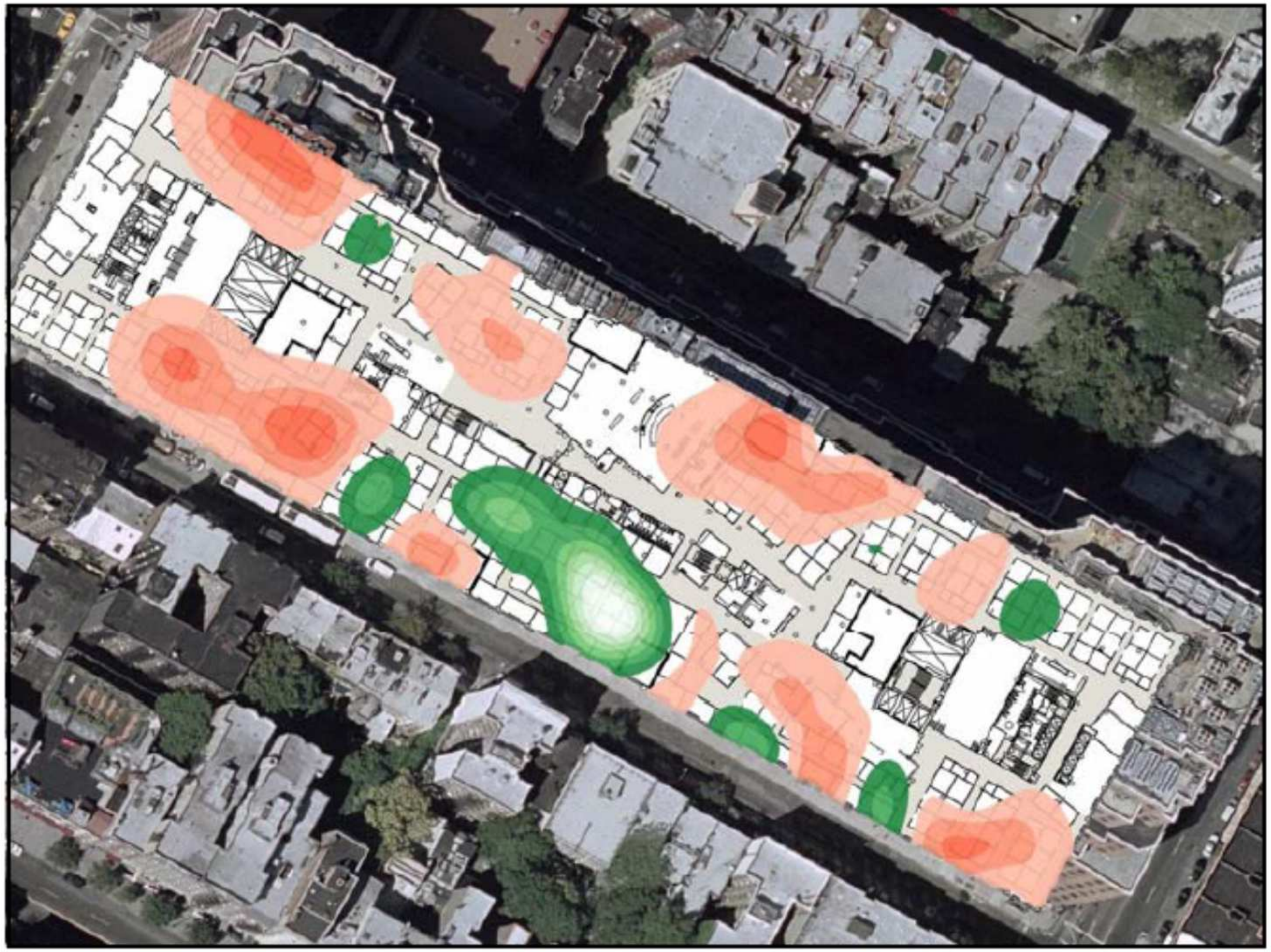


Do IMs work?

- Business applications

  - *HP*: forecasts of printer sales
  - *Siemens*: forecasts of project delivery times
  - *France Telecom*: forecasts on technology questions (e.g., Will Skype reach X million users by Y date?).
  - *GE–Hitachi Nuclear Power*: ideas markets to help answer business questions (e.g., What new technology ideas should we be investing in? What new products should we be developing?')
  - *Google*: forecasts of product launch date, new office openings and other strategic and organizational questions.

Do IMs work?



And why?

- **Theory**
  - Hayek (1945), The Use of Knowledge in Society, AER.

    The economic problem of society… [is] how to secure the best use of resources known to any of the members of society, for ends whose relative importance only these individuals know.
  - Essential insight: price is a mechanism for communicating information.
  - Efficient market hypothesis.

A proposal

- **Step 1**: **Call for proposals**
  - Identify a small set of areas, and issue a call for proposals for new projects.
  - Multifaced approach to maximize creativity.
  - Projects must be easily scalable to a large scale.
  - *Examples*
    1. Increase students' achievement.
    2. Shrink childhood poverty.
    3. Promote youth safer and healthier behaviors.

A proposal

- **Step 2: Markets for new ideas**
  - Use markets to generate and evaluate new ideas.
  - Start with a given number of virtual stocks associated to projects, and let traders to buy, hold or sell according to their beliefs on the projects' potential.
  - New stocks can enter the market through an IPO procedure.
  - Traders know that the most valuable stocks have the highest probability to be taken to the implementation stage.
  - Traders are rewarded according to the NAV of their portfolio as the market closes.

A proposal

- **Step 3: Contingent markets as a decision-support tool**
  - Design a set of securities based on combinations of events, so that each contract pays a positive payoff *iff* a certain event W occurs, provided that a second event Z has already happened.
  - Two possible applications.

Step 3 – Application 1

- Suppose the area chosen for making grants is "*Increase students' achievement*". A foundation want to collect information on the potential of similar projects proposed by different nonprofits.
- Target: set to zero the proportion of pupils below score 400 in the next round of PISA tests.

Step 3 – Application 1

- Let *S* be a particular project under scrutiny, x_T the average score in 2015 of the sub-sample of pupils which scored below the threshold in 2009, and $L_T = \min\{(x_T/400), 1\}$.
- A first pair of winner-take-all securities are then offered such that:
  a) The contract WTA_SY pays €1 if *S* is chosen, and 0 otherwise. The market price of this security is p_S.
  b) The contract WTA_SN pays €1 if *S* is not chosen, and 0 otherwise. The market price of this security is p_{notS}.

Step 3 – Application 1

- In addition to that, a second pair of index securities are designed such that:
  c) The contract I_SY pays €L_T *and* S is chosen, and 0 otherwise. The price of this security is q_S.
  d) The contract I_SN pays €L_T *and* S is not chosen, and 0 otherwise. The price of this security is q_{notS}.

- By construction, the two index securities pay a maximum amount (€1) if the goal set by the foundation - in this case, to cancel out the fraction of students below 400 points - is achieved.

Step 3 – Application 1

- The contracts a) and b) are such that the actual prices reflect the market expectations that *S* occurs or not, that is $p_S = E(S)$ and $p_{notS} = E(notS)$.
- The prices related to the contracts c) and d) reflect joint expected values, i.e. $q_S = E(L_T, S)$ and $q_{notS} = E(L_T, notS)$.
- We want to know the market's conditional expected value, $E(L_T | S)$. By the rule of conditional probability, $q_S = p_S E(L_T | S)$.

Step 3 – Application 1

- Set up two markets in which traders can exchange contracts.
  1. A market α, where shares of WTA_SY can be exchanged against shares of I_SY.
  2. A market β, where shares of WTA_SN can be exchanged against shares of I_SN.
- In equilibrium, the price ratio $\lambda_S=(q_S/p_S)$ represents the market's expected achievement conditional on the project being funded $E(L_T|S)$, while the correspondent price ratio $\lambda_{notS}=(q_{notS}/p_{notS})$ is the market estimate of the expected achievement if the project is not implemented $E(L_T|notS)$.
- If $\lambda_S > \lambda_{notS}$, the market expects the fraction of low-scoring students to be lower if the project S is approved than if not.

Step 3 – Application 2

- Suppose the area chosen for making grants is "*Shrink childhood poverty*". A foundation wants to collect information on the likely benefits and costs of a social program.
- Combine an information market with a reverse auction (*pay-for-performance* scheme).
- Let the consensus on the average cost for letting a child escape absolute poverty being €500.

Step 3 – Application 2

- Set up a conditional information market in which two index securities are traded.
  - The first contract will pay €0.01 for every 500 children who succeed in coming out of poverty at a given date, if and only if a project to attack the problem is funded.
  - The second security has a similar payoff structure, but final payments are conditional on the project not being implemented.

Step 3 – Application 2

- Suppose the price of the first security is p=1.12 and the price of the second one is p=0.18.
- Thus, the market is expecting that 56,000 children will be helped to escape poverty if a suitable program is developed, but also that 9,000 children are expected to be out of poverty at a given date regardless of it.
- Hence, the expected social value added of funding a project is to help 47,000 children, which amounts to a budget of 23.5 million euros.

Step 3 – Application 2

- Now run a reverse auction. Starting from a reserve price of €500 per unitary outcome achieved, prospective grantees can bid the price down according their internally estimated costs per child.
- Bids are then ranked from the lowest to the highest, allowing the auctioneer to determine which charity is the most competitive.
- Suppose that the bid of the winner is €460.
- Devise a contract with the grantee stating that the target of 47,000 children must be reached at a given date, and to do it the grantee receives payments amounting to a total 21.62 million euros (47,000 x 460).

Step 3 – Application 2

- If the established goal is achieved the foundation saves 1.38 million euros from its initial budget.
- This buffer that can be used to provide additional incentives to the grantee, as soon as the contract states that for any additional child snatched away from poverty over the 47,000 ones originally targeted, the consortium will pay €500 until exhaustion of the buffer.
- The charity can get €40 of extra funding for each child lifted out of poverty in addition to the contractual target, while the donor succeeds in reaching a possible maximum of 2760 more children without increasing the original budget.

Issues in market design

- **Market microstructure**
  - Continuous double auction *vs*. Market scoring rules.
  - Admit short-selling to limit bubbles and herding behaviors.
  - Manipulation.
  - Thin market.

Issues in market design

- **Accessibility and comprehensibility**
  - Real money *vs*. play money.
  - Increase participants' interest.
  - Final monetary prizes to best performers.
  - Provide traders with instructions and training.
  - Computer-based platforms.

Issues in market design

- **Initialization and duration**
  - If using play money, give each trader an initial endowment of shares and virtual cash.
  - Calibrate market liquidity.
  - Randomly determined closing.

Conclusions

- Asymmetric and incomplete information is a relevant problem in the decision-making process of grantmakers.
- Information markets are useful and practical tools to collect and aggregate dispersed information.
- Markets can be designed to be incentive-compatible (market scoring rules).
- Ease of implementation.

Thank you all!

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