Information Markets: Feasibility and Performance

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Information markets - also called 'prediction markets', 'decision markets', 'event derivatives', 'event futures,' and 'idea futures' - are markets designed specifically for the purpose of generating accurate information. Participants buy and sell assets whose payoffs are tied to the realization of future events. To illustrate, an information market might be used to forecast box office receipts for a new movie. A contract (or asset) might, for instance, pay $1 if ticket sales are above some pre-specified level by a pre-specified date and $0 otherwise. A market price of $0.43 would then be interpreted as a 43% chance of success.

Probably the best known information markets are the Iowa political markets.[1] These markets were set up in 1988 by Iowa university academics to allow the public to "bet" on US presidential elections. Since their creation many more applications have emerged and now markets predict a wide range of events. Researchers at the University of Iowa have gone on to develop a market to forecast outbreaks of Avian Flu,[2] whilst their contemporaries at the University of Miami have established a Hurricane Futures Market.[3] Elsewhere, Hollywood play-money markets invite the public to predict opening weekend box office sales and the Oscars,[4] and, significantly, some corporates have begun to explore the potential of information markets to harness collective wisdom internally. Firms such as Hewlett Packard, Google, General Electric and Microsoft are leading the way in experimenting with business information markets.[5] Trading in corporate markets typically involves an internal group of "experts" with contracts written on such matters as whether a project deadline will be met or a sales target exceeded. Interest is spreading in the potential use of markets to generate conditional estimates ("Will our product ship on time *if* we take the following action?"). Decision-makers in many settings could benefit from the potential for conditional markets to provide neutral guidance for actions.

In theory, as individuals trade on their private information, an asset's price will move to incorporate all relevant news; the price, as a result, will constitute a collective prognosis which at any point in time is the best forecast available (Fama 1970, Hayek 1945). Markets therefore should outperform other Information Aggregation Mechanisms (IAMs) in terms of forecast accuracy, including the traditional alternatives of asking an expert for a forecast, obtaining the opinions of multiple experts and somehow pooling these, conducting a poll or survey, or leaving a group to deliberate. We discuss in this paper some of the features of these other IAMs that can undermine their prediction accuracy:

- voting aggregates views but does not weight these by relevance (by contrast, in markets, misinformed traders will suffer heavy losses) and does not reward people for being right;

[1] http://www.biz.uiowa.edu/iem/
[2] http://fluprediction.uiowa.edu/fluhome/Market_AvianInfluenza.html
[3] http://hurricanefutures.miami.edu/
[4] http://www.hsx.com/
[5] http://en.wikipedia.org/wiki/Prediction_market

- individual experts are prone to biases (whereas markets help overcome these – experts who trade on biased views suffer losses);[6]
- deliberative groups, such as committees, are prone to "group think" and other biases (but traders submit views independently and anonymously).[7]

Empirical evidence supports the theoretical accuracy of market-based forecasts: in a host of real-world applications the: probabilities implied by market prices calibrate to actual event frequencies extremely well and forecasts beat prognoses from recognized experts and polls. Markets provide individuals with strong incentives to gather information and act upon this by trading; and the price mechanism provides a way of aggregating this information succinctly and continuously. As a result an information market can provide a remarkable "in running" crystal ball into the future and the prospect of harnessing this power is generating excitement among academics and real-world practitioners.

The goal of the present paper is to try to broaden the prevailing perspective on the topic. We note that the current discourse focuses disproportionately on forecast accuracy, and suggest that this encourages an inappropriately narrow consideration of the merit of information markets as a real-world forecasting institution. We set out to offer a multidimensional look at both performance and feasibility. Prediction accuracy, naturally, is a key consideration, but also important, we suggest, are such factors as costs of implementation, perceived legitimacy, and possible leakage of sensitive information. Our evaluation is only meaningful if comparative: alongside information markets, we consider the performance and feasibility of other IAMs.

Our review of the available evidence points to a somewhat mixed picture (summarized in tabular form in Tables II and III): not only is the feasibility of IAMs context-sensitive (for instance, information markets cannot be used to aggregate information in some settings due to the need to write unambiguous contracts and settle markets objectively), but even where all IAMs are feasible, the optimal choice of mechanism (as judged by the balance of costs and benefits) depends on the setting: is this a corporate event or an event of general public interest? If corporate, is the data generated of a sensitive nature? Is it important that the IAM not only predict but also offer some explanation for its forecast?

The problem of information aggregation does not have a one-size-fits-all solution, we find. Rather the relative costs and benefits of different IAMs will vary depending on the context. The literature has delivered insights to facilitate some of the necessary comparisons but important gaps remain. For instance, a number of findings point to the superior forecast accuracy of information markets compared to predictions from individual experts but little has been said about the relative costs involved and or the risk factors that may arise in each case, such as potential leakage of sensitive information. Equally little work exists to inform other important comparisons, such as whether overall a firm should opt for quick polling (as some now do) as an internal mechanism for a quick collective view on a matter or establish and operate an information market.

Overall, the study highlights the need for more "open" research on comparative IAM performance. The aim should be to shed objective light on the merits of alternative mechanisms for different categories of real-world forecasting problem. Ideally this research

[6] Many problems have appeared in practice. For example, corrections are often needed for cognitive biases. Risk-aversion, uncommon priors, and state-dependent utility can also make it hard to infer the information people have from the estimates they make. Additionally, whenever people are simply asked to state their expected outcome, incentive compatibility is a concern: does the chosen individual have the right incentives to report the truth? Vaughan Williams (2005) reviews the efficacy of expert predictions in comparison to market-based forecasts.

[7] See Sunstein (2006) for analysis of information aggregation in deliberative groups. Deliberative groups amplify cognitive errors, and fall prey to informational cascades and group polarization.

should involve randomized trials in realistic field settings (much experimentation is carried out in laboratories or by firms behind closed doors).

Comparative analysis, which, for instance, puts the market-mechanism head-to-head with alternatives such as quick voting, should be a priority. Despite papers such as Spann and Skiera (2003), still very little is understood about the impact of market design features on information accuracy, and practitioners and the academic literature alike have had very little to say on the matter of implementation and operational costs. Information markets almost certainly have operational limits (they appear to work best in 'thick' situations, where many traders possess small bits of information, behave competitively, are good at Bayesian updating, and also do not have a significant stake in the outcome) but we have only a partial understanding of these.

The possibility of using conditional information markets as decision-making guides deserves further research. Information markets have the potential to revolutionize the way decision-making is guided in many setting, including ultimately the policy realm. However, the point has been made that detailed decision analysis could require potentially many conditional markets, which would tend to thin markets out (Ledyard, 2006). Research should explore this issue (and possible workarounds) systematically. Alternative market designs, such as call markets and market scoring rules, have been proposed to address some of the problems such as thinness, but more work is needed to gauge the effectiveness of these mechanisms across different real-world settings.

Further complications that warrant the time and attention of researchers include the implications of running markets in which traders have a large stake in the outcomes of interest and often are in exclusive possession of important pieces of information that they may withhold strategically (this could often be the case in business settings). A further exciting avenue for further research lies in exploring whether some combination of predictions information markets and other channels (e.g. polls) could offer superior forecasts (Chen and Pennock, 2005). The relaxation of existing US regulatory provisions would make more viable (Arrow et. al, 2007) these and other related lines of research.

References

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Table I. Feasibility: Information Markets vs. Alternatives

	Expert Opinion	**Pooled Expert Opinion**	**Polls**	**Surveys**	**Deliberative Groups**	**Information Markets**
Perceived legitimacy	HIGH – it is intuitive that experts should be consulted.	HIGH – it is intuitive that experts should be consulted.	MED?	MED?	HIGH: Deliberation increases confidence and decreases variance (=> perceived legitimacy)	LOW: at the present time where info markets remain unfamiliar in many settings and can "breed confusion and distrust." Managers may feel undermined and so question legitimacy.
Scope	HIGH?	MED-HIGH?	MED-HIGH	HIGH	HIGH: handle any question.	MED- Not all questions are suitable for mkts.
Regulation	HIGH? – no problems?	HIGH? – no problems?	HIGH? – no problems?	HIGH? – no problems?	HIGH: no regulatory concerns.	LOW-MED - US restricts use of real-money markets. However, money may not matter.
Participation	HIGH	HIGH	HIGH	HIGH	HIGH.	HIGH

Table II. Performance: Information Markets vs. Alternatives

		Expert Opinion	Pooled Expert Opinion	Polls	Surveys	Deliberative Groups	Information Markets
Quality of Information	Accuracy	LOW-MED – lack of incentive for honest forecasting?	LOW-MED – difficult to aggregate.	LOW-MED – polls assign arbitrary weight to info.	LOW-MED – how to aggregate results?	LOW (problems with bias, "group-think" polarization, etc.)	HIGH - provided they are well-designed, markets aggregate information more efficiently than other IAMs..
	"In-running"	LOW-MED	LOW-MED	LOW-MED	LOW – snapshot.	LOW?	HIGH: markets yield continuously updated - "in-running" - predictions.
	Explanatory content	HIGH – can ask expert to justify.	HIGH – can ask for explanations.	LOW-MED no explanation for voting by default but could use wikis	HIGH – surveys can elicit explanations for forecasts/ views.	HIGH – principal can understand the process that lead to collective forecast.	LOW-MED-Design dependent; if wikis/blogs used to elicit trading motivations then okay.
Cost-Efficiency	Setup	LOW-MED (need to identify experts)	LOW-MED (identify experts and design mech.)	HIGH – easy and cheap to setup online.	LOW – costly to set up.	MED – identify participants, schedule meetings etc.	LOW-MED – markets need to be designed and implemented technologically. Participants may need training.
	Operation	HIGH	HIGH	HIGH – easy and cheap to run.	LOW – costly to administer/analyze	LOW – deliberation can take long time.	MED-HIGH- once operational markets can be very cheap to run.
	Control of sensitive info,	HIGH (only expert and principal need know the forecast etc.)	HIGH (experts and others need not see collective intelligence)	HIGH (participants need not see collective intelligence)	HIGH (participants need not see collective intelligence)	LOW-MED. All group members see sensitive information.	LOW-HIGH. By default all participants see current forecast. However, some firms (e.g. HP) are experimenting with designs which restrict the visibility of market aggregates.
	Positive side effects e.g. fun	LOW?	LOW	MED - people like to have their voices heard.	LOW – people like to have their say but may resent long surveys.	LOW? People tend to find meetings low fun.	MED-HIGH – trading can be fun and people like to have their say (an lower agency costs inside an organization). However, pessimistic forecasts can upset morale and motivation.