# Prediction Markets and Natural Resource Management

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Markets are all about information. An efficient market will aggregate dispersed information about the value of a resource, and disseminate it via price. In the classic market, buyers and sellers each hold information about the cost and value of a resource. The market provides each with an incentive to reveal this information. If a buyer sees that the price is below her value for the item in question, she will buy, and the price will rise. Similarly if a seller sees that the price is above his cost, he will sell and the price will fall. This process continues until the market clearing price is reached, where demand and supply are equal. At this point all relevant information has been revealed and the resource is allocated in the most efficient way possible. If changing circumstances cause costs or values to change, this is reflected by changes in the willingness of traders to buy or sell at a particular price. Consequently the price will adjust to reflect the changed circumstances.

Therefore markets represent an extremely powerful tool for aggregating and disseminating widely dispersed information. The market price represents the combined wisdom of everyone involved in a market. As such it is likely to be more reliable than the opinions of one or a few experts. Clearly markets represent the most efficient means of allocating scarce resources when information about the value of those resources is dispersed. However there is also potential to take the information gathering properties of markets one step further. Prediction markets (also called information markets) are markets that are specifically intended to generate information about future events. Like normal markets, they provide individuals with an incentive to reveal the information that they hold, aggregate this information and disseminate it via the price. Unlike normal markets, there is usually no actual good being traded.

In some cases it is already clear that markets are excellent predictors of future events. For instance, if you want to know the likelihood of future interest rate changes, the futures market for bonds will give a better overall picture than listening to often contradictory opinions from experts. And orange juice futures markets have been shown to be a better predictor of the weather in Florida than official forecasts.[1] In both these cases, the market can put together high quality predictions, even from scattered and often contradictory information.

[1] Roll R. (1984) Orange juice and weather. *American Economic Review* **74**: 861–880.

Establishing a prediction market involves creating a contract that pays out a certain amount contingent on a future event. For instance, a contract could be set up to pay $100 if Brazil wins the 2006 Wold Cup. On the settlement date (immediately after the final), if Brazil have won then each contract is worth $100. If Brazil has not won, each contract is worth nothing. If I currently believe that Brazil have a 50% chance of winning, then that contract has an expected value of $50 to me. If the price is less than $50 I will buy; if it is greater than $50 I will sell. In this way the price adjusts to account for the beliefs and information held by everyone in the market. As new information becomes available, for instance as players get injured or come in and out of form, the price will adjust as people change their beliefs.

Prediction markets require contracts based on outcomes that can be measured and verified. For instance, 'Brazil will have a good World Cup' cannot necessarily be measured, so people cannot trade with certainty. By contrast, 'Brazil will win' or 'Brazil will reach the semi-finals' is clearly verifiable. Prediction markets have been used to predict the outcome of US presidential elections, proving considerably more accurate than opinion polls and expert opinion.[2] They are increasingly being tried out by some of the world's leading firms to predict sales or research outcomes, and there is even a market to forecast box office takings for movies.[3] A well designed prediction market can avoid many of the pitfalls of collective decision making, such as groupthink. In many cases prediction markets have been shown to outperform all other forecasting methods. Note that not everyone need be correct for an information market to work. Just as in other markets, it is only the trades at the margin that affect the price.

**Prediction markets and natural resource management?**

The ability of these markets to generate accurate predictions from widely dispersed information suggests they could be a powerful tool in natural resource management (NRM). Information about natural resources, as with many other commodities, is often highly dispersed. Many individuals know something about the state of the resource. However relying on the information held by any one individual is most unlikely to yield an accurate prediction. Collating and interpreting all the information held by many individuals is a challenging task, especially as much of it may be contradictory. Markets are able to do just that. They aggregate and disseminate information concerning the value of a resource, and express it via the price. Therefore, the market mechanism can be applied to generate information.

Prediction markets have great potential in NRM issues where information is widely dispersed. They could be applied to produce more accurate forecasts, for instance of crop production, water availability or pest pressure. Additionally, well-established prediction markets would also provide a hedging tool for businesses with exposure to these issues. Such markets are likely to work best where they provide both a means of profiting from information as well as a means of offsetting risk. The more traders use the market to hedge their risks, the greater the opportunities for those who hold information about the outcome to reveal it through the market.

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[2] Berg *et al.* (2003) Accuracy and forecast standard error of prediction markets www.biz.uiowa.edu/iem

[3] Hollywood Stock Exchange www.hsx.com

There is great potential to apply prediction markets to issues such as rainfall or water availability (eg dam levels). There would be great public benefits from improved forecasts. Currently expert forecasters and computer modellers provide useful forecasts. A prediction market could provide a means of aggregating the information produced by these forecasts, and also potentially incorporate other specialised and local knowledge. The market could also provide a means for hedging. For instance irrigators could buy 'low rainfall' contracts, which will pay out if rainfall is below a certain level, which would offset their crop losses in a dry year. Similarly those who stand to lose out during wetter times (eg pub owners, car insurers) could hedge the other way.

**A pilot market**

We are working with world leaders in this field: Dave Porter of George Mason University and Chris Hibbert of CommerceNet (both in the USA), to develop and test a prediction market in the field. We are running this pilot project as a first step towards testing the potential of prediction markets to contribute to natural resource management in Australia. It will serve to develop our knowledge and experience of this unusual type of market, and test the effectiveness of such markets as predictive tools in the field. This market will be applied to a highly policy relevant and topical issue at the CSIRO Sustainable Ecosystems site at Gungahlin, Canberra. Collectively, all the relevant information about this issue exists, but it would be extremely difficult for any one person to gather. So our question is, can a prediction market produce accurate forecasts? We hope that what we learn from this initial demonstration can be applied to make a contribution to some challenging NRM issues.

**Further information**

For more information about prediction markets see:
www.biz.uiowa.edu/iem
www.commerce.net

And to see prediction markets in action, check out:
http://news.us.newsfutures.com
www.tradesports.com
www.hsx.com

Some of the best papers about the use of prediction markets are by Robin Hanson of George Mason University – at the time of writing his website seems to have disappeared!