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Finance, the Wisdom of Crowds, and “Uncannily Accurate” Predictions

Russ Ray

Abstract

This paper examines and thereafter models an innovative and relatively new type of market -- financial “decision” markets. Thriving on both expert opinion and inside information, decision markets – also known as “prediction” markets – have proven to be “uncannily accurate” predictors of all types of events. Financial forecasts from these international markets include predictions of stock prices, commodity prices, exchange rates, interest rates, inflation rates, Federal Reserve decisions, and even interest- rate swaps. Existing in cyberspace and completely unregulated, decision markets may be the most efficient markets in all of history.

Key words: decision/prediction markets, financial predictions, inside information.
JEL classification: F230

Introduction

Corporate utilization of “decision” markets has dramatically increased in the past several years. Microsoft, Hewlett-Packard, Eli Lilly, and many other major corporations use decision markets to forecast sales, earnings, product success, project times, and myriad other corporate variables. Economic Derivatives, a decision market created and jointly operated by Goldman Sachs and Deutsche Bank, routinely turns over hundreds of millions of dollars in real-cash betting on a single event, such as whether or not the U.S. Federal Reserve will increase the fed-funds rate, and, if so, by how much. Decision-market consultants, such as NewsFutures, will create and operate a decision market for any organization willing to pay its fee. In an April 2003 analysis of decision markets, Credit Suisse First Boston reported that these markets have “proven to be uncannily accurate in predicting all types of events” (*Wall Street Journal*, July 30, 2003, p. C1.).

This paper models “decision” markets, also known as “prediction” markets, and thereafter examines their “uncannily accurate” ability to predict the future. The paper is organized as follows.

The next two sections discuss, respectively, the evolution and mechanics of these markets. The section thereafter examines these markets within the context of efficient markets. The final section of this paper statistically models these markets for decision-making purposes.

The Evolution of Decision Markets

Interestingly, decision markets were first conceived in the 17th century. Debus (1970) examines science and education in the 1600s and finds that a few major European universities monopolized research, ignoring the work of “outsiders” who were not part of their inner circle. Many of these outsiders argued that the validity of their theories should be judged by empirical observation, and not by whether their theories did or did not agree with the “prevailing wisdom” of the inner circle. Arguing for empiricism, chemical physicians in the 17th century -- outsiders at the time, and not allowed to teach in British medical schools -- offered the following wager:

> *“On ye Schooles…Let us take out of the hospitals, out of the camps, or from elsewhere, 200 or 500 poor people, that have fevers, pleurisies, etc. Let us divide them into halfes, let us cast lots, that one halfe of them may fall to my share, and the other halfe to yours;…we shall see how many funerals both of us shall have; But let the reward of the contention or wager, be 300 Florens, deposited on both sides: Here your business is decided.”*

(c. 1651, as cited by Debus, 1970)

For reasons that can only be conjectured, this concept lay dormant for more than three centuries until the late 1900s, when such betting markets (now called "decision" markets) began to flourish. Exhibit 1 lists a few of the world's major decision markets, which utilize both real cash and "virtual" currencies, often with real-cash prizes accruing to correct predictors in the latter markets. Exhibit 2 lists the betting categories within one of the more popular decision markets, the Foresight Exchange. All of these markets are online markets existing solely in cyberspace. Their web sites can easily be accessed by inserting the name of the respective market into a search engine such as Google.

The Mechanics of Decision Markets

Decision markets operate on the same principle as pari-mutuel horse racing, in which all betting goes into a common pot, and the winners divide the betting pool (after the exchange takes out its transaction costs, including a fair profit for itself). Anybody can enter a "claim" in these markets, and bettors will thereafter bet for or against the particular claim. A claim is simply a statement that some event will happen by a certain date. For example, one of the claims currently trading in the TradeSports market is that the Dow Jones Industrial Average will close above 12,000 on December 30, 2005.

Typically, a winning claim in a decision market (i.e., a claim that comes true) pays $1.00, or some multiple of a dollar, while a losing claim (i.e., one that does not come true) pays $0.00. As of this writing, the bid/ask spread of the claim above (i.e., that the Dow will close above 12,000 on 12/30/05) is 14/18. This spread means that the marginal bettors in the TradeSports market are currently offering to buy this claim for 14 points, and currently offering to sell this claim for 18 points. In the TradeSports decision market, each point is worth $.10. Thus, the bid/ask spread of this claim is actually $1.40/$1.80. A winning claim in this market pays 100 points (i.e., $10), while a losing claim pays nothing. If a bettor were to buy this claim for 18 points (= $1.80) and the Dow subsequently closed above 12,000 on 12/30/05, then this bettor would earn 100 points (= $10), thus clearing a profit of $8.20. A bettor can bet as much money as he/she desires in the TradeSports market, as long as the betting is in increments of $10 (e.g., to wager $10,000, a bettor would go long on 1,000 "contracts").

In a decision market, the price of a claim is actually the market's consensus estimate of the probability of that claim coming true. This property can be derived by simply considering the winning and losing payoffs of a claim: a $1.00 payoff (or some multiple of $1) represents 100% probability, while a $0.00 payoff represents 0% probability. Intervening values are thus the market's consensus probabilities. In the TradeSports example above, the market's consensus (using the midpoint of the bid/ask spread) is that, as of this writing, the Dow has a 16% probability of closing above 12,000 on December 30, 2005.

Decision Market Predictions and Strong-Form Efficiency

Decision markets are the only free markets to continually exhibit strong-form efficiency, as posited by the Efficient Market Theory. (For comprehensive reviews of both the theory and evidence regarding efficient markets, see Fama (1998) and Ball (1995); for shorter and more current reviews, see Malkiel (2003) and Shiller (2003)). Essentially, the evidence is nearly unanimous that financial markets in capitalistic economies are semi-strong efficient. However, except for rare (and ephemeral) instances, no evidence exists that such markets display strong-form efficiency. In fact, trading on inside information is illegal in all developed economies. If insider trading was not illegal, outside investors would quickly lose confidence in financial markets, and the resulting lack of an intermediation process for savings and investment would soon cripple any economy.

The first and most famous decision market is the Iowa Electronic Market (IEM). It's well known that this market has successfully predicted every U.S. presidential election since its inception in 1988. Moreover, the IEM also accurately predicts the percentage of votes obtained by the presidential candidates, forecasting more accurately than even voter polls and expert opinion. Anyone in the world can bet up to $500 (in real money) in this market, utilizing any information available, including inside information. Other universities in other countries have recently created similar markets to attempt to predict their respective elections (e.g., the Austrian Electronic Market created by the Vienna University of Technology, and the Columbia Election Stock Market created by the University of British Columbia). Their track records have yet to be determined.

Few people realize that "election" decision markets, such as the IEM, are only the "tip of the iceberg" of decision markets, all of which trade extensively on inside information. Essentially, bettors in these markets wager money on whether or not certain events will occur in the realms of politics, economics, science, culture, catastrophes, natural disasters, terrorism, and many other categories (Again, see Exhibit 2). For example, within the realm of finance alone, these markets continually make predictions regarding stock prices, commodity prices, exchange rates, interest rates, inflation rates, and even interest rate swaps, to name only a few of the many financial-prediction categories in these markets (See Exhibit 3).

The predictive ability of these markets is impressive. In an April, 2003, analysis of decision markets, Credit Suisse First Boston reported that these markets have "proven to be uncannily accurate" in predicting all types of events (*Wall Street journal*, July 30, 2003, p. C1). Dobbs (2003) and Surowiecki (2003) report that Hewlett-Packard used decision markets on 16 different occasions to make unofficial forecasts of its sales. Remarkably, the HP decision markets forecasted the company's sales more accurately than even its own official forecasts, 15 out of 16 times. The Hollywood Stock Exchange predicts movie revenues more accurately than the movie studios' official sales forecasts; it also predicts Oscar winners more accurately than any other prediction tool. For other examples of how decision markets successfully predict a myriad of variables, see Wolfers and Zitzewitz (2004). For a historical review of the "wisdom of crowds" in making accurate predictions, see Surowiecki (2004).

Statistically, Pencock, Lawrence, Giles, and Nielsen (2001) report, "We find that [decision market] prices [i.e., forecasts] strongly correlate with observed outcome frequencies" (p. 987). In another statistical study, Wolfers and Zitzewitz (2004) find that, "Prediction markets are extremely useful for estimating the market's expectations of certain [statistical] moments. Simple market designs can elicit expected means or probabilities, more complex market designs can elicit variances, and contingent [decision] markets can be used to elicit the market's expectations of co-variances and correlations" (p. 23). Servan-Schreiber, Wolfers, Pennock, and Galebach (2004) compared the predictive power of real-cash decision markets and virtual-currency decision markets and found that both yielded predictions that correlated highly with actual event outcomes.

Predictive Ability

Why are the predictions made in these markets so "uncannily accurate"? Hanson (1999), Plott (2000), and Berg and Rietz (2003) correctly deduce that decision markets are extremely efficient at quickly flushing out and aggregating information from around the world, including inside information. Further, Surowiecki (2003) also points out that these markets are unimpeded by government regulations and political pressures. Thus, decision markets continually reflect the informed opinions of knowledgeable experts and savvy people everywhere, as these bettors seek to profit from their information, including their inside information.

This aggregation property was the reason that the U.S. Pentagon recently created the Terrorism Futures Market (but subsequently terminated it when its existence was made public in July, 2003, and infuriated Congress). At first, a market for trading terrorism futures seems ghoulish, but this market (if allowed to open) would most likely have done exactly what it was designed to do, i.e., flush out inside information regarding potential terrorism, and thereby allow the Pentagon to preempt (or, at least, hedge against) such acts. However, and not surprisingly, an angry Congress, not knowing the predictive abilities of these markets, quickly pressured the Pentagon to terminate this venture (For a longer discussion and analysis of the Terrorism Futures Market, see Ray (2004)).

To date, the literature of finance, with the exception of the Iowa Electronic Market, has largely ignored decision markets. Interestingly, since these markets exist in cyberspace and are completely unregulated, decision markets are arguably the most efficient markets in all of history, continually displaying such efficiency in all three forms: weak, semi-strong, and strong.

Modeling Decision Markets

Plott (2000) first modeled decision markets within the classical context of "rational expectations." (For an overview of the theory of rational expectations, see Young and Darity (2001)). Although decision markets have never been modeled within the context of efficient-markets, they can be easily so modeled:

$$E_m(\rho_{j,t}) = (P_{j,t} \mid \theta_t),$$

where

E_m = the market's expectation;
$\rho_{j,t}$ = the probability, at time t, of claim j being realized;
$P_{j,t}$ = the price of claim j at time t; and,
θ_t = the information set utilized by the market at time t to form its expectation.

In a decision market, θ_t contains both public information and *inside* information, thereby making the market efficient in the strong form of the theory, by definition.

Given the "uncannily accurate" ability of decision markets to forecast the future, a forecasting model of these markets would be highly valuable to managers, hedgers, speculators, regulators, policy makers, and others who could utilize the predictions in decision markets for their respective purposes.

One method would be to simply define a probability of, say, .75 (or higher) to be significantly greater than random chance, and to define a probability of, say, .25 (or smaller) to be significantly less than random chance.

A more exact method would be to use a statistical tool such as a test for the difference between two means. To derive such a measure, define

$$\mu_{t+n} = \rho_{j,\,t+n} - .5; \quad n = 0, 1, 2, 3, \ldots$$

so that μ is the probability distribution of deviations from random chance (i.e., ρ = .5), having mean $\overline{\mu}_t$ and standard deviation σ_μ . Any reasonable assumption regarding the distribution of a given claim (e.g., that the distribution is a poisson distribution) would generate a mean and standard deviation for the distribution so that with two means ($\overline{\mu}_t$ and .5) and two standard deviations, the difference between two means could easily be tested. Such a test would ascertain when a given claim (i.e., forecast) was significantly greater or less than a forecast of random chance. A software program could easily monitor any decision market and continually perform tests for the difference between two means, alerting hedgers, speculators, regulators, policy makers, and other decision makers when such differences are statistically significant.

The least restrictive assumption regarding the distribution of claims (and, thus, the most powerful decision rule) is the assumption that claims in a decision market can follow *any* distribution. The decision rule in this case can be derived by using Chebyshev's Inequality (which is "distribution free" and applies to all probability distributions, regardless of the values of any of their moments). (For readers unfamiliar with Chebyshev's Inequality, see any comprehensive textbook in statistics; for example, see Shiffler and Adams (1990)).

To derive a distribution-free decision rule, define ψ to be

$$\psi = \mu_t - \overline{\mu}_t,$$

where μ_t and $\overline{\mu}_t$ are defined as above. Let π be the probability distribution of ψ. In accordance with Chebyshev's Inequality:

$$\pi(\psi \geq K\sigma_\mu) \leq (K^2)^{-1},$$

where $K = \sqrt{2}$ so that $(K^2)^{-1}$ = .5, i.e., random chance.

Finally, define π^* to be any probability that is significantly less or significantly greater than random chance. Expanding Chebyshev's Inequality above,

$$\overline{\mu}_t - \sqrt{2}\,\sigma_\mu \geq \pi_t^* \geq \overline{\mu}_t + \sqrt{2}\,\sigma_\mu$$

and values of π^* so derived at time t represent probabilities significantly less and significantly greater than those of random chance. Forecasts so derived could offer considerable utility to managers, hedgers, speculators, regulators, policy makers, and others who routinely rely upon forecasts in order to make their respective decisions.

Summary and Conclusion

Decision markets are a growing and interesting innovation. Operating in cyberspace and completely unregulated, these global markets are arguably the most efficient markets in all of history. Unlike regulated markets, decision markets thrive on inside information.

A large body of anecdotal evidence, as well as a smaller body of statistical evidence, has found that the predictions in these markets have proven to be "uncannily accurate" forecasts of the future, including the financial future. Decision rules can be derived to identify which forecasts are significantly different from those predicted by random chance. Financial forecasts so identified offer considerable managerial, economic, social, and political utility.

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Exhibit 1

Selected Decision Markets

MARKET	DECISIONS / PREDICTIONS
Iowa Electronic Markets*	elections, monetary policy
Economic Derivatives*	comprehensive
Foresight Exchange**	comprehensive
NewsFutures**	comprehensive
TradeSports*	sports, current events
Long Bets*	long-term predictions
Wahl$treet*	German politics/economy
Athletic Stock Exchange**	athletic performance
Hollywood Stock Exchange**	movie-related events

*Real-cash exchange
**Virtual-currency exchange

Exhibit 2

Foresight Exchange: Claim Categories

- Arts & Entertainment
- Finance: U.S. Finance
- Finance: World Finance
- Misc.: Religion, New Age, etc.
- News: Disasters
- News: U.S. News
- News: World News
- Politics: U.K. Politics
- Politics: U.S. Politics
- Science & Technology

Exhibit 3

Selected Financial Predictions of Decision Markets

- NewsFutures Exchange
  - Global stock indices
  - Exchange rates
- TradeSports Exchange
  - Gold prices and exchange rates
  - Major economic announcements
  - Federal Reserve's FOMC announcements
- Iowa Electronic Markets
  - U.S. monetary policy
  - Selected industry returns
  - Selected stock prices
- Foresight Exchange
  - Exchange rates
  - Oil prices
  - Stock market indices
  - Inflation rates
  - Business cycles of selected countries
- EconomicDerivatives
  - Financial/Economic Announcements
  - Financial/Economic Statistics