Do Prediction Markets Add Value to the Forecasting Process

Northfield Information Services, Inc.

Autumn 2008

www.northinfo.com

Outline

- Traditional forecasting methods
- Overview and history of prediction markets
- Prediction markets in theory and practice
- Business and investment applications
- Resources
- References

Traditional Forecasting Methods

- Consensus
  - Sell-side earning estimates
  - Economic forecasts
  - Northfield Short-term U.S. Risk Model incorporates option implied volatility based on looking at current market opinion
- Heuristics-based
  - Intuition
  - Judgment
- Multivariate Statistical Techniques
  - Simulation & Scenario Analysis
  - Time Series
- Other
  - Expert panel discussions
    - Delphi Method
  - Questionnaires, surveys, opinion polls
    - Northfield's Analytical Hierarchy Process (AHP)

Overview of Prediction Markets

- Also known as “information markets”, “decision markets” or “event futures”
- Used to gather information from range of sources to predict future outcome of an event. Payoff tied to the outcome
- Types of events
  - Political
  - Entertainment and sporting
  - Business and economic
- Prices as means of efficiently allocating resources
  - “*Fundamentally, in a system in which the knowledge of the relevant facts is dispersed among many people, prices can act to coordinate the separate actions of different people…”* (Hayek, 1945)

Prediction Markets History

- Early History
  - Rhode and Strumpf (2004) detailed the existence of large-scale election betting even during the George Washington election
  - Election betting was often illegal, the activity was openly conducted by "betting commissioners" and employed standardized contracts that promised a fixed dollar payment if the designated candidate won office
  - At times in the late 19th and early 20th centuries, betting on political outcomes at the Curb Exchange in New York would exceed trading in stocks and bonds
  - In contests such as 1896, 1900, 1904, 1916, and 1924, the New York Times, Sun, and World provided nearly daily quotes from early October until Election Day
  - In the 15 elections between 1884 and 1940, the mid-October betting favorite won 11 times (73 percent) and the underdog won only once (Wilson in 1916)

Prediction Markets History

- Iowa Electronic Markets (IEM)
  - Established 1988
  - More accurately predicted eventual winner of U.S. Presidential elections than traditional polls
- Policy Analysis Market (PAM)
  - Defense Advanced Research Projects Agency (DARPA) developed in 2003
    - *Side-note: Northfield employs the son of one of the major contributors to precursor of the Internet: ARPANET*
  - PAM was to focus on economic, civil, military futures of Middle Eastern nations and impact of U.S. involvement with each
  - Market scrapped after political backlash. "Terrorism futures", betting on terrorist attack…

Prediction Market in Theory

- (Wolfers and Zitzewitz, 2006) tested theory that prediction markets can efficiently aggregate information and where prices coincide with mean beliefs
  - They consider participants with log utility and initial wealth y. In deciding how many contracts, *x*, to buy at a price π given that they believe the probability of winning is q

$$\underset{\{x\}}{Max}\ EU_j = q_j Log[y + x_j(1-\pi)] + (1-q_j)Log[y - x_j\pi]$$

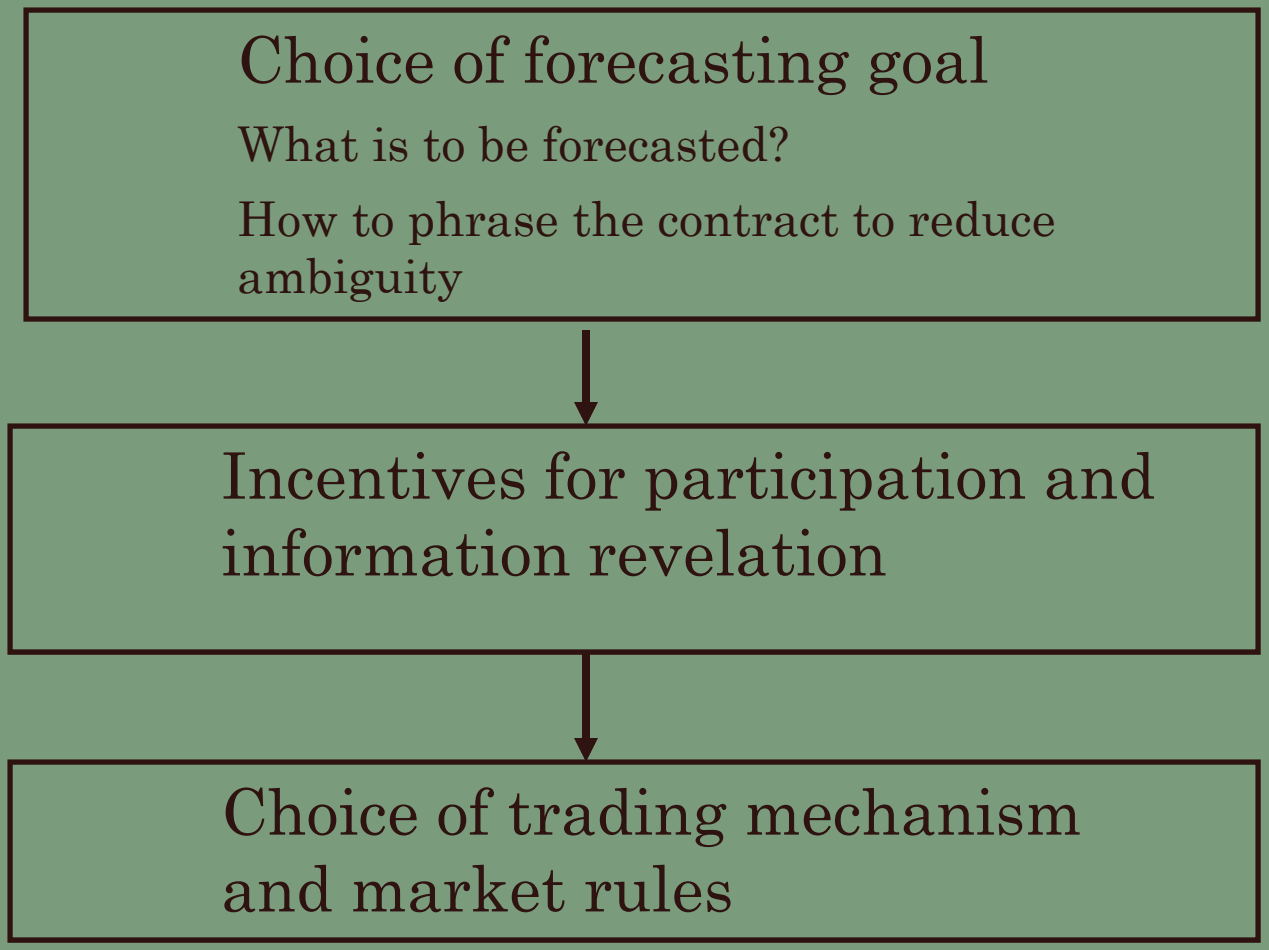
$$yielding: \quad x_j^* = y\frac{q_j - \pi}{\pi(1-\pi)}$$

  - Thus only under log utility, does the prediction market prices equal the mean beliefs of participants
  - No assumption required about distribution of beliefs
  - Looking at a range of alternative utility functions and distributions of beliefs usually leads to prediction market prices that differ from the mean beliefs by only a small amount

Prediction Market in Theory

- Manski (2004) found example where prediction market prices fail to aggregate information appropriately.
  - Traders will to risk a fixed amount of exactly $100
  - If contract paying $1 if an event X occurs is selling for $.667 than buyers will purchase 150 contracts
  - Sellers can afford to sell 300 contracts (at price of $.333)
  - Can only be in equilibrium if there are twice as many buyers as sellers, implying market price must be at 33rd percentile of belief distribution not the mean
  - So market price of P implies that 1-P% of participants believe that the event has less than P% chance of occurring

Prediction Market Design



Prediction Market Design

- Clear and Easily Understood Contracts
  - Clearly state the period which event must occur
- Diverse and Independent Opinions
  - Prediction markets won't work well if there is near-unanimous agreement on eventual outcome
- Matching Buyers with Sellers
  - Continuous Double Auction
    - A system in which buyers enter competitive bids and sellers enter competitive offers simultaneously
    - Similar to stock exchanges, ex. NYSE
  - Pari-mutuel System
    - All bets are pooled together before an event and distributed among the participants who bet correctly on the outcome winner.
    - It is a common form of betting for sports events such as horse racing, and the practice is widespread throughout the world

Market Design

- Choice of Real vs. Play Money
  - Both types of markets exhibit strong predictive power (Servan-Schreiber, et al, 2004)
    - Experiment with 208 NFL games in fall of 2003 using real money market: TradeSports.com and play-money market: NewsFutures
    - Overall 65.9% of Tradesports" teams won and 65.6% of NewsFutures teams won
    - Strong correlation between trading prices and outcome frequencies : .96 and .94 for TradeSports and NewsFutures respectively.
    - Both types of markets performed very well in competition against 1,947 individual participants, ranking #11 and #12, respectively

Prediction Market Examples

Market	Description	Payout Type
Iowa Electronic Markets www.biz.iowa.edu/iem Run by University of Iowa College of Business	Small-scale election markets.	Tens of thousands of dollars (Traders limited to $500 positions)
TradeSports www.tradesports.com For profit company	Trades in a rich set of political futures, financial contracts, current events, sports and entertainment.	Hundreds of thousands of dollars, sometimes millions
Newsfutures www.newsfutures.com For profit company	Political, finance, current events and sports markets. Also technology and pharmaceutical futures for specific clients.	Virtual currency redeemable for monthly prizes (such as a TV)
International Securities Exchange Alternative Markets www.ise.com	Pari-mutuel Dutch auction platform that enables trading in events and occurrences that do not have an underlying cash market, like real estate, economic statistics and weather	Real currency
iPredict www.ipredict.co.nz Wholly owned company by Victoria University of Wellington, and the Institute for the Study of Competition and Regulation (ISCR),	Political, social and community issues	Real currency

Iowa Electronic Markets (IEM)

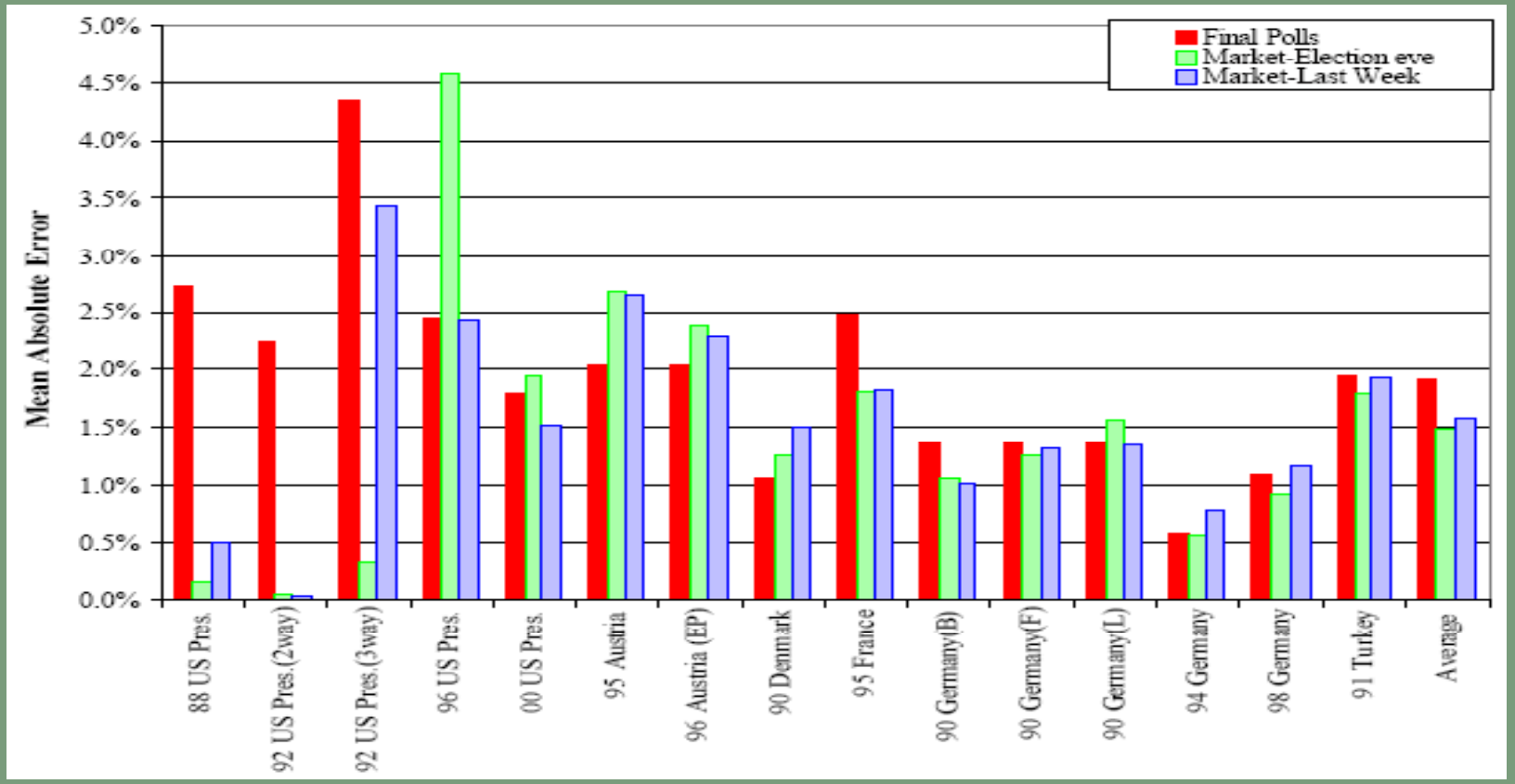
- Operate 24-hours a day, using a continuous, double-auction trading mechanism
- Investment limited to 500 USD per participant
- Winner Takes All Market
  - Based on the popular vote winner
  - Expected Payoff
    - Profit = Payoff– Cost
    - E(Profit) = E(X) – c
    - E(Profit) = p – c
    - Market price is the probability of the event occurring
- Vote Share Market
  - Based on vote shares won by the two major party candidates
  - Expected Payoff
    - Profit = $1*X%
      - Where X is the popular vote received by the candidate
    - Market price is the expected vote share received by the candidate

Election Prediction Accuracy

- Berg et al. (2003) found that the Iowa Electronic Markets have yielded accurate forecasts of US election results and have outperformed more widely-publicized polls.
- The market outperformed polls in 9 of 15 cases
- As seen in the graph on the following page across all elections, the average poll error was 1.91% while the average market error was 1.49%
- In Australia, election-eve betting markets correctly predicted that the Coalition would win the 2001 and 2004 federal elections.
- By contrast, a Coalition win was predicted y election-eve polls of only two out of three major polls in 2001 and only two out of four major pollsters in 2004. (Leigh, Wolfers, 2007)

IEM Accuracy vs. Election Polls

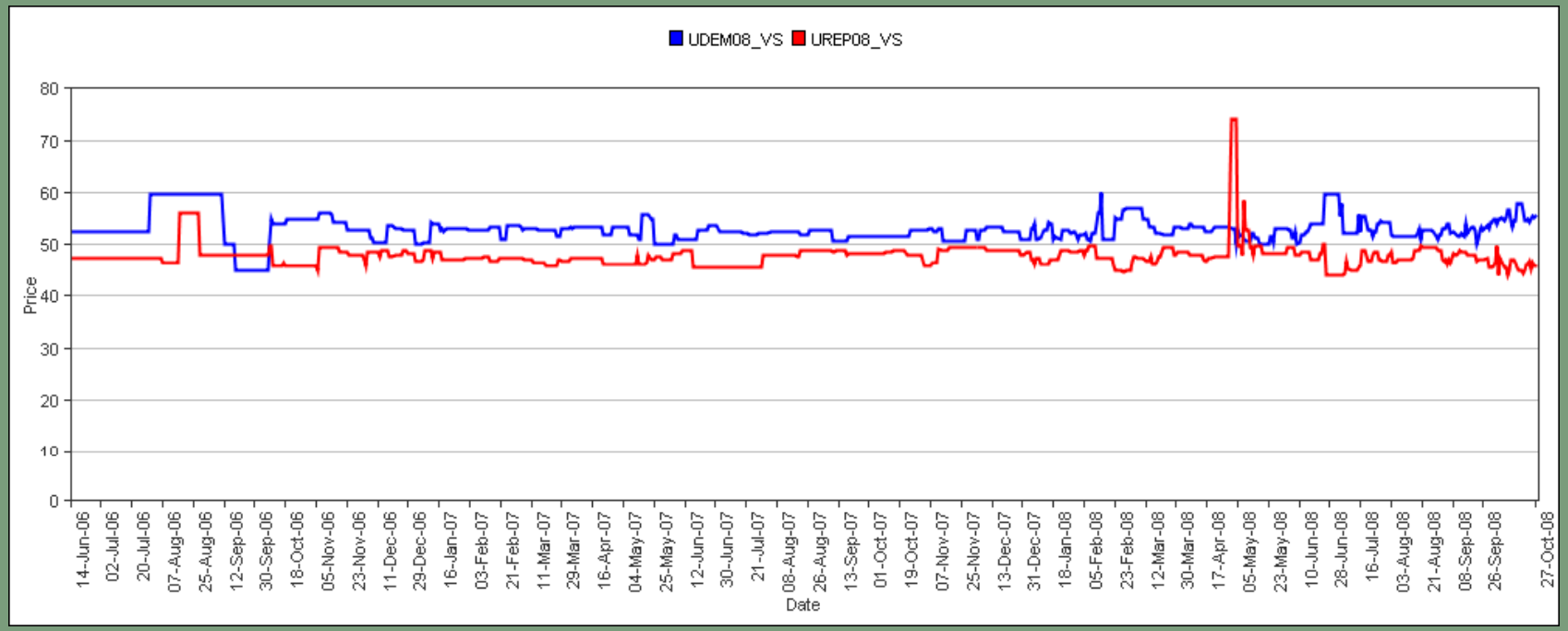
Market Results Day before Election, Week before Election vs. Final Poll Results



University of Iowa,Henry B. Tippie College of Business
http://www.biz.uiowa.edu/iem/media/accuracy.html

Iowa Electronic Markets

- 2008 US Presidential Election Vote Share Market
  - What % of vote cast will each candidate receive?

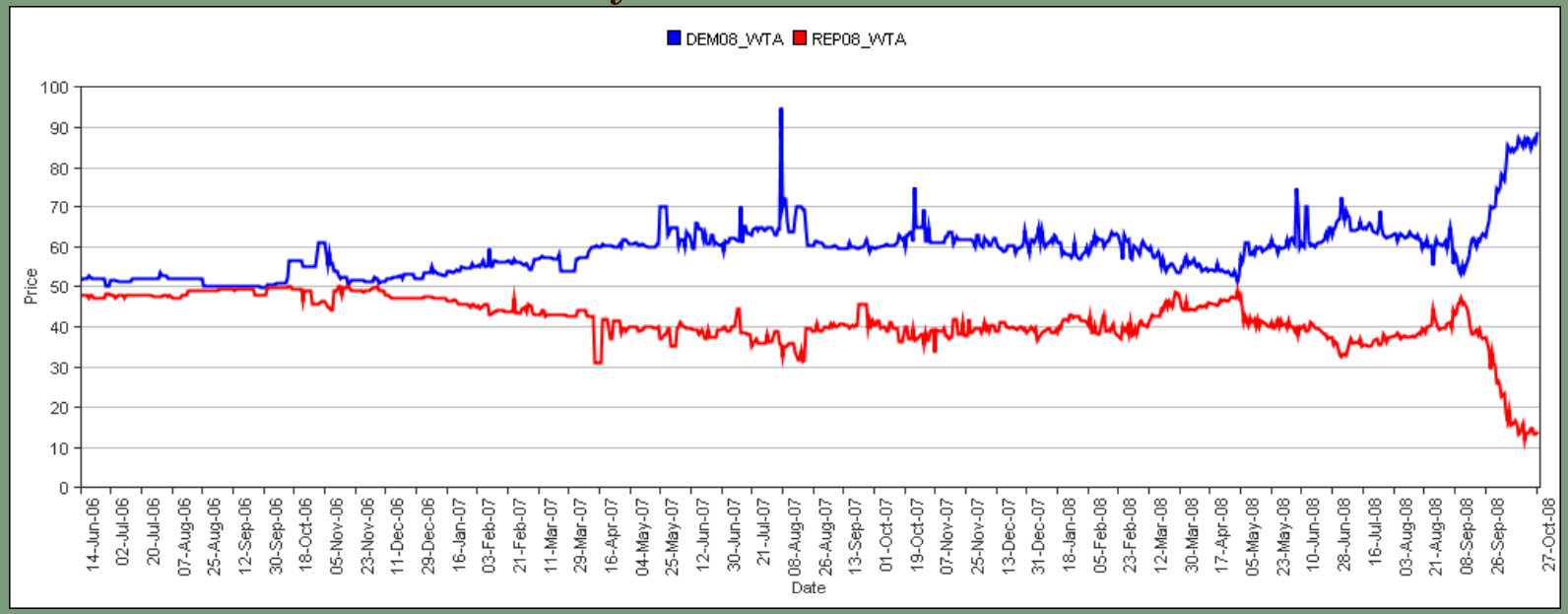


Name	Description
UDEM08_VS	$1.00 times two-party vote share of unnamed Democratic nominee
UREP08_VS	$1.00 times two-party vote share of unnamed Republican nominee

Source: Iowa Election Markets, as of October 27, 2008

Iowa Electronic Markets

- 2008 US Presidential Election Winner Takes All Market
  - What is the Probability that a candidate wins the election?



Name	Description
DEM08_WTA	$1 if the Democratic Party nominee receives the majority of popular votes cast for the two major parties in the 2008 U.S. Presidential election, $0 otherwise
REP08_WTA	$1 if the Republican Party nominee receives the majority of popular votes cast for the two major parties in the 2008 U.S. Presidential election, $0 otherwise

Source: Iowa Election Markets, as of October 27, 2008

2008 U.S. Presidential Election Results
(Popularity Vote Share)

	Actual Results	IEM	Avg. of 10 Polls
McCain	46.2%	46.5%	44.4%
Obama	52.5%	53.5%	52.3%

Pollster	Dates	McCain	Obama	Undecided
ABC/Post	10/30-11/2/08	44	53	1
CNN	10/30-11/1/08	46	53	1
FOX	11/1-2/08	43	50	5
Gallup	10/31-11/2/08	44	55	-
Harris Interactive	10/30-11/3/08	44	52	-
NBC/WSJ	11/1-2/08	43	51	-
Pew	10/29-11/1/08	46	52	-
Rasmussen	11/1-3/08	46	52	-
Reuters/ C-SPAN/ Zogby	10/31-11/3/08	43	54	3
YouGov/Polimetrix	10/18-11/1/08	45	51	2
Average		**44.4**	**52.3**	**2.4**

www.pollster.com

Business Applications

- Wolfers and Zitwitz (2006) cite use of corporate prediction markets in forecasting, decision-making and risk management.
  - "The idea behind these markets is to elicit knowledge from within an organization that might otherwise be lost somewhere in a poor organizational design."
- Prediction Markets and Non-Profits
  - *"Prediction markets could consolidate information about which nonprofits provide the highest social returns on investment."* (Goldberg, Steven. Harvard Business Review, October 2008)
  - Will the United Way reduce by half the number of students who drop out of high school in New York City?
- Enterprise Solution Providers
  - Consensus Point
  - NewsFutures
  - Inkling Markets

Business Applications

- Yahoo
  - Created prediction market called Tech Buzz Game to forecast technology trends
- Siemens
  - Internal market predicted that the firm would fail to deliver software project on time, even when other more traditional forecasting methods suggested that the deadline would be met (Ortner, 1998)
- Hewlett Packard
  - 1996 researchers at H-P Labs setup prediction market to predict monthly printer sales
  - In a test over the next three years, the markets beat official forecasts in six out of eight tries.
  - Hewlett-Packard produced more accurate forecasts of printer sales than the firm's sales forecasting

Business Applications

- Google (Cowgills, Wolfers and Zitzewitz, 2008)
  - Started in April 2005
  - One of largest (if not the largest) corporate users
  - Each calendar quarter from Q2/2005 – Q3/2007 about 25-30 different markets were created
  - Typical questions:
    - How many users will Gmail have at end of the quarter?
    - Will Apple release an Intel-based Mac computer?
  - At end of quarter, "currency" was converted into raffle tickets and prizes were raffled off.
  - Of 6,425 employees with a prediction market account, 1,463 placed at least one trade.

Google Results

- Four specific biases:

Overpricing of favorites	Short aversion
Optimism	Under pricing of extreme outcomes

- New employees and inexperienced traders suffered from these biases
- Market had a distinctly pro-Google bias.
- Participants tended to be more optimistic about events specific to Google when Google's stock price went up
- Found a strong relationship between physical proximity to the participants and trading relationship.
- People who sat next to each other trade alike even if they don't work on the same projects. People who work on same project but don't sit near each other do not trade alike.

Potential Issues - Legal & Liquidity

- Legal Issues
  - Restrictions on online gambling
  - Disclosures recommended to limit liability of sponsoring firm
- Liquidity Issues
  - Many contracts are fairly small compared those on NYSE, TSE or ASX
  - Markets will work better with widely discussed events
  - Need contracts where there is disagreement among participants
  - Contracts that have been setup on events that only relatively few insiders would care or posses information advantage have failed
    - Tradesports contract on next Supreme Court judge retirement
    - Virgin Galactic to send paying customer into suborbital space (70 miles) on/before 31 Dec 2010

Potential Issues - Arbitrage & Price Manipulation

- Arbitrage
  - In Wolfers and Zitzewitz, 2004, show bid/ask prices of contract that paid if Arnold Schwarenegger was elected California governor in 2003 on two markets: Tradesports, World Sports Exchange. Bid/ask prices of both exchanges moved very close together, resulting in virtually no arbitrage opportunity.
  - Tetlock (2004) surveys a wide range of data from Tradesports and found that their contracts were largely efficiently priced.
- Manipulation
  - Several known attempts have been made but none with much success
  - Potential opportunity for manipulation by terrorists was a concern for the DARPA market.
  - US Presidential election campaign in 2004 one trader on Tradesports.com spent several thousands of dollars trying to reduce the odds of a John Kerry defeating George Bush, but prices recovered to their previous level within an hour. (Rhode and Strumpf, 2006)

Psychological & Behavioral Issues

- Long-Shot Bias
  - (Wolfers and Zitzewitz, 2004) found evidence to suggest that prediction markets suffer from similar behavioral biases as other financial markets
  - Compared Tradesports prices with actual option prices in Chicago Mercantile Exchange and found that extremely unlikely results of S&P500 are relatively overpriced on Tradesports.
  - Bettors tend to overvalue extreme long shots, resulting in lower payoffs for such bets. (Thaler and Ziemba, 1988) discuss this favorite-long shot bias in horse races
- Trading according to personal beliefs
  - Favorite team bias
  - Personal political party bias

Investment Field Applications

- Hoguet (2007) states that prediction markets can provide a mechanism for investors to:
  - Determine consensus and observe its evolution
  - Establish probabilities of various outcomes
  - Contrast views with that of the consensus
  - Manage financial risks
- Supplement other forecasting tools
  - Use with opinion surveys, expert opinion, panel groups
- Eliminates need for probability distribution assumptions
- Use as a management tool
  - Can be used to find and promote those analysts with superior forecasting ability

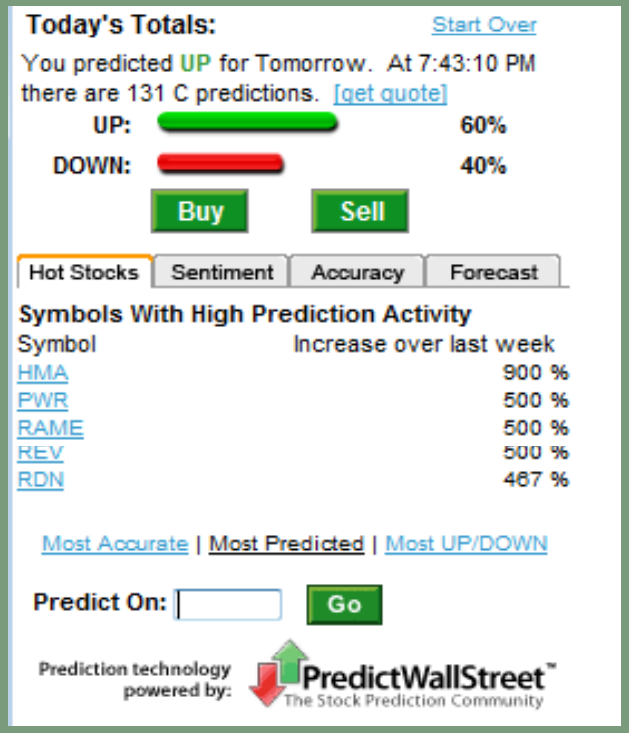
Investment Field Applications

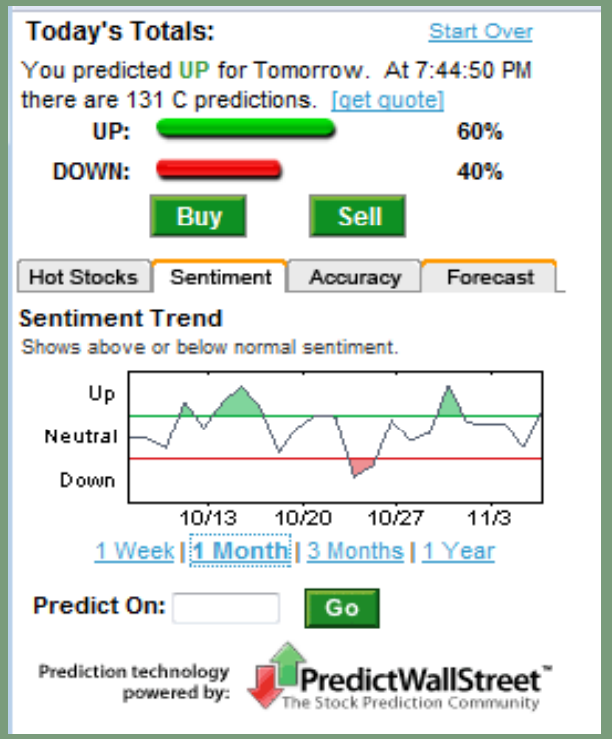
- Economic Derivatives
  - Nonfarm Payroll Futures and Options available on Chicago Mercantile Exchange.
  - Soon to have Consumer Price Index (CPI), Gross Domestic Product (GDP)
- Earnings Forecasts
  - HedgeStreet announced (*but not yet available*) a "Corporate Actions" contracts enables investors to trade on the anticipated revenues and earnings per share (EPS)
    - Amazon.com (AMZN); Apple (AAPL); Citigroup (C); Ford Motor (F); Google (GOOG), etc…
    - Binary contracts with payout value of $100 each.
    - Traders have the opportunity to "buy" if they believe the reported value of a company's earnings will be above a certain level, or "sell" if they believe the number will be reported at or below that level.

Investment Field Applications

- PredictWallStreet (www.predictwallstreet.com)
  - Available since August 2005
  - Identifies a stock and asks site visitors "Will this stock go up or down?"
  - Everybody who makes a prediction gets an accuracy rating.
  - Rates everybody making predictions and posts those ratings so that viewers may determine the credibility of the predictor.
- Also provides contests with real cash reward
  - Players register and make predictions over the course of five business days
  - PredictWallStreet analyzes closing prices against contestants' guesses to determine the up or down direction and, finally, the data is translated into percentages.
  - Contestants are awarded cash -- $300 for first place, $200 for second and $25 for third.

PredictWallStreet

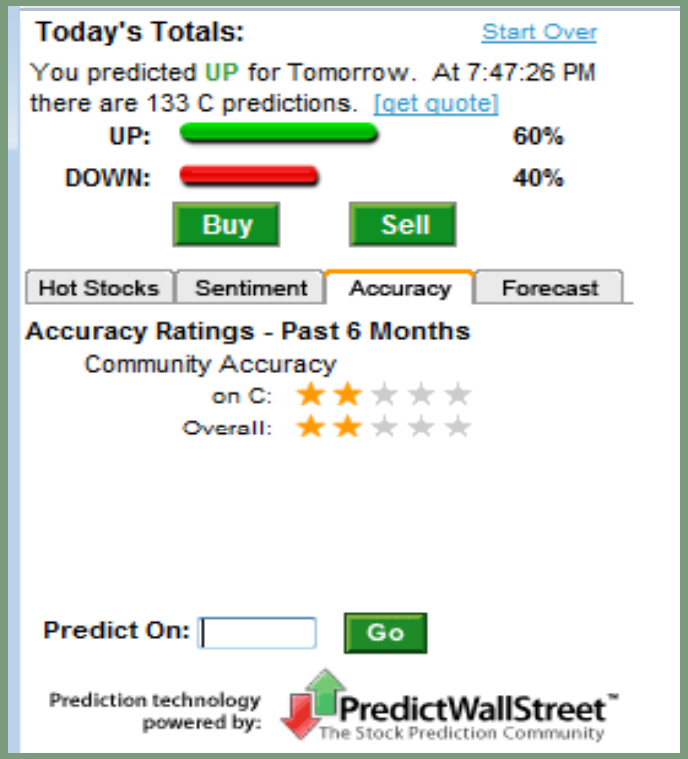


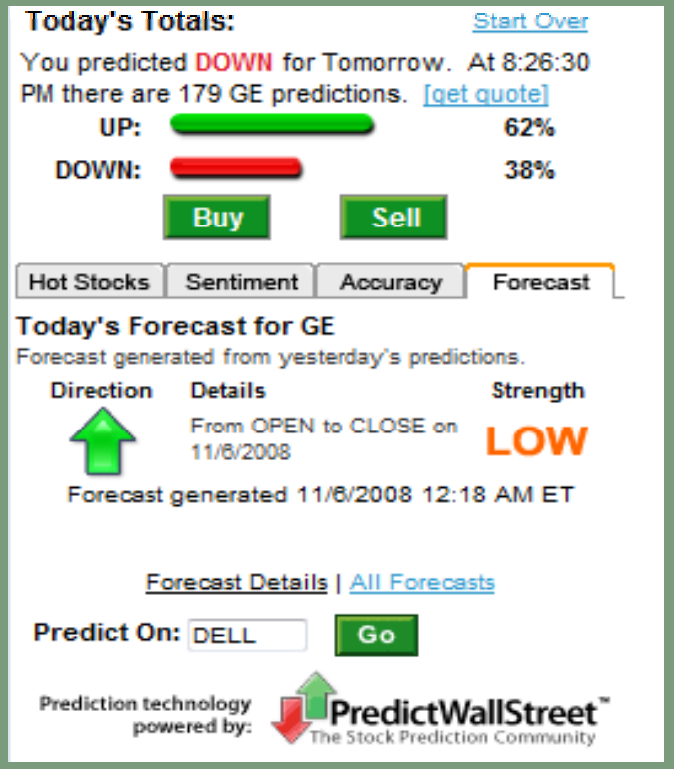


- **Hot Stocks**: Most Accurate / Most Predicted and the Most UP/DOWN stocks. Most Accurate is a list of stocks that have the best accuracy over the past week – predictors have been very correct on these stocks this past week. Most Predicted is a list of stocks that have received an abnormally high number of predictions today. Most UP/DOWN is a list of stocks that have an extremely high percentage of UP or DOWN predictions

- **Sentiment** Trend shows the prediction pattern for a given security. The graph shows the sentiment moving within three zones: Up, Neutral, and Down. When the sentiment is in the Up zone, the community is bullish compared to historical norms. The community is bearish when the sentiment is in the Down zone. The farther the sentiment moves towards the upper or lower edge of the graph, the stronger the sentiment.

PredictWallStreet

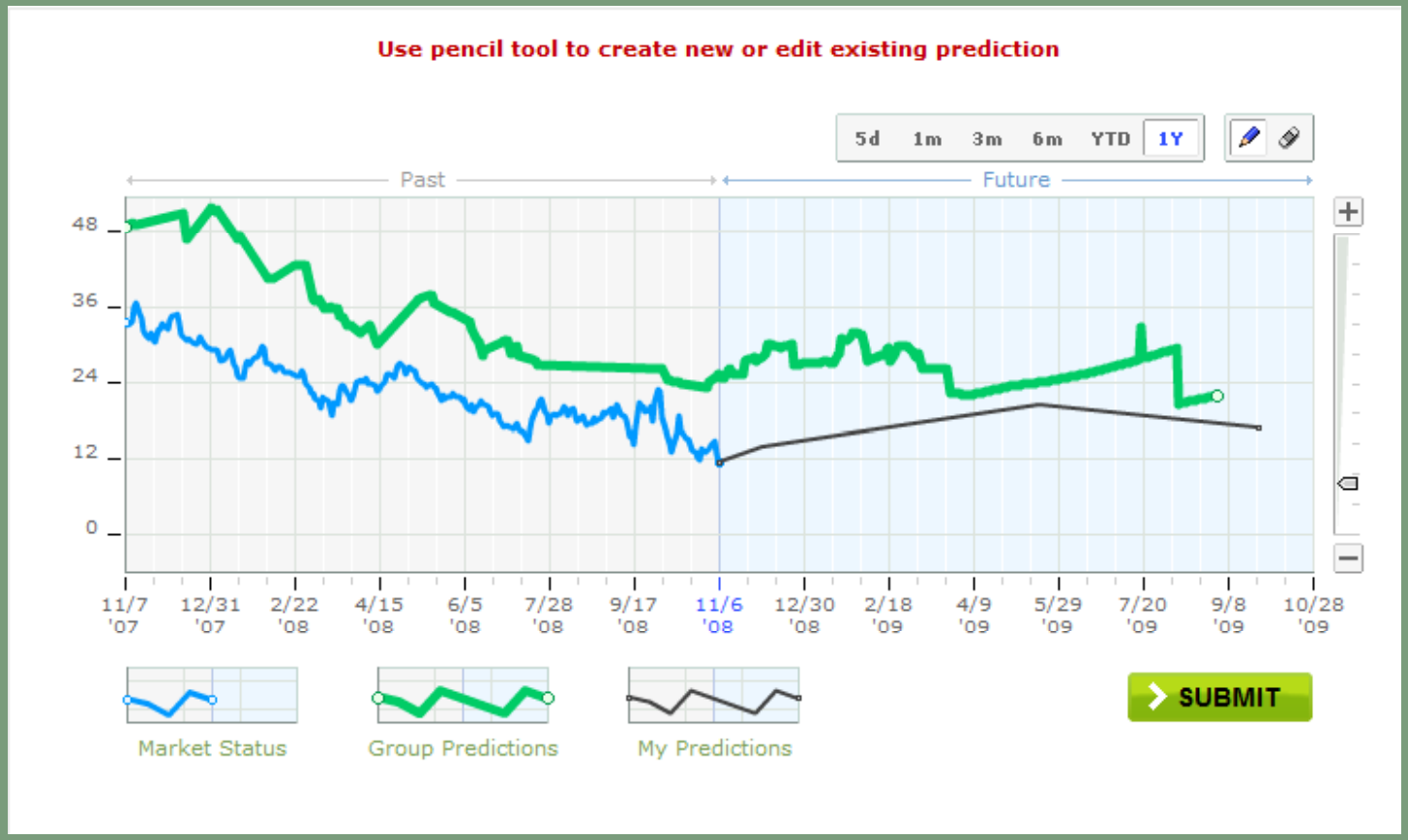




- **Accuracy**: Plots the accuracy of all predictions on a curve. Five stars indicates a consistently outstanding performer. Five star predictors have above-average accuracy and rank in the top percentile regarding consistency. One star indicates an extreme contrarian performer; consistently predict the opposite of what actually happens.

- **Forecast**: Forecasts are based on algorithms the firm developed that take into account many factors including the number of predictions, the security being predicted on, and the past accuracy of the person making the prediction. Historically the algorithms have been more than 50% accurate.

PredictWallStreet



- View one's own and group's forecast of a security

Investment Field Applications

- PredictWallStreet Forecast Record

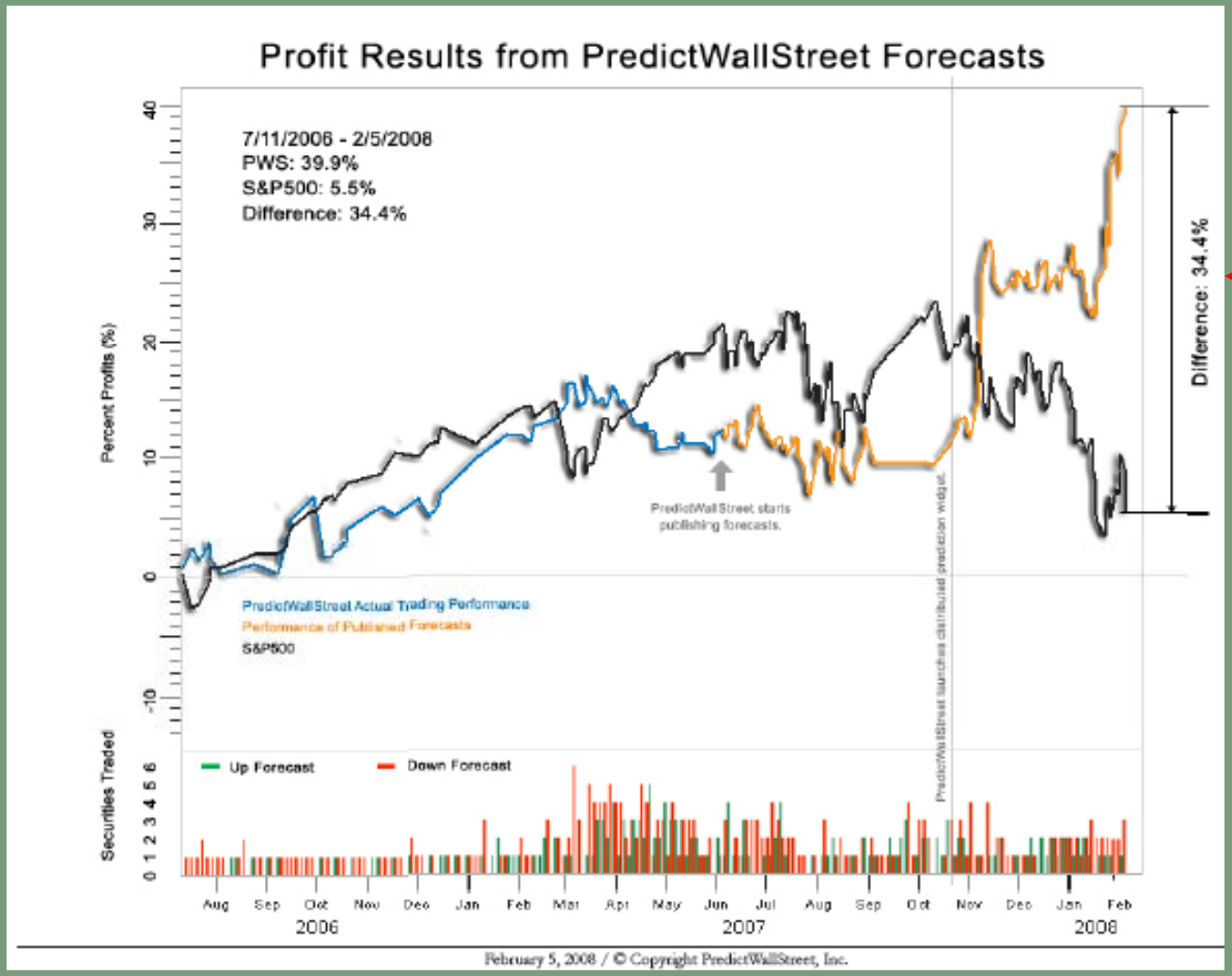
Period Tracked	07/11/2006 - 02/05/2008*	10/19/2007 - 02/05/2008**
Total Return	39.9%	28.6%
Forecasts/Trades	449	158
Securities Traded	70	38
"Up" Forecasts	179 (40%)	66 (42%)
"Down" Forecasts	270 (60%)	92 (58%)
Largest Daily Loss	-4.2%	-2.4%
Correlation to SPY	0.00	-0.67
Days in Market	181	59
Mean Monthly Return	2.0%	5.7%
Standard Deviation of Monthly Return	4.1%	5.5%
Sharpe Ratio	1.32	3.36
Estimated Annual Return***	24.0%	68.6%
Average Dollar Volume per day of Daily Forecast	$10 Billion USD	
Distribution of Forecasts by Sector:		
Technology	27%	30%
Financial	10%	14%
Healthcare	6%	5%

* May 24, 2007 = first published forecasts on our website.
** October 19, 2007 = distributable widgets launched.
*** Mean monthly return multiplied by 12.

- July 11, 2006 to Feb 5, 2008 shows the actual trading profits (including commission costs) of third party trading partner, on a restricted set of securities.
- On May 24, 2007 began releasing forecasts on a much wider range of securities to the public at large via website.

Investment Field Applications

- Interesting Results though short performance history



Cumulative profit from forecasts beat S&P500 by 34.4%

Conclusions

- Prediction markets provide a way to gauge consensus market forecast of a future event
  - Information discovery
  - Aggregate opinion
- Current use
  - Individuals – entertainment purposes
  - Corporations – strategic planning, sales forecasting
- Future Investment Industry Potential
  - Useful when continuously updated dynamic forecasts are important
  - Internal prediction market to complement other forecasting methods
    - Tactical Asset Allocation decisions
      - Asset class
      - Sector over/under weights
    - Macro-economic forecasts
      - GDP growth / Inflation / Interest rates
  - Develop and test new contracts (factors)
    - Contingency contract tied to the outcomes of more than one event.

Conclusions

- Questions Remain (Wolfers & Zitzewitz, 2006)
  - How to attract uninformed traders?
  - Trade off between an event of interest and writing that event in an enforceable contract?
  - How to limit manipulation?
  - Are markets well calibrated on small probabilities?
  - How to separate correlation from causation?

Resources

- Consensus Point
  - www.consensuspoint.com
- Forecasting Principles
  - http://www.forecastingprinciples.com/welcome.html
- International Institute of Forecasters
  - http://www.forecasters.org/
- Journal of Prediction Markets
  - http://www.predictionmarketjournal.com/
- List of Real-Money and Play-Money Market Sites
  - http://www.midasoracle.org/exchanges/
- Prediction Market Industry Association
  - http://www.pmindustry.org/
- MacroMarkets
  - www.marcromarkets.com
- Mercury Research and Consulting blog on prediction markets
  - http://blog.mercury-rac.com/

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