Prediction Market Research

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Note: References are in the handout “Research Bibliography”
How do Prediction Markets Work?

Design
Contracts
Traders
Information

Market → Prediction
Understanding Prediction Markets

- Accuracy
- Polls and Markets
- Market Dynamics
- Forecast Standard Errors
- Trader Characteristics
- Trader Interaction
- Biases and Small Markets
- Other Arenas
- Opportunities and Issues
Accuracy

- At short horizons, prices are accurate and unbiased predictors
  - Berg, Forsythe, Nelson and Rietz, 2001
  - Berg and Rietz, 2001a

- At long horizons, bid/ask midpoints are efficient forecasts
  - Berg, Nelson and Rietz, 2001

- Incentives matter
  - Gruca, Berg and Cipriano, 2002
  - Camerer and Hogarth, 1999
Predictive Accuracy

Berg, Forsythe, Nelson and Rietz (2001)

US Presidential Elections
Avg. Abs. Err. = 1.37%
(5 Markets, 12 Contracts)

Other US Elections
Avg. Abs. Err. = 3.43%
(14 Markets, 50 Contracts)

Non-US Elections
Avg. Abs. Err. = 2.12%
(30 Markets, 175 Contracts)
WTA Accuracy
Berg and Rietz, 2002a

Price Range

Predicted and Actual Frequency

IEM Price  Payoff

Berg and Rietz, 2002a
Polls and Markets

- At short horizons, markets are on par with polls
  - Berg, Forsythe, Nelson and Rietz, 2001
- At long horizons, markets outperform polls
  - Berg, Nelson and Rietz, 2001
- Polls do not drive the market, the market leads polls according to Granger tests
  - Forsythe, Nelson, Neumann and Wright, 1992
Predictive Accuracy
Berg, Forsythe, Nelson and Rietz (2001)
IEM versus Polls: 1996
(Berg, Nelson and Rietz, 2001)

Predicted Clinton Winning Margin

-10% -5% 0% 5% 10% 15% 20% 25% 30% 35% 40%

Market
Outcome
Dem. Conv.
Debates
Super Tuesday

Polls:
A = ABC
C = CBS
N = NBC
G = Gallup
H = Harris
T = Time
L = Hotline
P = CNN/Princeton
Z = Zogby

<table>
<thead>
<tr>
<th>Days included in sample</th>
<th>Item</th>
<th>1988</th>
<th>1992</th>
<th>1996</th>
<th>2000</th>
<th>all years</th>
</tr>
</thead>
<tbody>
<tr>
<td>All (from the beginning of the market)</td>
<td>Number of polls</td>
<td>59</td>
<td>151</td>
<td>157</td>
<td>229</td>
<td>596</td>
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<tr>
<td></td>
<td>poll “wins”</td>
<td>25</td>
<td>43</td>
<td>21</td>
<td>56</td>
<td>145</td>
</tr>
<tr>
<td></td>
<td>market “wins”</td>
<td>34</td>
<td>108</td>
<td>136</td>
<td>173</td>
<td>451</td>
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<tr>
<td></td>
<td>% market</td>
<td>58%</td>
<td>72%</td>
<td>87%</td>
<td>76%</td>
<td>76%</td>
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<tr>
<td></td>
<td>p-value (1sided)</td>
<td>0.148</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

| Last 100                | Number of polls | 45   | 82   | 124  | 180  | 431       |
|                         | poll “wins”     | 24   | 23   | 18   | 54   | 119       |
|                         | market “wins”   | 21   | 59   | 106  | 126  | 312       |
|                         | % market        | 47%  | 72%  | 85%  | 70%  | 72%       |
|                         | p-value (1sided)| 0.724| 0.000| 0.000| 0.000| 0.000     |

- The market dominates polls at long horizons
Market Dynamics

- Large, developed market bid/ask midpoints follow a random walk
  - Initially, they may not
  - Thin markets may not
  - Berg, Nelson and Rietz, 2001

- Markets react quickly
  - Powell Nomination Market among others
  - Berg and Rietz, 2002b

- Markets can help identify meaningful news
  - Forsythe, Nelson, Neumann and Wright, 1992

- Arbitrage opportunities are capped in large markets, but may be pervasive in small markets
### NLLS versus Time Series Estimation Results (Berg, Nelson and Rietz, 2001)

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>OLS/Bootstrap Time Series Estimates</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.0011</td>
<td>0.0031</td>
<td>0.0077</td>
<td>0.0001</td>
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<tr>
<td>Robust Std. Err.</td>
<td>0.0007</td>
<td>0.0014</td>
<td>0.0056</td>
<td>0.0009</td>
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<tr>
<td>Lagged Spread</td>
<td>0.9874</td>
<td>0.9282*</td>
<td>0.9312</td>
<td>0.9480</td>
</tr>
<tr>
<td>Robust Std. Err.</td>
<td>0.0189</td>
<td>0.0316</td>
<td>0.0547</td>
<td>0.0411</td>
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<tr>
<td>Bootstrap Std. Err.</td>
<td>0.0185</td>
<td>0.0882</td>
<td>0.0948</td>
<td>0.0870</td>
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<tr>
<td><strong>NLLS Estimates</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagged Spread</td>
<td>1.0149</td>
<td>1.0028</td>
<td>1.0093</td>
<td></td>
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<tr>
<td>Robust Std. Err.</td>
<td>0.0068</td>
<td>0.0014</td>
<td>0.0073</td>
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<tr>
<td>Z-Test vs Bootstrap</td>
<td>-0.9804</td>
<td>-0.7552</td>
<td>-0.7021</td>
<td></td>
</tr>
</tbody>
</table>
Speed: Powell Nomination Market

Price vs. Time (in hours and tenths of hours; 0.00 represents 8:10 am CST)
What is News?
Berg, Nelson and Rietz, 2001
Forecast Standard Errors

- Since markets follow a random walk, forecast standard errors increase at approximately root-t
  - Berg, Nelson and Rietz, 2001
- Inter-market relationships also show this
  - Berg, Nelson and Rietz, 2001
Predicting Prediction Error: 2000

Call election for Bush 10/29 (-9 days) & 11/6 (-1 day)

Random Walk Sigma: 0.85%
Predicting Prediction Error: 1996

Call election for Clinton 9/14 (-52 days)

Random Walk Sigma: 0.75%
IEM versus Polls: 1996

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Predicted Clinton Winning Margin

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Trader Characteristics

- A representative sample is not necessary

- Many traders are biased
  - Forsythe, Nelson, Neumann and Wright, 1992, Forsythe, Ross and Rietz, 1999

- Large markets overcome this
  - Forsythe, Nelson, Neumann and Wright, 1992, Forsythe, Ross and Rietz, 1999

- Small market may not
  - Forsythe, Ross and Rietz, 1999
Trader Interaction

- Traders self-select into roles

- “Marginal” traders seem less affected by bias
  - Forsythe, Nelson, Neumann and Wright, 1992, Forsythe, Ross and Rietz, 1999

- Market makers seem more rational
  - Forsythe, Ross and Rietz, 1999, Oliven and Rietz, 2002
Biases and Small Markets

- Small markets may be more affected by irrationality and biases

- Market structure matters
  - Protects traders from their own mistakes and minimizes impact on prices in large markets
  - Oliven and Rietz, 2002

- WTA markets may have a slight overconfidence bias at intermediate horizons
  - Berg and Rietz, 2001a
Other Areas

- Markets have been run successfully in:
  - Accounting projections
    - Berg, Dickhaut, Hughes, McCabe and Rayburn, 1995
  - Movie box office projections
    - Gruca, 2000, and Gruca, Berg and Cipriano, 2002
    - Hollywood Stock Exchange
  - Corporate sales
    - Plott, 1999
  - Completion dates
    - Ortner, 1997 & 1998
  - Conditional markets
    - Berg and Rietz, 2002b
Markets as Decision Tools
Berg and Rietz, 2002b

- Could markets tell us about things that may or may not happen?
- Examples:
  - Would Powell have won if he ran against Clinton in 1996?
  - Was Dole the right candidate to run against Clinton?
  - Will this movie idea be a blockbuster?
  - Will a terrorist attack occur and, if so, under what National Security Threat Level?
- Combinations of regular and conditional markets can help answer such questions
Was Dole the Best Choice I?

- **Republican nomination (event probability) market**
  - Question: Who will win the Republican nomination?
  - Contracts
    - Dole: $1 if Dole is the Republican nominee
    - Forbes: $1 if Forbes is the Republican nominee
    - Etc.

- **Presidential winner-takes-all (event probability) market**
  - Question: Who will win the Presidency?
  - Contracts
    - Clin: $1 if Clinton wins the popular vote
    - OTDem: $1 if another Democrat wins the popular vote
    - Rep: $1 if a Republican wins the popular vote
    - Other: $1 if another candidate wins the popular vote
Dole versus Clinton

Forecast Probabilities for Dole's Nomination/Percent of Delegates Committed to Dole

<table>
<thead>
<tr>
<th>Date</th>
<th>Forecast Probabilities for Dole's Nomination/Percent of Delegates</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/4/1996</td>
<td></td>
</tr>
<tr>
<td>2/11/1996</td>
<td></td>
</tr>
<tr>
<td>2/18/1996</td>
<td></td>
</tr>
<tr>
<td>2/25/1996</td>
<td></td>
</tr>
<tr>
<td>3/3/1996</td>
<td></td>
</tr>
<tr>
<td>3/10/1996</td>
<td></td>
</tr>
</tbody>
</table>

Forecast Probabilities for Clinton Election Win

Dole Win Nomination
Dole Percent of Delegates
Clinton Win Election

Legend:
- Blue line: Dole Win Nomination
- Black line: Dole Percent of Delegates
- Pink line: Clinton Win Election
Was Dole the Best Choice II?

- Conditional Vote Share Market
  - Contracts
    - V.DOLE: $1 \times \text{Dole's vote share if Dole is nominated}
    - CL|DOLE: $1 \times \text{Clinton's vote share against Dole if Dole is nominated}
    - V.FORB: $1 \times \text{Forbes' vote share if Forbes is nominated}
    - CL|FORB: $1 \times \text{Clinton's vote share against Forbes if Forbes is nominated}
  - Etc.

- Prices predict conditional vote shares
Powell versus Clinton

- **Powell nomination (event probability) market**
  - Question: Will Powell’s name be placed in nomination at the 1996 Republican Convention?
  - Contracts
    - P.YES: $1 if Powell’s name placed in nomination
    - P.NO: $1 if Powell’s name not placed in nomination

- **Presidential winner-takes-all (event probability) market**
  - Question: Who will win the Presidency?
  - Contracts
    - Clin: $1 if Clinton wins the popular vote
    - OTDem: $1 if another Democrat wins the popular vote
    - Rep: $1 if a Republican wins the popular vote
    - Other: $1 if another candidate wins the popular vote
Powell versus Clinton
So...What have we learned?

- **The good news:**
  - Markets are good information aggregators
    - Absolutely
    - Relative to next best alternative
  - Markets seem to be good forecasters
  - Markets can even tell us about what might have been

- **Caveats and Issues**
  - Incentives and market structure important
  - Subject pool important
    - Markets can only aggregate what’s known
  - Traders make mistakes and display biases
    - Do they affect markets and, if so, when and how?
  - Small markets