

Wrapping Up: Review and Looking Ahead

EES 4760/5760

Agent-Based and Individual-Based Computational Modeling

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Class #26: Wednesday, November 20 2024

Final Week

Housekeeping

- Please fill out the survey on Brightspace for which day you would prefer to give your project presentation.
- Before class on the day you will give your presentation, please upload a copy or your slides to the Brightspace Assignment for the presentation.
- By the end of the day on Friday Dec. 6, please upload your final paper to Brightspace,

Presentations

- 5 minutes each plus 2 minutes for questions (change from original assignment)
- Structure:
 1. Start by describing your research question
 2. Briefly describe your model
 3. Describe the experiments you performed:
 - What outputs did you observe or measure?
 - What parameters did you change?
 - What did you see? (e.g., behaviorspace graphs or screenshots of the model)
 4. Conclusions
- General recommendations:
 - 5 slides, one minute each.
 - As much as you can, use figures (graphs, illustrations, images, etc.) instead of text.
 - Avoid slides with a lot of text
- You can't say everything you did, so focus on the most interesting highlights.
- You can present what you did in depth in your paper.

Final Paper

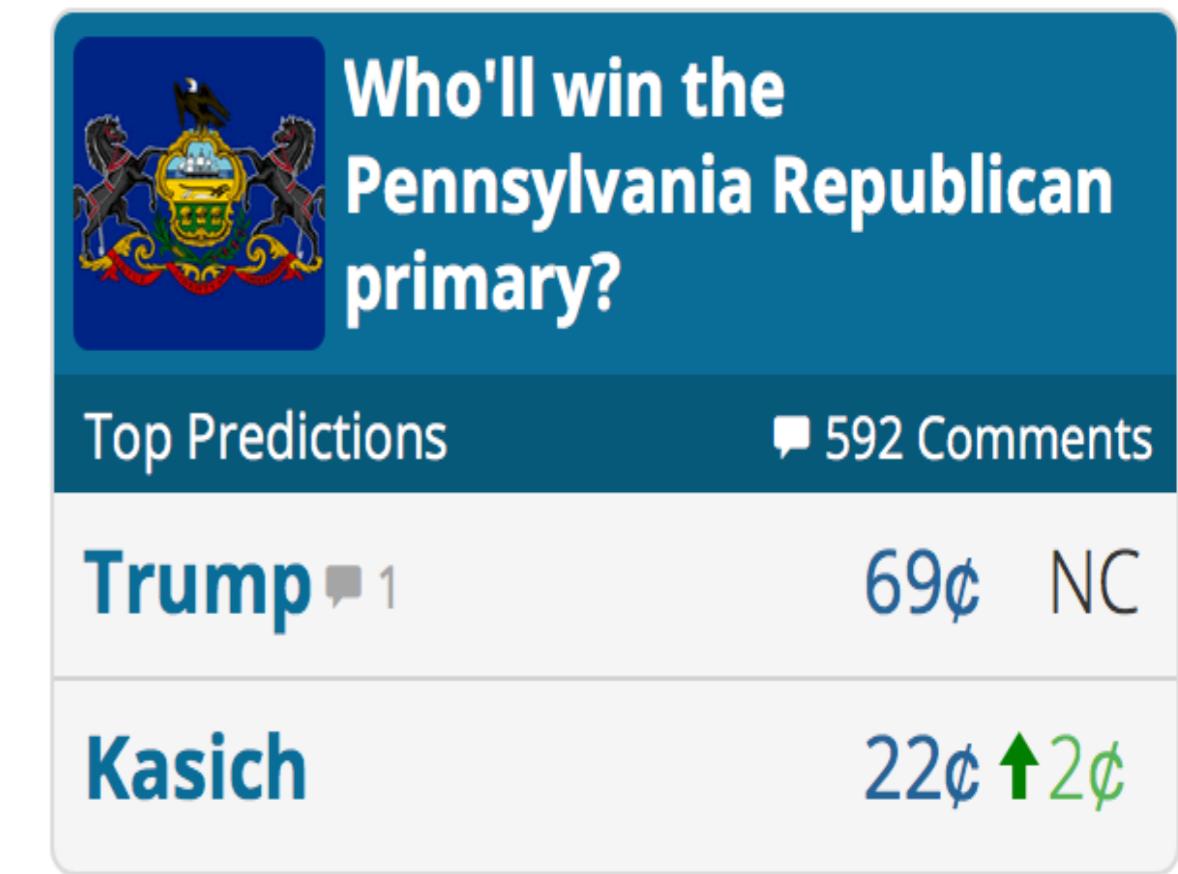
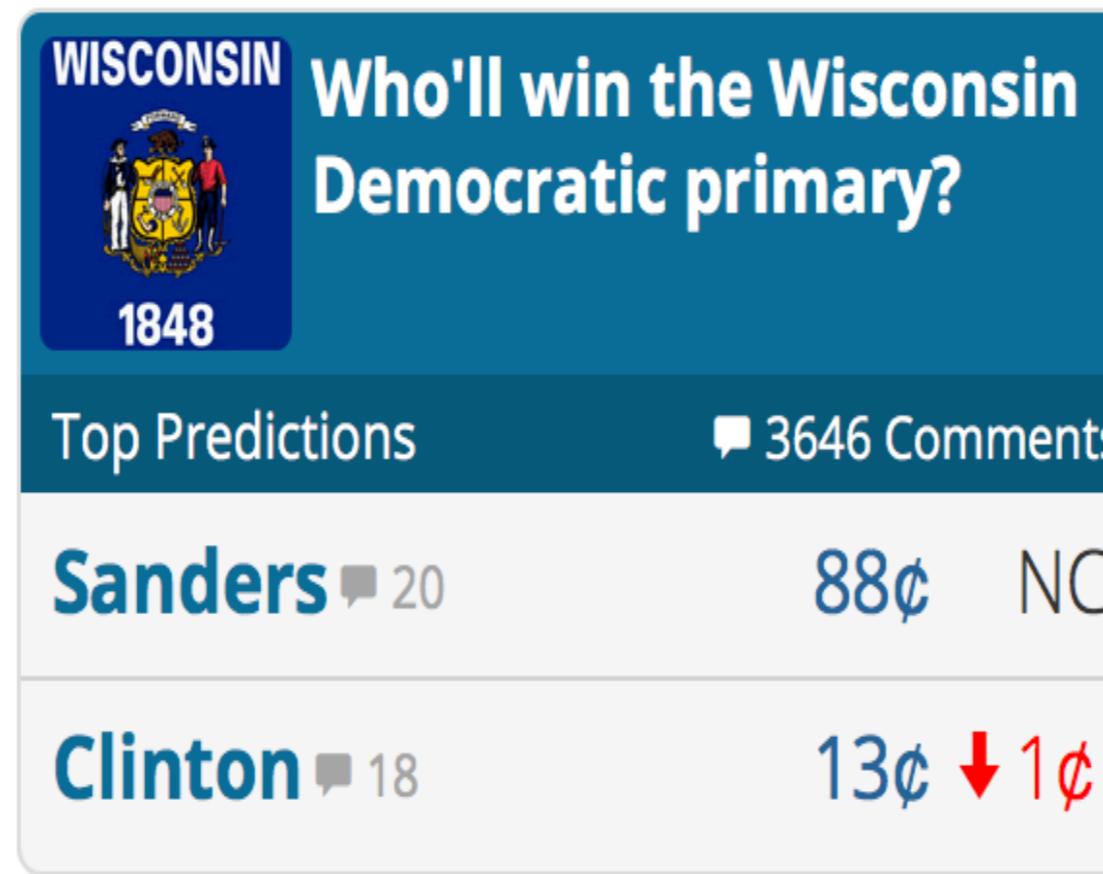
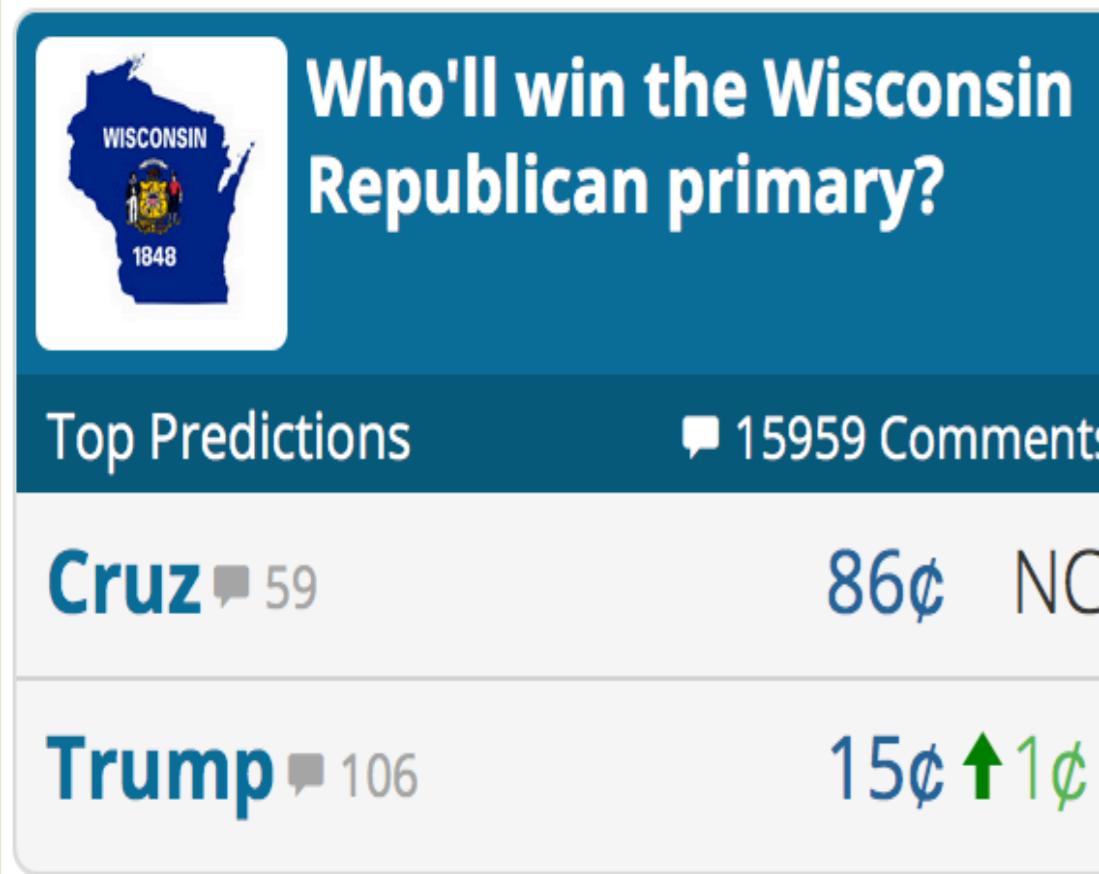
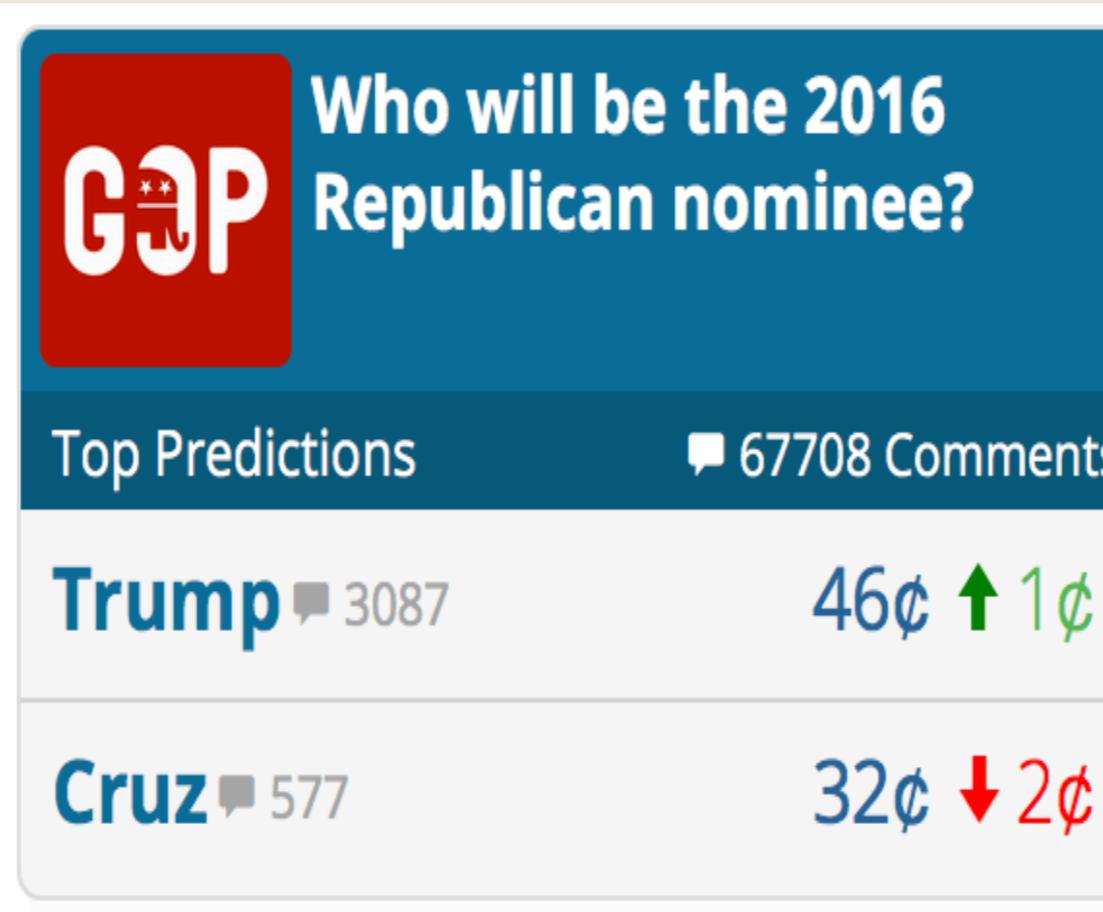
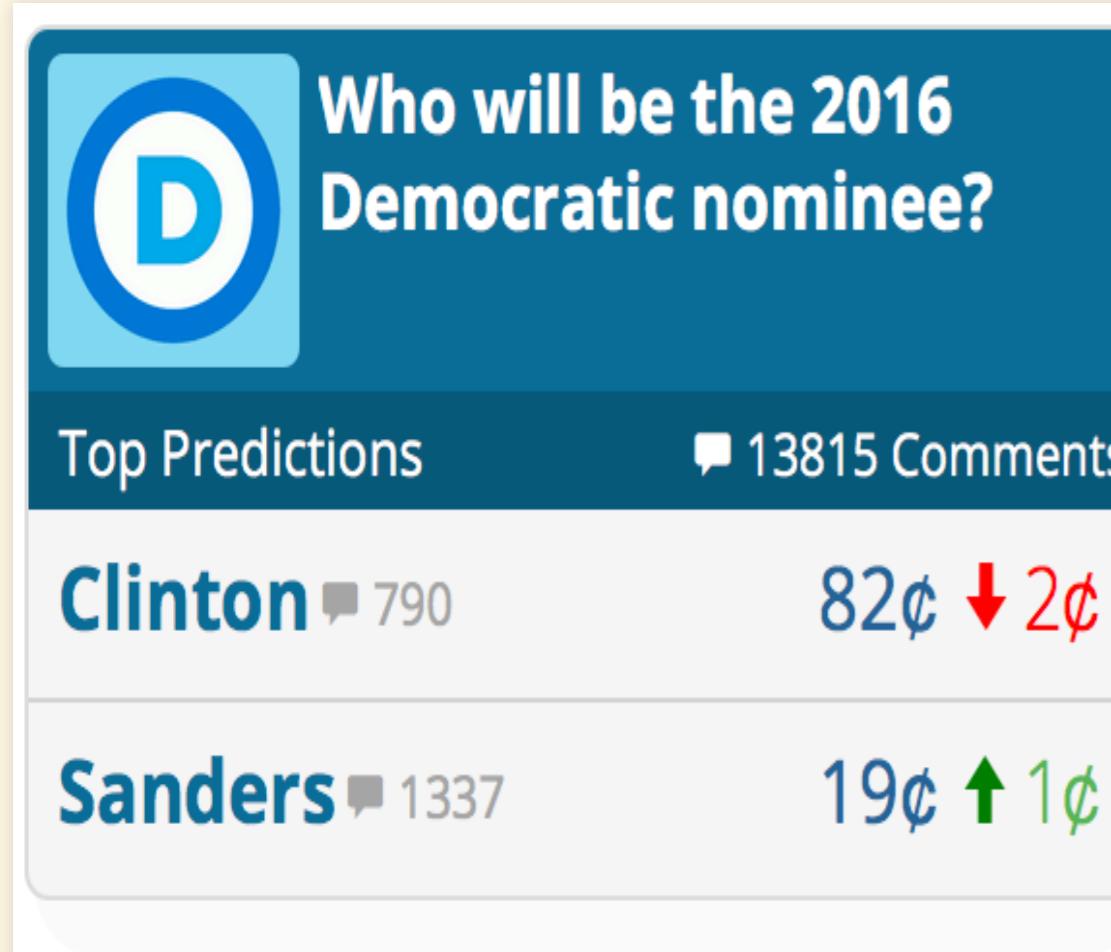
- Updated assignment on Brightspace & course web site with recommended structure
- Write this up as though it were a scientific journal paper:
 1. Abstract (1 paragraph summary of the paper, focusing on highlights)
 2. Introduction
 - Research question and why it's interesting
 3. Methods
 - Describe the model you started with and how you changed it to answer your research question
 - Describe the experiments you ran with the model.
 - Describe what outputs you measured
 4. Results
 - What did you see (graphs of output, pictures of turtles on patches, etc.)
 5. Discussion, conclusions:
 - What did you learn from the results of your experiment?
 - If you had more time, what would you do next with your model?
 - Do you think these results point to possible uses for your model?

Agent-Based Models for Policy Design

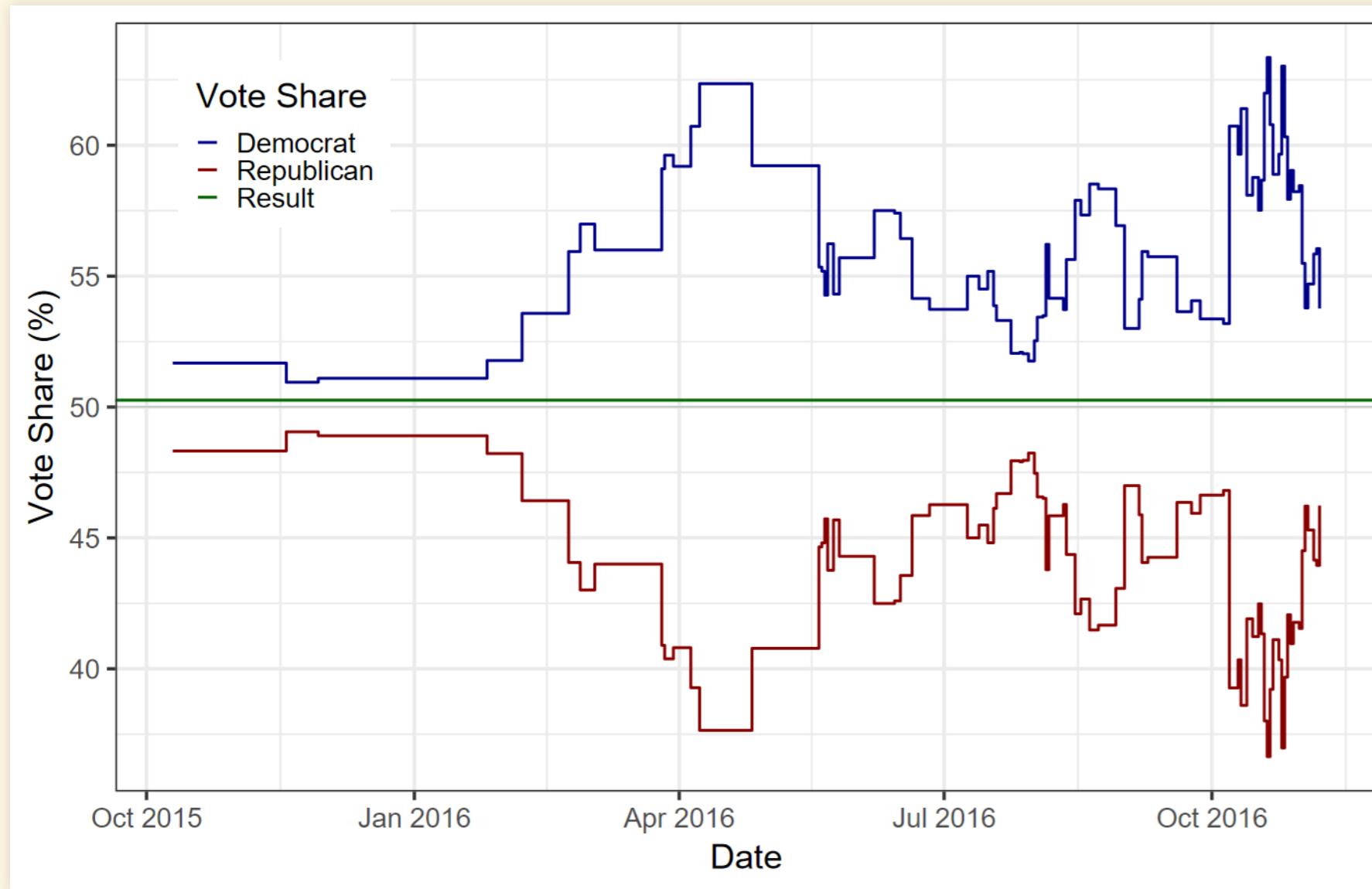
Election Prediction Markets



2016 Presidential Elections

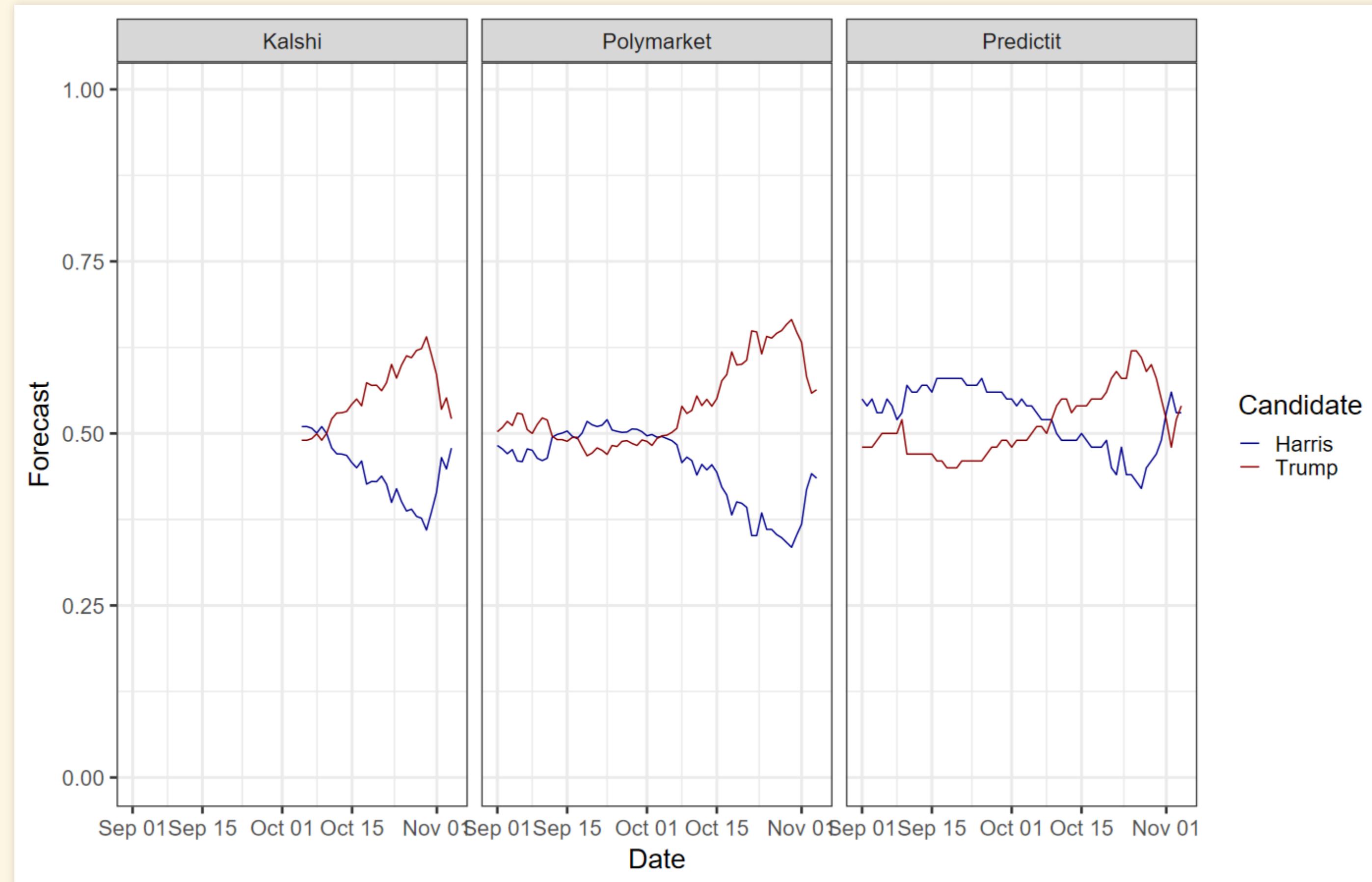


2016 Prediction Markets and Beliefs



- Predictions overestimated Clinton by ~5%
- Losers may re-evaluate beliefs
- Winners' beliefs reinforced

2024 Prediction Markets



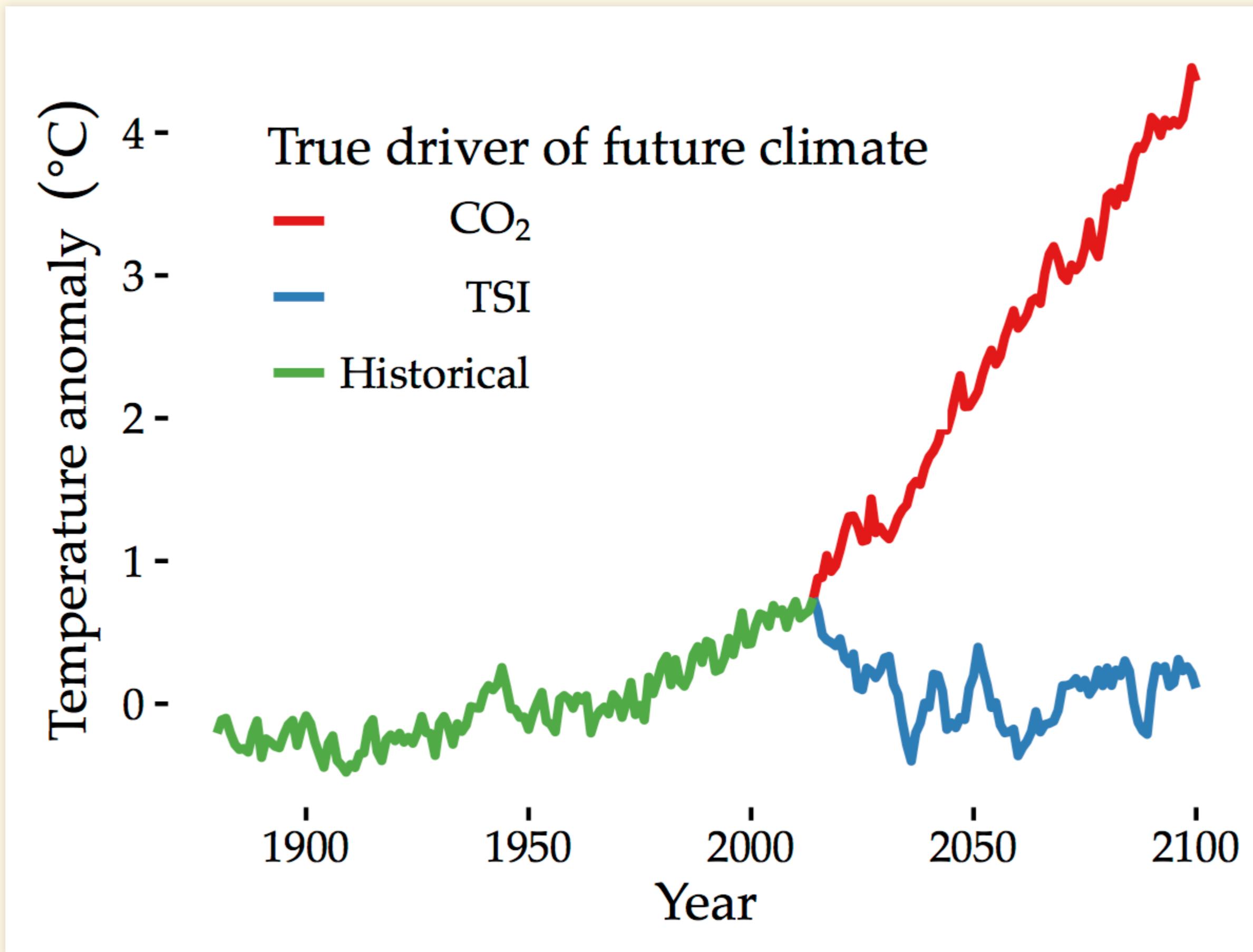
Climate Change and Prediction Markets

- From 1990–2013, increasing scientific confidence that recent warming is mostly caused by human activity.
 - From very uncertain in 1990 to 95% certain in 2013.
- **But**, public's beliefs did not change much.
 - Distrust of scientists
 - People who distrust scientists may trust markets
- Prediction markets: “Put your money where your mouth is”
 - Efficient information aggregation.
 - Do they also change beliefs?

Prediction Market Simulation

- Research Question:
 - *Might prediction markets be useful for increasing convergence of climate beliefs?*
 - *If so, under what conditions?*
- Why simulation?
 - Real prediction markets focus on near term events.
 - Difficult to extrapolate to climate case.
 - We can observe traders' actions, but not their beliefs
- Simulation modeling informed by climate and economic theory to study potential of prediction markets for producing agreement.

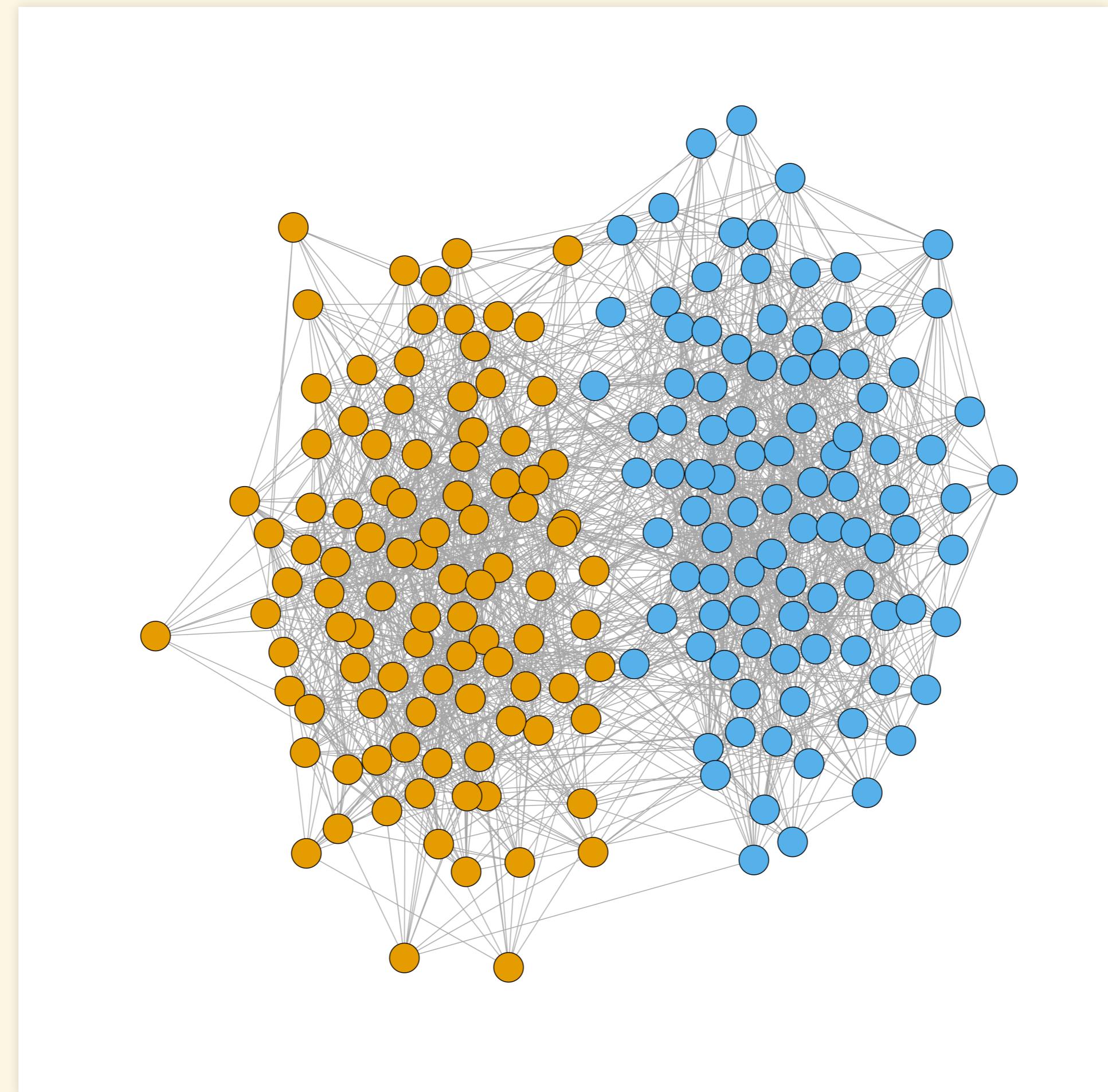
Two Alternate Realities



Trader Beliefs

- Initialize traders with half believing each cause of climate change.
 - CO₂ or Total Solar Irradiance?
- Traders using correct model may not make accurate predictions
 - *Functional form* correct, but must calibrate parameters on noisy temperature records.

Social Network



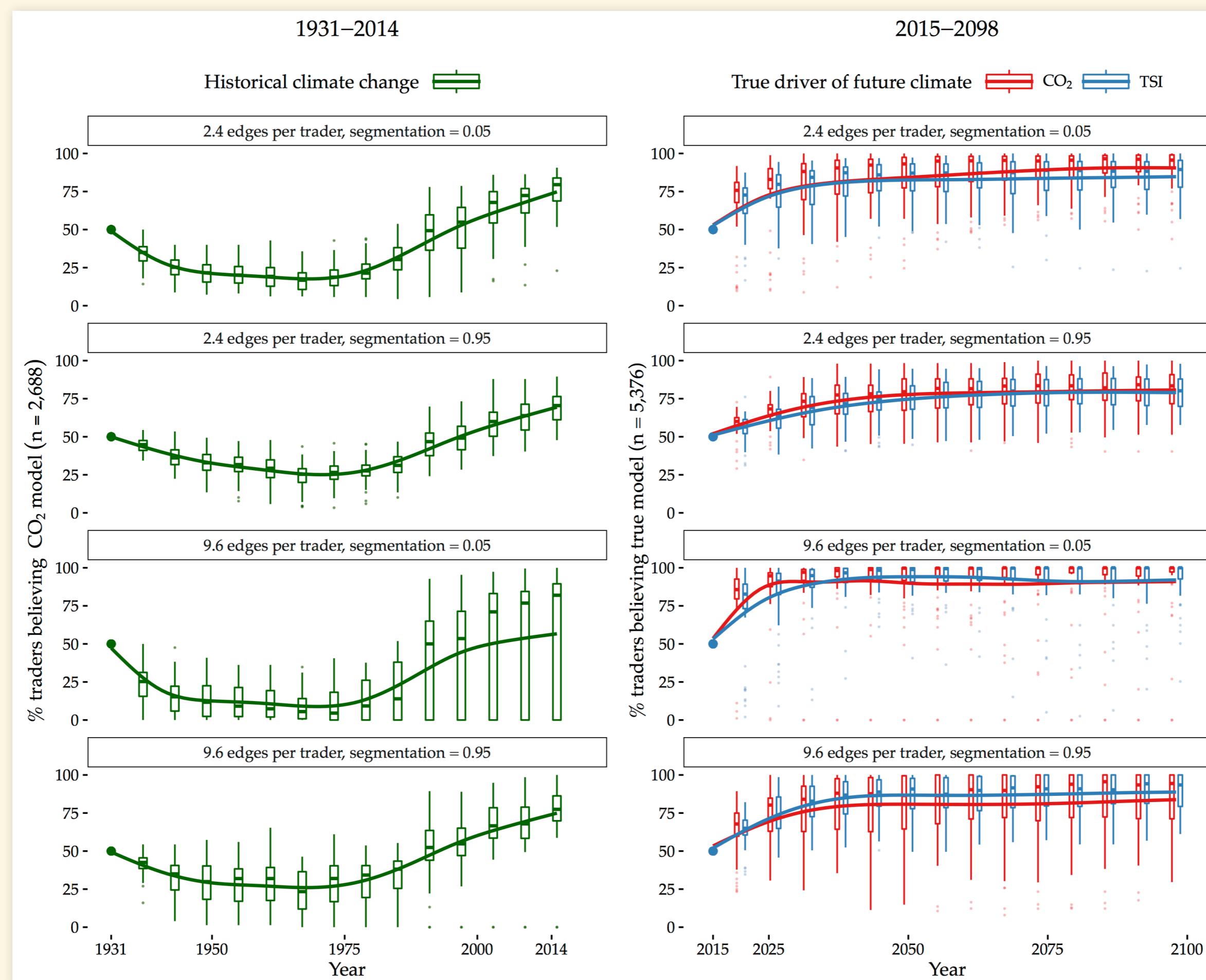
Simulation Model

1. Traders estimate forecasting model.
2. Six years of trading
3. Payoffs at end of 6 years.
4. Decide whether to adopt beliefs of wealthiest neighbor in social network.
5. Repeat

Trading Sequence

- Securities represent temperature ranges.
 - At maturity, pay \$1 if temperature is within range
- Each year, traders use last year's T to update personal model
 - Predict probability distribution $p(T)$ for T at maturity date
 - Assign expected value to temperature securities.
- Continuous double-auction:
 - Each trader takes a turn:
 - Picks a random security in portfolio to sell (willing-to-accept price, WTA)
 - Picks a random security to buy (willing-to-offer price, WTO)
 - Trading whenever one trader's WTO \geq another trader's WTA

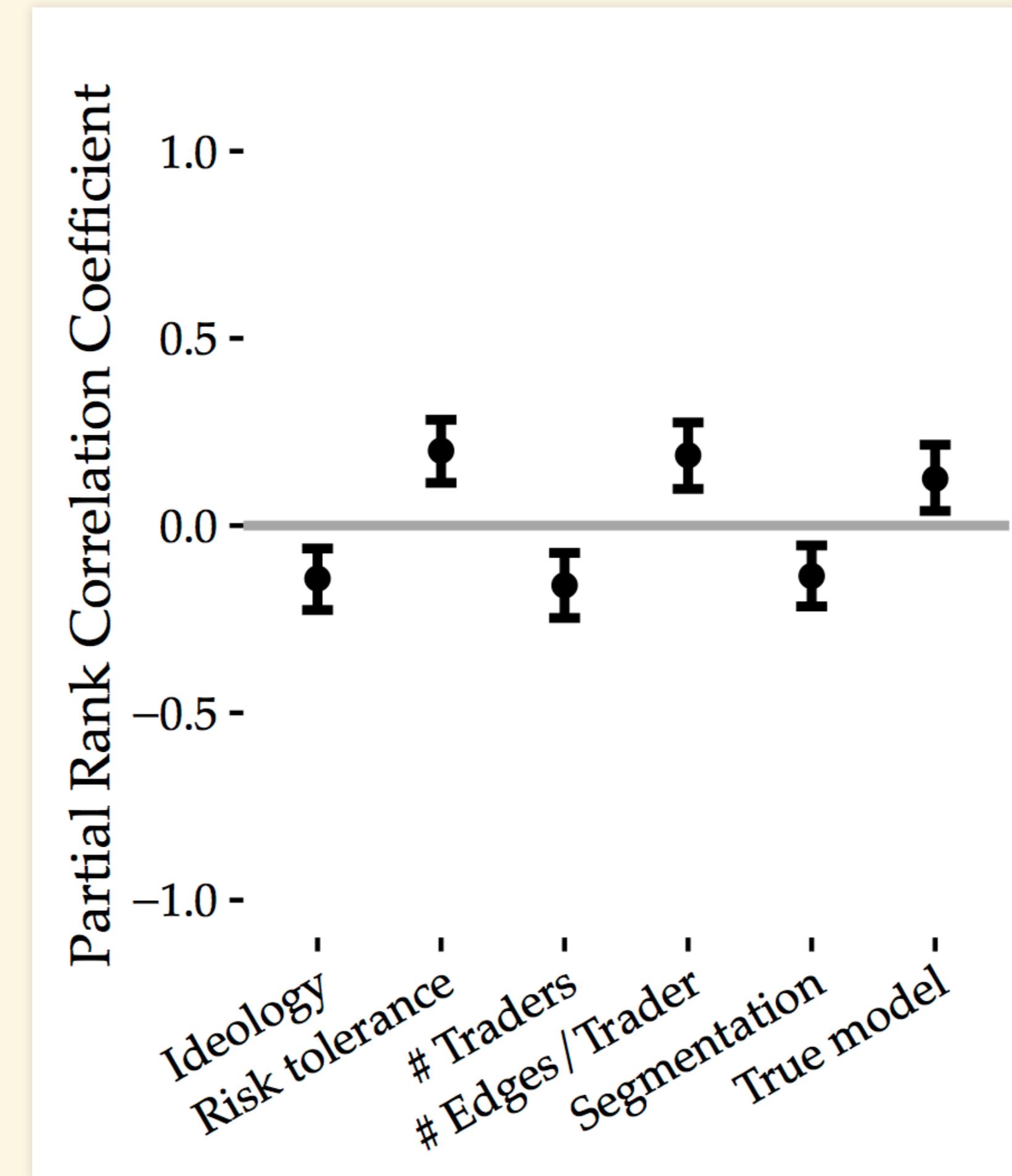
Convergence Over Time



Market Parameters

- Ideology: resistance to changing beliefs
- # traders: size of market
- # edges per trader: density of social network
- Risk tolerance: aggressive WTO, WTA prices, greater risk of not finding counterparty.
- Segmentation: is social network an echo chamber?
- True model: 1 for CO₂, 0 for solar irradiance.

Sensitivity Analysis Results



Conclusions

- It appears that traders in a climate prediction market would converge to the correct belief about the cause of climate change.
- Convergence is much faster if social networks effectively link people with different beliefs.
 - Echo chambers inhibit learning
 - In a highly connected network, convergence to correct belief takes about 10 years.
- Results are not very sensitive to any of the parameters.

Next Steps

- Worked with faculty in Law School & Owen School of Management to set up a real prediction market.
- We were close to making a deal with a prediction market when the US government ordered the company to stop running betting markets in the US

