

Extended annotated bibliography for chapter on
“Computational aspects of prediction markets”
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1 Bibliographic Notes

Tziralis and Tatsiopoulos [TT06], Wolfers and Zitzewitz [WZ04, WZng], and Berg and Rietz [BR03] provide excellent surveys of prediction market research. Masse maintains an extensive web portal on prediction markets [Cen], and many other good web resources exist [MW, MyW, Md]. A number of popular press articles [Arca] and books, most notably Surowiecki’s [Sur04], discuss prediction markets and their applications in business, forecasting, and decision making. Prediction markets have been used or proposed as tools to help companies [CP02, Plo00], scientists [Han95], policy makers and decision makers [BR03, Han99, HT06], the government [Han03], and the military [PHLI03, Arcb, WZ03].

1.1 Empirical Studies

Rhode and Strumpf [RS04] look at the historical record of US Presidential betting markets dating back more than a century.

A number of studies investigate forecast accuracy and trader behavior on the Iowa Electronic Market [Mar], one of the longest-running active prediction markets. Berg *et al* [BFNR01] surveys this work. Forsythe *et al* [FNNW92, FRR99] develop the marginal trader theory. Oliven and Rietz [OR04] show that accuracy persists even in the face of irrational and mistake-prone traders. Pennock *et al* [PDGG02] evaluate IEM and other prediction markets according to the logarithmic scoring rule.

Other empirical studies examine markets on TradeSports.com [Tra], an Irish betting exchange. Wolfers and Zitzewitz [WZ06] perform regression analysis against prices in a 2003 market designed to predict Saddam Hussein’s ouster in order to draw inferences about the projected effect of the US war in Iraq on economic indicators like oil prices and the S&P 500 stock market index. Wolfers and Zitzewitz [WSZ07] use similar techniques to tease out the relative economic effects of electing a Democrat versus a Republican US President. Borghesi [Bor06] finds evidence of under-reaction to information in TradeSports’s US National Football League markets. Tetlock [Tet04, Tet06] finds evidence that, on TradeSports, the finance-related markets are more efficient than the sports-related markets, and that, counterintuitively, the less liquid markets are more accurate than the more heavily-traded markets.

Perhaps surprisingly, even play-money market games¹ designed to predict everything from Oscar winners to whether $P=NP$ to natural disasters perform well compared to experts and real-money markets [CCMP05, PLGN01, PLNG01, SSWPG04, SS03, MDF⁺05].

The field tests at Hewlett Packard were conducted by Chen and Plott [CP02, Plo00].

A common concern is that prediction market prices may be manipulated by wealthy traders with ulterior motives. Rhode and Strumpf [RS06] analyze both controlled and uncontrolled manipulation attempts in real markets and find that the effects of manipulations are for the most part minimal and short lived. Hanson

¹Examples include the Hollywood Stock Exchange [Excb], NewsFutures [New], the Foresight Exchange [Exca], and the Yahoo!/O’Reilly Tech Buzz Game [Gam].

and Oprea [HO04] theorize that manipulators—like noise traders—can actually help market liquidity and accuracy. Hanson *et al* [HOP06] find that markets appear robust to manipulation in a laboratory setting.

Most markets are designed to allocate resources or risk, not explicitly designed to elicit forecasts. Nonetheless, traditional financial markets [SGT96, JR96, Fig79, Rol84, Hay45] and sports betting markets [Ali77, DPL⁺03, GDBZ98, Ros65, SW02, Sny78, TZ88, Wei65] have a long history of providing very accurate forecasts. In fact, it is largely on the basis of this track record that researchers have thought to turn market design inside out and consider creating markets solely or primarily for the purpose of generating predictions.

1.2 Laboratory Experiments

Sunder [Sun95] reviews a number of laboratory experiments involving prediction markets.

Plott and Sunder [PS82, PS88] and Forsythe and Lundholm [FL90] conducted a seminal series of laboratory experiments to test rational expectations theory. In most experiments, the behavior of participants trading in a continuous double auction was characterized more closely by rational expectations theory than other equilibrium concepts like classical Walrasian theory. Plott *et al* [PWY97] show similar positive results when participants wager in a parimutuel market instead of trading in a continuous double auction.

Christiansen [Chr06] studies the effect on accuracy of varying the number of traders in a prediction market. Ledyard *et al* [LHI05] show that a market scoring rule market maker supports better information aggregation when the number of traders per market is low, as would be the case for example in a combinatorial market setting. Guarnaschelli *et al* [GKP03] show that the so-called *winners curse* common in one-shot sealed-bid auctions is not as severe in iterative prediction markets. Chen and Kwasnica [CK06] show that the design of a security can strongly effect the degree of information aggregation that occurs.

In small, illiquid markets, information aggregation can sometimes fail. Chen *et al* [CFH01, CFH03] propose a two stage process that seems to work well for small groups: (1) trade in a market to assess participants risk attitude and predictive ability; (2) query participants probabilities using the logarithmic score; (3) compute a weighted average of probabilities, with weights derived from step 1.

1.3 Theoretical Underpinnings

Wurman *et al* [WWW98] provide a good discussion of m th price and $m + 1$ st price call market auctions and the incentives of buyers and sellers.

The theory of rational expectations was introduced by Muth [Mut61] and further developed by Lucas [Luc72]. The article by Grossman [Gro81] is a good introductory survey. Several researchers have studied the existence and non-existence of fully revealing equilibria; see Radner [Rad79] and the references therein. No-trade theorems [MS82] have their roots in the theory of common knowledge [Aum76, GP82]. Several authors discuss a procedural explanation of rational expectations, showing that repeated announcement of an aggregate statistic of the agents' beliefs will drive the agents to a consensus, if they begin with common priors [Han98, MP86, MP90, NBG⁺90]. Jackson and Peck [JP99] describe why the lack of a price-formation process is a problematic aspect of rational expectations theory. The oft-cited *efficient market hypothesis* [Fam70] is rooted in rational expectations theory.

Pennock *et al* [PDGG02] derive a formula connecting price variance to information incorporation in a prediction market, under an efficient market assumption. Pennock and Wellman [PW01] show that, for two specific utility functions, equilibrium prices can be viewed as weighted algebraic or geometric means of the agents' beliefs, where weights correspond to the agents' relative risk tolerances. The authors further show that, if agents update their beliefs based on price feedback, then weights are a combination of risk tolerances

and confidence judgments. Wolfers and Zitzewitz [WZ05] show that under a large variety of assumptions about agents' beliefs and utilities, prediction market prices can be viewed as a form of mean beliefs, backing up their theory with substantial empirical evidence.

1.4 Computational Aspects

Shoham and Tennenholtz [ST05] develop a theory of *non-cooperative computation*, deriving several results characterizing what boolean functions can be computed when the input bits are held privately by rational, self-interested agents with lexicographic utility functions. Ronen and Wahrmann [RW05] investigate *prediction games* where a mechanism designer seeks to compute a function of agents' information, but agents incur a cost to access their own information. The authors derive mechanisms that pay agents as little as possible to induce them to access and report just enough information to correctly compute the function. Shoham and Tennenholtz [ST01] explore what functions an auction can compute and examine the communication complexity of the process. Nisan and Ronen [NR00] and Brewer [Bre99] explore auction scenarios where agents have bounded rationality due to computational limitations.

The analysis of combinatorial prediction markets follows Fortnow *et al* [FKPW05]. Bossaerts *et al* [BFL02] introduce the *combined value trading* framework, providing algorithms for clearing prediction markets when combined orders are allowed. They show that the clearing problem reduces to linear programming and is polynomial for divisible orders and NP-hard for indivisible orders. The authors also conduct laboratory experiments showing that allowing combined value trading improves convergence behavior and accuracy in thin markets. Lin and Vitter [LV91] show that minimizing the number of threshold gates in a neural network is NP-hard.

The description of compact prediction markets that take advantage of (conditional) independence among events is based on work by Pennock and Wellman [PW00, PW05]. Their conditions for operational completeness are actually fairly severe, so their results can be viewed as negative characterizations showing the difficulty of taking advantage of independence in a prediction market setting. This mirrors a long line of paradoxes and *impossibility results* that crop up in a wide range of group coordination settings, including voting, belief aggregation, group decision making, and auctions.

Market scoring rules were introduced by Hanson [Han03, Han06]. Hanson describes how the market scoring rule market maker is especially well suited for combinatorial prediction markets, and discusses some of the associated computational challenges. Scoring rules have long been used to measure forecast accuracy [Sav71, WM68]. Dynamic parimutuel markets were introduced by Pennock [Pen04]. Schwarz [Sch05] shows that a linear market maker is the minimax-optimal discrete market maker algorithm.

The analysis of the computational properties of information markets follows the work of Feigenbaum *et al* [FFPS05]. Chen *et al* [CMC06] examine an extended model where aggregate uncertainty remains in equilibrium. The result on common expectations at equilibrium follows from a result due to McKelvey and Page; see Nielsen *et al* [NBG⁺90] for more details. The market model is based on a model due to Shapley and Shubik [SS77].

References

- [Ali77] Mukhtar M. Ali. Probability and utility estimates for racetrack bettors. *Journal of Political Economy*, 85(4):803–816, 1977.
- [Arca] NewsFutures Prediction Market Press Archive. <http://us.newsfutures.com/home/articles.html>.

- [Arcb] The Policy Analysis Market Archive. <http://hanson.gmu.edu/policyanalysismarket.html>.
- [Aum76] Robert Aumann. Agreeing to disagree. *Annals of Statistics*, 4:1236–1239, 1976.
- [BFL02] Peter Bossaerts, Leslie Fine, and John Ledyard. Inducing liquidity in thin financial markets through combined-value trading mechanisms. *European Economic Review*, 46:1671–1695, 2002.
- [BFNR01] J. E. Berg, R. Forsythe, F. D. Nelson, and T. A. Rietz. Results from a dozen years of election futures markets research. In C. A. Plott and V. Smith, editors, *Handbook of Experimental Economic Results (forthcoming)*. 2001.
- [Bor06] Richard Borghesi. Underreaction and framing bias in an online information exchange. Working Paper, 2006.
- [BR03] J. E. Berg and T. A. Rietz. Prediction markets as decision support systems. *Information Systems Frontier*, 5:79–93, 2003.
- [Bre99] Paul J. Brewer. Decentralized computation procurement and computational robustness in a smart market. *Economic Theory*, 13:41–92, 1999.
- [CCMP05] Y. Chen, C. H. Chu, T. Mullen, and D. M. Pennock. Information markets vs. opinion pools: An empirical comparison. In *Proceedings of the Sixth ACM Conference on Electronic Commerce (EC'05)*, Vancouver, Canada, June 2005.
- [Cen] Prediction Market Central. <http://www.chrisfmasse.com/3/3/>.
- [CFH01] Kay-Yut Chen, Leslie R. Fine, and Bernardo A. Huberman. Forecasting uncertain events with small groups. In *Proceedings of the Third ACM Conference on Electronic Commerce (EC'01)*, pages 58–64, Tampa, Florida, 2001.
- [CFH03] K. Chen, L. Fine, and B. Huberman. Predicting the future. *Information System Frontier*, 5(1):47–61, 2003.
- [Chr06] Jed D. Christiansen. Prediction markets; Practical experiments in small markets and behaviours observed. *Journal of Prediction Markets*, 1(1), 2006.
- [CK06] Yiling Chen and Anthony M. Kwasnica. Security design and information aggregation in markets. Working Paper, 2006.
- [CMC06] Yiling Chen, Tracy Mullen, and Chao-Hsien Chu. An in-depth analysis of information markets with aggregate uncertainty. *Electronic Commerce Research*, 6(2):201–221, 2006.
- [CP02] K. Y. Chen and C. R. Plott. Information aggregation mechanisms: Concept, design and implementation for a sales forecasting problem. Working paper No. 1131, California Institute of Technology, Division of the Humanities and Social Sciences, 2002.
- [DPL⁺03] Sandip Debnath, David M. Pennock, Steve Lawrence, Eric J. Glover, and C. Lee Giles. Information incorporation in online in-game sports betting markets. In *Proceedings of the Fourth Annual ACM Conference on Electronic Commerce (EC'03)*, pages 258–259, June 2003.

- [Exca] Foresight Exchange. <http://www.ideosphere.com/fx/>.
- [Excb] Hollywood Stock Exchange. <http://www.hsx.com/>.
- [Fam70] E. F. Fama. Efficient capital market: A review of theory and empirical work. *Journal of Finance*, 25:383–417, 1970.
- [FFPS05] Joan Feigenbaum, Lance Fortnow, David M. Pennock, and Rahul Sami. Computation in a distributed information market. *Theoretical Computer Science*, 343:114–132, 2005. (A preliminary version appeared in the 2003 ACM Conference on Electronic Commerce).
- [Fig79] Stephen Figlewski. Subjective information and market efficiency in a betting market. *Journal of Political Economy*, 87(1):75–88, 1979.
- [FKPW05] Lance Fortnow, Joe Kilian, David M. Pennock, and Michael P. Wellman. Betting boolean-style: A framework for trading in securities based on logical formulas. *Decision Support Systems*, 39(1):87–104, 2005.
- [FL90] Robert Forsythe and Russell Lundholm. Information aggregation in an experimental market. *Econometrica*, 58(2):309–347, 1990.
- [FNNW92] Robert Forsythe, Forrest Nelson, George R. Neumann, and Jack Wright. Anatomy of an experimental political stock market. *American Economic Review*, 82(5):1142–1161, 1992.
- [FRR99] Robert Forsythe, Thomas A. Rietz, and Thomas W. Ross. Wishes, expectations, and actions: A survey on price formation in election stock markets. *Journal of Economic Behavior and Organization*, 39:83–110, 1999.
- [Gam] Yahoo!/O’Reilly Tech Buzz Game. <http://buzz.research.yahoo.com/>.
- [GDBZ98] John M. Gandar, William H. Dare, Craig R. Brown, and Richard A. Zuber. Informed traders and price variations in the betting market for professional basketball games. *Journal of Finance*, LIII(1):385–401, 1998.
- [GKP03] Serena Guarnaschelli, Anthony M. Kwasnica, and Charles R. Plott. Information aggregation in double auctions: Rational expectations and the winners curse. *Information Systems Frontiers*, 5:61–75, 2003.
- [GP82] John Geanakoplos and Heracles Polemarchakis. We can’t disagree forever. *Journal of Economic Theory*, 28(1):192–200, 1982.
- [Gro81] Sanford J. Grossman. An introduction to the theory of rational expectations under asymmetric information. *Review of Economic Studies*, 48(4):541–559, 1981.
- [Han95] Robin D. Hanson. Could gambling save science? Encouraging an honest consensus. *Social Epistemology*, 9(1):3–33, 1995.
- [Han98] Robin Hanson. Consensus by identifying extremists. *Theory and Decision*, 44(3):293–301, 1998.
- [Han99] Robin Hanson. Decision markets. *IEEE Intelligent Systems*, 14(3):16–19, 1999.

- [Han03] Robin Hanson. Shall we vote on values, but bet on beliefs? Working Paper, 2003.
- [Han06] Robin Hanson. Logarithmic market scoring rules for modular combinatorial information aggregation. *Journal of Prediction Markets*, 1(1), 2006.
- [Hay45] F. A. Hayek. The use of knowledge in society. *American Economic Review*, 35(4):519–530, 1945.
- [HO04] Robin D. Hanson and Ryan Oprea. Manipulators increase information market accuracy. Technical report, George Mason University, 2004.
- [HOP06] Robin Hanson, Ryan Oprea, and Dave Porter. Information aggregation and manipulation in an experimental market. *Journal of Economic Behavior and Organization*, page (to appear), 2006.
- [HT06] Robert W. Hahn and Paul C. Tetlock, editors. *Information Markets: A New Way of Making Decisions*. AEI-Brookings Press, 2006.
- [JP99] Matthew Jackson and James Peck. Asymmetric information in a strategic market game: Re-examining the implications of rational expectations. *Economic Theory*, 13:603–628, 1999.
- [JR96] Jens Carsten Jackwerth and Mark Rubinstein. Recovering probability distributions from options prices. *Journal of Finance*, 51(5):1611–1631, December 1996.
- [LHI05] John Ledyard, Robin Hanson, and Takashi Ishikida. An experimental test of combinatorial information markets. Working Paper, 2005.
- [Luc72] Robert E. Lucas. Expectations and the neutrality of money. *Journal of Economic Theory*, 4(2):103–24, 1972.
- [LV91] Jyh-Han Lin and Jeffrey Scott Vitter. Complexity results on learning by neural nets. *Machine Learning*, 6:211–230, 1991.
- [Mar] Iowa Electronic Market. <http://www.biz.uiowa.edu/iem/>.
- [Md] Prediction Markets-del.icio.us. <http://del.icio.us/search/?p=prediction+markets>.
- [MDF⁺05] Bernard Mangold, Mike Dooley, Gary W. Flake, Havi Hoffman, Tejaswi Kasturi, David M. Pennock, and Rael Dornfest. The tech buzz game. *IEEE Computer*, 38(7):94–97, July 2005.
- [MP86] Richard McKelvey and Talbot Page. Common knowledge, consensus, and aggregate information. *Econometrica*, 54(1):109–127, January 1986.
- [MP90] Richard D. McKelvey and Talbot Page. Public and private information: An experimental study of information pooling. *Econometrica*, 58(6):1321–1339, 1990.
- [MS82] Paul Milgrom and Nancy Stokey. Information, trade, and common knowledge. *Journal of Economic Theory*, 26:17–27, 1982.
- [Mut61] John A. Muth. Rational expectations and the theory of price movements. *Econometrica*, 29(6):315–335, 1961.

- [MW] Prediction Markets-Wikipedia. http://en.wikipedia.org/wiki/prediction_market.
- [MyW] Prediction Markets-Yahoo! MyWeb. <http://myweb.yahoo.com/myweb?tag=prediction+markets>.
- [NBG⁺90] Lars Tyge Nielsen, Adam Brandenburger, John Geanakoplos, Richard McKelvey, and Talbot Page. Common knowledge of an aggregate of expectations. *Econometrica*, 58(5):1235–1238, 1990.
- [New] NewsFutures. <http://us.newsutures.com>.
- [NR00] Noam Nisan and Amir Ronen. Computationally feasible VCG mechanisms. In *Second ACM Conference on Electronic Commerce (EC'00)*, pages 242–252, 2000.
- [OR04] K. Oliven and T.A. Rietz. Suckers are born, but markets are made: Individual rationality, arbitrage and market efficiency on an electronic futures market. *Management Science*, 50(3):336–351, 2004.
- [PDGG02] David M. Pennock, Sandip Debnath, Eric J. Glover, and C. Lee Giles. Modeling information incorporation in markets, with application to detecting and explaining events. In *Proceedings of the Eighteenth Conference on Uncertainty in Artificial Intelligence*, pages 405–413, 2002.
- [Pen04] David Pennock. A dynamic parimutuel market for information aggregation. In *Proceedings of the Fourth Annual ACM Conference on Electronic Commerce (EC '04)*, June 2004.
- [PHLI03] Charles Polk, Robin Hanson, John Ledyard, and Takashi Ishikida. Policy analysis market: An electronic commerce application of a combinatorial information market. In *ACM Conference on Electronic Commerce*, pages 272–273, June 2003.
- [PLGN01] David M. Pennock, Steve Lawrence, C. Lee Giles, and Finn Årup Nielsen. The real power of artificial markets. *Science*, 291:987–988, February 9 2001.
- [PLNG01] David M. Pennock, Steve Lawrence, Finn Årup Nielsen, and C. Lee Giles. Extracting collective probabilistic forecasts from web games. In *Proceedings of the 7th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, pages 174–183, 2001.
- [Plo00] Charles R. Plott. Markets as information gathering tools. *Southern Economic Journal*, 67(1):1–15, 2000.
- [PS82] Charles R. Plott and Shyam Sunder. Efficiency of experimental security markets with insider information: An application of rational-expectations models. *Journal of Political Economy*, 90(4):663–98, 1982.
- [PS88] Charles R. Plott and Shyam Sunder. Rational expectations and the aggregation of diverse information in laboratory security markets. *Econometrica*, 56(5):1085–1118, 1988.
- [PW00] David M. Pennock and Michael P. Wellman. Compact securities markets for Pareto optimal reallocation of risk. In *Sixteenth Conference on Uncertainty in Artificial Intelligence (UAI-2000)*, pages 481–488, July 2000.
- [PW01] David M. Pennock and Michael P. Wellman. A market framework for pooling opinions. Technical Report 2001-081, NEC Research Institute, 2001.

- [PW05] David M. Pennock and Michael P. Wellman. Graphical models for groups: Belief aggregation and risk sharing. *Decision Analysis*, 2(3):148–164, 2005.
- [PWY97] C. R. Plott, J. Wit, and W. C. Yang. Parimutuel betting markets as information aggregation devices: Experimental results. Technical Report Social Science Working Paper 986, California Institute of Technology, April 1997.
- [Rad79] Roy Radner. Rational expectations equilibrium: Generic existence and the information revealed in prices. *Econometrica*, 47(3):655–678, 1979.
- [Rol84] R. Roll. Orange juice and weather. *The American Economic Review*, 74(5):861–880, 1984.
- [Ros65] Richard N. Rosett. Gambling and rationality. *Journal of Political Economy*, 73(6):595–607, 1965.
- [RS04] Paul W. Rhode and Koleman S. Strumpf. Historical presidential betting markets. *Journal of Economic Perspectives*, 18(2):127–142, 2004.
- [RS06] Paul W. Rhode and Koleman S. Strumpf. Manipulating political stock markets: A field experiment and a century of observational data. Working Paper, 2006.
- [RW05] Amir Ronen and Lyron Wharmann. Prediction games. In *Workshop on Internet and Network Economics*, 2005.
- [Sav71] Leonard Savage. Elicitation of personal probabilities and expectations. *Journal of the American Statistical Association*, 66(336):783–801, 1971.
- [Sch05] Michael Schwarz. Bid ask spreads and market microstructure: Are narrow spreads always feasible? Working Paper, 2005.
- [SGT96] Bruce J. Sherrick, Philip Garcia, and Viswanath Tirupattur. Recovering probabilistic information from options markets: Tests of distributional assumptions. *Journal of Futures Markets*, 16(5):545–560, 1996.
- [Sny78] Wayne W. Snyder. Horse racing: Testing the efficient markets model. *Journal of Finance*, 33(4):1109–1118, 1978.
- [SS77] Lloyd Shapley and Martin Shubik. Trade using one commodity as a means of payment. *Journal of Political Economy*, 85:937–968, 1977.
- [SS03] M. Spann and B. Skiera. Internet-based virtual stock markets for business forecasting. *Management Science*, 49(10):1310–1326, 2003.
- [SSWPG04] E. Servan-Schreiber, J. Wolfers, D. M. Pennock, and B. Galebach. Prediction markets: Does money matter? *Electronic Markets*, 14(3):243–251, 2004.
- [ST01] Yoav Shoham and Moshe Tennenholtz. Rational computation and the communication complexity of auctions. *Games and Economic Behavior*, 35(1–2):197–211, 2001.
- [ST05] Yoav Shoham and Moshe Tennenholtz. Non-cooperative computing: Boolean functions with correctness and exclusivity. *Journal of Theoretical Computer Science*, 343:97–113, 2005.

- [Sun95] S. Sunder. Experimental asset markets. In J. H. Kagel and A. E. Roth, editors, *The Handbook of Experimental Economics*, pages 445–500. Princeton University Press, 1995.
- [Sur04] J. Surowiecki. *The Wisdom of Crowds: Why the many are smarter than the few and how collective wisdom shapes business, economies, societies, and nations*. Doubleday, 2004.
- [SW02] Carsten Schmidt and Axel Werwatz. How accurate do markets predict the outcome of an event? the Euro 2000 soccer championships experiment. Technical Report 09-2002, Max Planck Institute for Research into Economic Systems, 2002.
- [Tet04] Paul C. Tetlock. How efficient are information markets? evidence from an online exchange. Working Paper, 2004.
- [Tet06] Paul C. Tetlock. Does liquidity affect securities market efficiency? Working Paper, 2006.
- [Tra] TradeSports. <http://www.tradesports.com/>.
- [TT06] George Tziralis and Ilias Tatsiopoulos. Prediction markets; An extended literature review. *Journal of Prediction Markets*, 1(1), 2006.
- [TZ88] Richard H. Thaler and William T. Ziemba. Anomalies: Parimutuel betting markets: Race-tracks and lotteries. *Journal of Economic Perspectives*, 2(2):161–174, 1988.
- [Wei65] Martin Weitzman. Utility analysis and group behavior: An empirical study. *Journal of Political Economy*, 73(1):18–26, 1965.
- [WM68] R. L. Winkler and A. H. Murphy. Good probability assessors. *Journal of Applied Meteorology*, 7:751–758, 1968.
- [WSZ07] Justin Wolfers, Erik Snowberg, and Eric Zitzewitz. Partisan impacts on the economy: Evidence from prediction markets and close elections. *Quarterly Journal of Economics*, 122(2), 2007.
- [WWW98] P.R. Wurman, W.E. Walsh, and M.P. Wellman. Flexible double auctions for electronic commerce: Theory and implementation. *Decision Support Systems*, 24:17–27, 1998.
- [WZ03] Justin Wolfers and Eric Zitzewitz. The furor over ‘terrorism futures’. *Washington Post*, page A19, Thursday, July 31, 2003.
- [WZ04] Justin Wolfers and Eric Zitzewitz. Prediction markets. *Journal of Economic Perspective*, 18(2):107–126, 2004.
- [WZ05] Justin Wolfers and Eric Zitzewitz. Interpreting prediction market prices as probabilities. Technical report, NBER Working Paper No. 10359, 2005.
- [WZ06] Justin Wolfers and Eric Zitzewitz. Using markets to inform policy: The case of the iraq war. Under Review, 2006.
- [WZng] Justin Wolfers and Eric Zitzewitz. Prediction markets in theory and practice. In Larry Blume and Steve Durlauf, editors, *The New Palgrave Dictionary of Economics*, 2nd edition. Forthcoming.