Application: Prediction Markets

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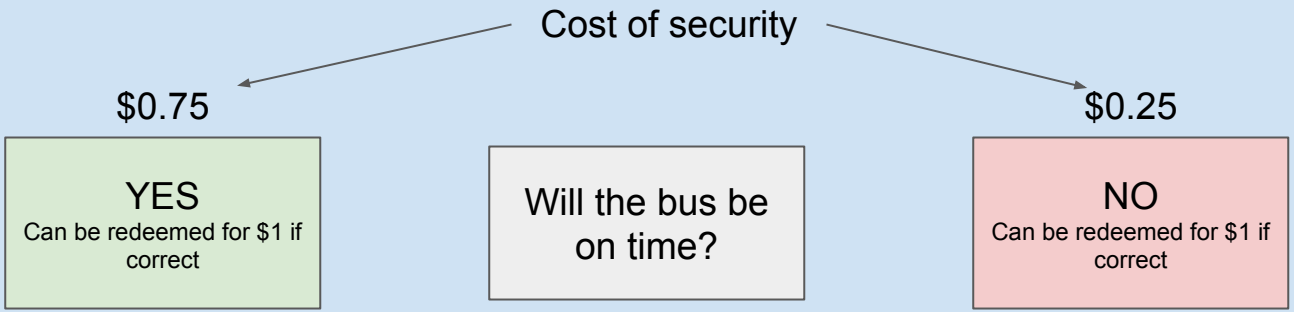
Prediction Markets: Overview

Based on the concept of incentives to give accurate result

Operates in a share-trading style

Price of security should theoretically be probability of event happening



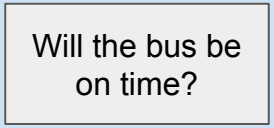
Prediction Markets: Types

Contract Types: Estimating Uncertain Quantities or Probabilities

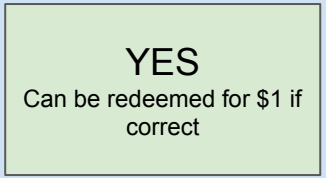
Contract	*Example*	*Details*	*Reveals market expectation of . . .*
Winner-take-all	Event y: Al Gore wins the popular vote.	Contract costs $\$p$. Pays \$1 if and only if event y occurs. Bid according to value of $\$p$.	Probability that event y occurs, $p(y)$.
Index	Contract pays \$1 for every percentage point of the popular vote won by Al Gore.	Contract pays $\$y$.	Mean value of outcome y: $E[y]$.
Spread	Contract pays even money if Gore wins more than y^*% of the popular vote.	Contract costs \$1. Pays \$2 if $y > y^*$. Pays \$0 otherwise. Bid according to the value of y^*.	Median value of y.

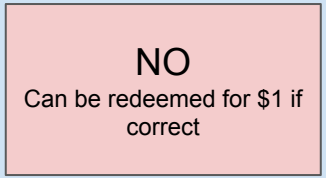
Prediction Markets: How they work

1. Identify probability that you would like to know, and create securities



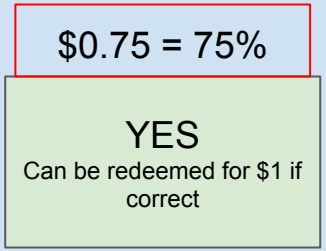
2. Set the payoff of each futre to a set amount ($1 is simplest-cents determine probability)

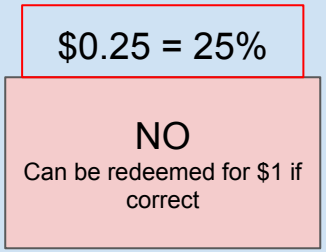




3. Release securities for trade into correct crowd (covered later)

4. Check price of shares to determine probability





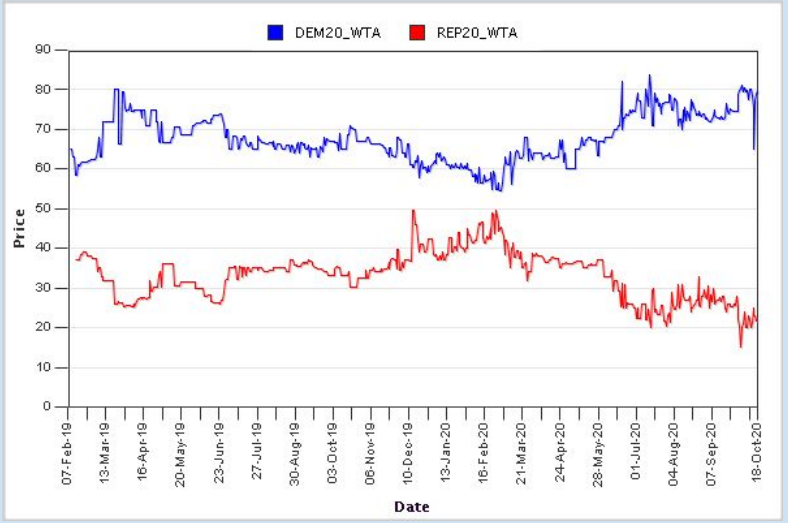
Prediction Markets: Uses

Longest-running example is Iowa Electronic Markets

Most prolific use is political campaign predictions

TradeSports- political, entertainment, current events

Hollywood Stock Exchange- success of movies



Examples:

HP ran an internal market to predict sales of printers. This improved the predictions of sales compared to traditional method

Siemens ran a market that predicted late completion on a software project while a schedule predicted on-time release. The project was indeed late.

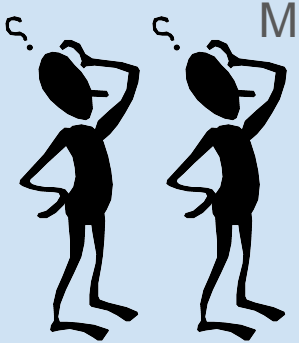
Prediction Markets: Crowd Requirements

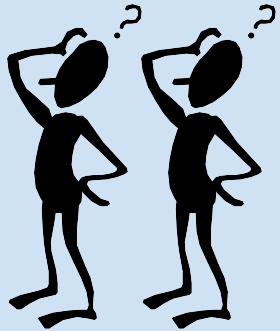
Crowd must have enough traders to encompass a wide breadth of information

Parts of the crowd must have exclusive information

Size of the market determines susceptibility to manipulation

- Knowledgeable traders can mitigate these manipulations
- Monetary motives is often sufficient to counter manipulation





Prediction Markets: Types of Traders

Main Types

- Individual traders
  - Susceptible to bias
  - Potentially smaller knowledge base
  - Able to change direction and react quickly to changing circumstances
- Group traders
  - Resistant to bias
  - Potentially larger, more diverse knowledge base
  - Slower to react to situations

Sub-category

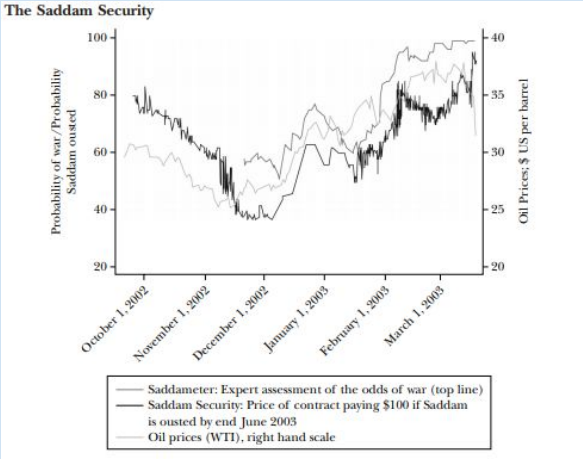
- Marginal/market traders
  - Not biased
  - Only cares about making profit from securities
- “Normal”
  - Has biases and information on situation
  - Behaves according to events by trading

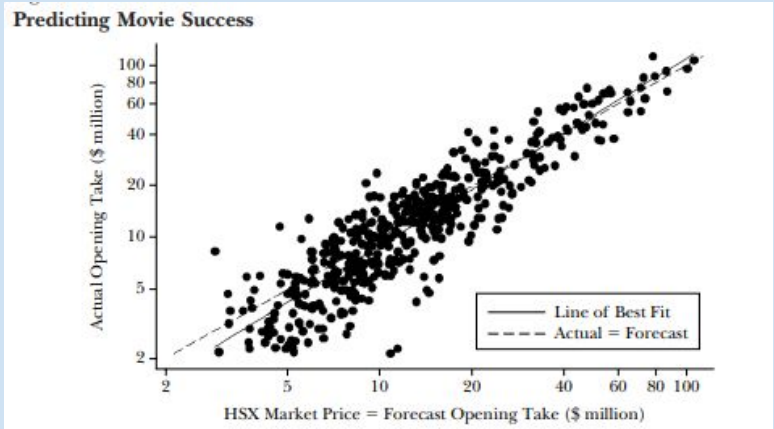
Prediction Markets: Accuracy

Accuracy increases with a group as individual biases are removed

	Many contracts	**Few contracts**
Group of traders	Fairly accurate	Very accurate
Individual traders	Inaccurate	Accurate with trends but inaccurate

Right: Expert opinion (individual) vs market (group)





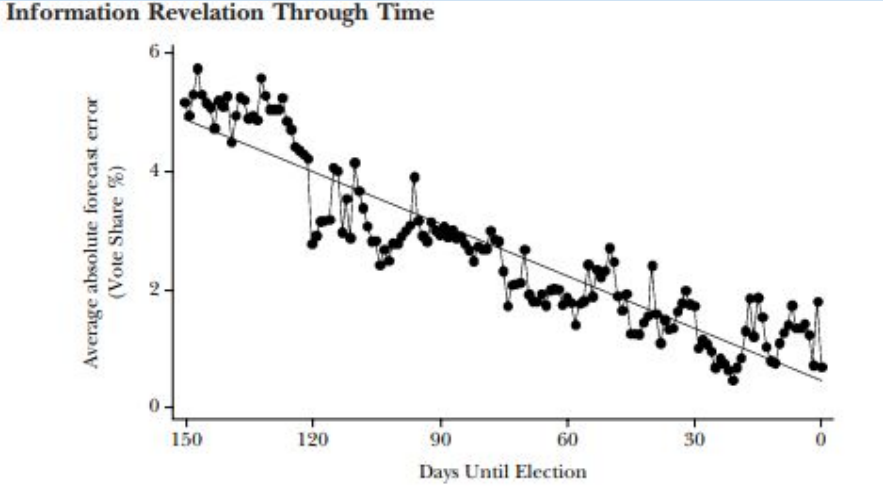
Left: Many choices reviewed by groups of traders

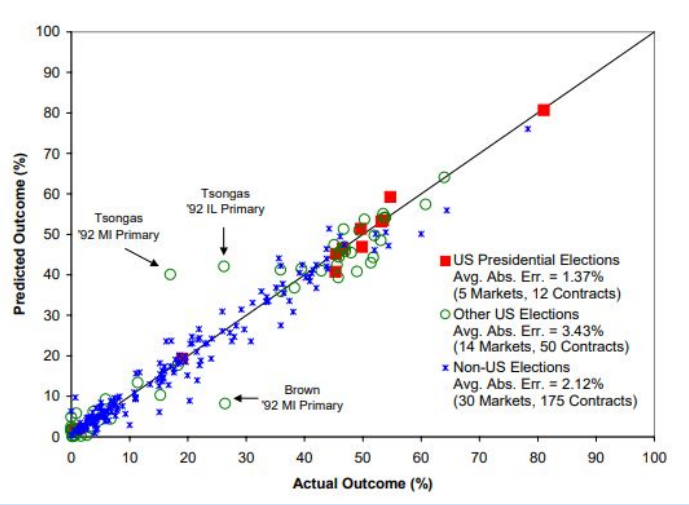
Prediction Markets: Accuracy

Prediction markets performed better than polls 9/15 times

In political vote predictions polls averaged 2.1% error, markets averaged 1.5%

Markets vary constantly, we take predictions at set times, such as election eve





Prediction Markets: Flexibility

Polls are the main “competitor” of prediction markets

Prediction markets react in real time to new information

Potential sampling rate much higher than polls

Data on trader activities can also be analyzed to gather demographic information

Discussion

What do you think are advantages or disadvantages of prediction markets?

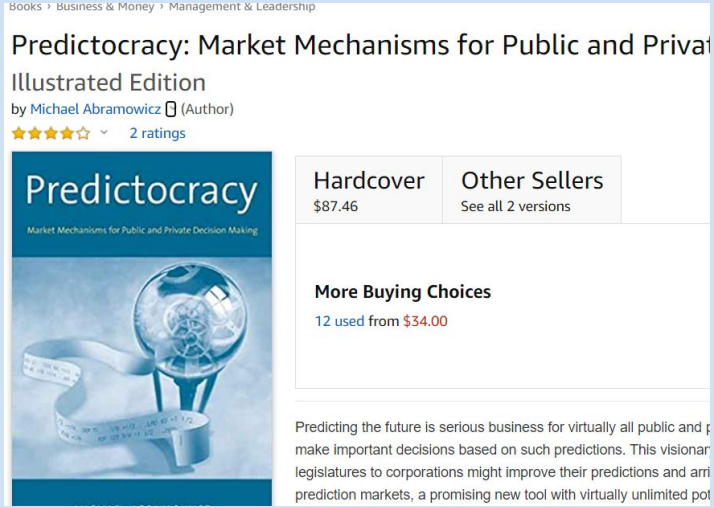
- Strengths vs. polls? Weaknesses vs. polls?
- Are there problems with analyzing the market price of each security?
- Are there certain types of traders that can lower the accuracy?

What do you think markets get more accurate with fewer contracts?

Prediction Markets: Summary- Pros and Cons

Pros	Cons
Real-time data: security price reflects probability	Erratic data- markets change frequently
Monetary incentive	Few opportunities for arbitrage (trading for higher results)
Markets react to current events	Traders can be biased

Prediction Markets: Overall Issues



Are Political Markets Really Superior to Polls as Election Predictors?*

Public Opinion Quarterly, forthcoming

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The Fall Of Intrade And The Business Of Betting On Real Life

There's always been a thin line between investing and gambling, and one firm turned the concept into a multimillion-dollar industry until the government shut it down. As number crunchers like Nate Silver become cultural touchstones, how does Intrade's fate predict the future of how we process the world?

Using Prediction Markets to Track Information Flows: Evidence from Google[1]

Bo Cowgill
Google

Justin Wolfers
Wharton, U. Penn
NBER, CEPR, IZA

Eric Zitzewitz
Dartmouth College

Context/How they Work

- Study of an internal PM from Google
- Workers placed bets on both internal and external events

Table 1. Prediction markets at Google

Type	Example	Share of markets
Demand forecasting	# of Gmail users at end of quarter	20%
Performance	Google Talk quality rating	15%
Company news	Russia office to open	10%
Industry news	Will Apple release an Intel-based Mac?	19%
Decision markets	Will users of feature A users use feature B more?	2%
Fun	How many "rotten tomatoes" will Episode III get?	33%
Unique participants		1,463
Orders		253,192
Trades		70,706
Markets run (questions)		270
Securities (answers)		1,116

Research Demographics

- Gender
- Background
- Geographic location
- Other hobbies

Dependent variable	= 1 if ever placed trade							
Department								
Engineering	0.074	***	0.042	***	0.031	***	0.010	
	(0.003)		(0.003)		(0.003)		(0.031)	
Sales	0.053	***	0.034	***	0.026	***	-0.065	*
	(0.006)		(0.006)		(0.006)		(0.037)	
Operations	0.064	***	0.049	***	0.024	***	-0.014	
	(0.009)		(0.009)		(0.008)		(0.037)	
Product Management	0.015	***	0.022	***	0.011	***	-0.054	**
	(0.002)		(0.004)		(0.004)		(0.022)	
Coder? (Participated in code review)			0.066	***	0.025	***	-0.004	
			(0.005)		(0.005)		(0.026)	
Level (Distance from CEO)			-0.002		-0.001		0.016	**
(Range = 1 to 7)			(0.001)		(0.001)		(0.007)	
Hire date			-0.010	***	0.013	***	0.009	
(In years)			(0.001)		(0.002)		(0.006)	
NYC-based			0.021	***	0.015	*	-0.006	
			(0.008)		(0.008)		(0.027)	
Mountain View (MTV)-based			0.016	***	0.015	***	0.016	
			(0.004)		(0.004)		(0.025)	
Distance to Noname Café in miles (0 if non-MTV)			-0.031	***	-0.035	***	-0.012	
(Mean = 0.1, SD = 0.2, Max = 1.1)			(0.010)		(0.010)		(0.044)	
Email lists subscribed to (/100)					0.154	***	0.246	***
					(0.013)		(0.038)	
Economics list?					0.140	***	0.159	***
					(0.034)		(0.050)	
Financial planning list?					0.059	***	0.026	
					(0.013)		(0.022)	
Investing list?					0.108	***	0.126	**
					(0.035)		(0.053)	
Poker list?					0.155	***	0.163	***
					(0.028)		(0.045)	
Undergrad major = CS, EE, Math, or Science							0.045	**
							(0.020)	
Undergrad major = Economics or Business							0.003	
							(0.015)	

Research Questions

Is there bias within the prediction markets?

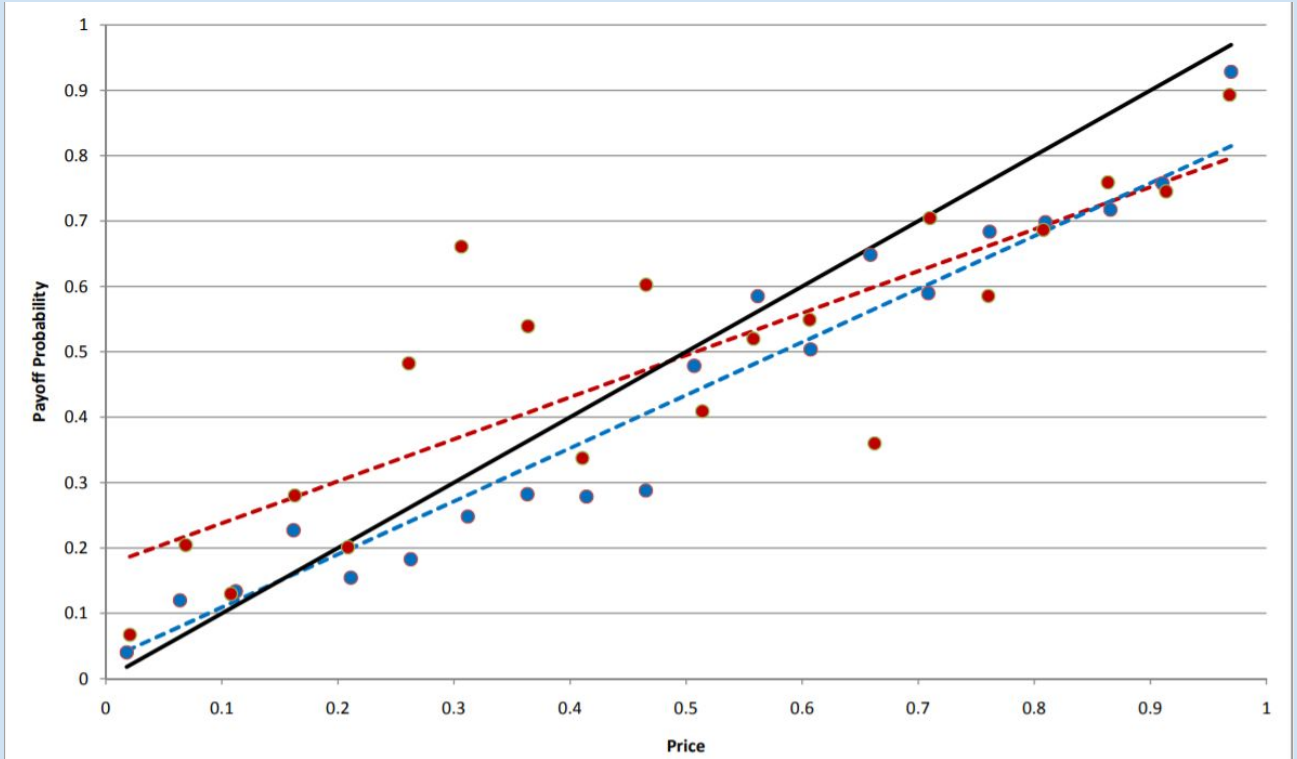
Results - Favorability Bias

Table 5. Optimistic bias in the Google markets

	Obs.	Avg price	Avg payoff	Return (SE)	
All markets	70,706	0.357	0.342	-0.015***	(0.003)
Markets with implication for Google	37,910	0.310	0.293	-0.017***	(0.004)
Two-outcome markets with implication for Google	9,023	0.509	0.492	-0.017***	(0.006)
Best outcome for Google	4,556	0.456	0.199	-0.256***	(0.063)
Worst	4,467	0.563	0.790	0.227***	(0.064)
Five-outcome markets with implication for Google	26,511	0.239	0.222	-0.017***	(0.005)
Best outcome for Google	5,592	0.244	0.270	0.027	(0.040)
2nd	5,638	0.271	0.246	-0.025	(0.066)
3rd	5,539	0.296	0.179	-0.118**	(0.053)
4th	5,199	0.206	0.178	-0.028	(0.041)
Worst	4,543	0.162	0.236	0.074	(0.056)

Notes: Standard errors are heteroskedasticity robust and adjust for clustering of outcomes within markets.

Results - Reverse Longshot Bias



Trades in two (red) and five-outcome (blue) markets (22,452and 42,416, respectively) are sorted into 20 bins according to price (i.e., 0-5, 5-10, etc.), and then average price and payoff probability for the bin is plotted. Dashed lines plot regression equations using OLS.

Table 4. Reverse favorite-longshot bias

Dependent variable: returns to expiry

Independent variable	Sample	Obs.	Unique markets	Coeff.	S.E.	Constant	S.E.
Price	All trades	70,706	270	-0.188***	(0.072)	0.050*	(0.027)
Price - 1/N	All trades	70,706	270	-0.232***	(0.089)	-0.006	(0.005)
Price - 1/N	Fun markets	29,122	90	-0.229	(0.182)	0.000	(0.012)
Price - 1/N	Serious markets	41,584	180	-0.235***	(0.081)	-0.009**	(0.004)
Price - 1/N	2 outcome markets	22,452	79	-0.357	(0.227)	-0.005	(0.005)
Price - 1/N	5 outcome markets	42,416	155	-0.189***	(0.072)	-0.010**	(0.005)
Price - 1/N	2005 (Q2 to Q4)	17,766	73	-0.252*	(0.148)	-0.009	(0.006)
Price - 1/N	2006 (Q1 to Q4)	39,396	108	-0.292**	(0.142)	-0.002	(0.008)
Price - 1/N	2007 (Q1 to Q3)	13,544	94	-0.048	(0.065)	-0.012*	(0.007)
Price - 1/N	First month of calendar quarter	27,021	170	-0.441***	(0.167)	0.007	(0.007)
Price - 1/N	Second month	24,513	207	-0.164*	(0.089)	-0.008	(0.006)
Price - 1/N	Third month	17,614	172	-0.059	(0.066)	-0.023***	(0.005)
Price - 1/N	Trade #11 and subsequent	61,225	249	-0.213**	(0.098)	-0.005	(0.006)
Price (t-1) - 1/N	Trade #11 and subsequent	61,225	249	-0.178*	(0.099)	-0.006	(0.006)
Price (t-10) - 1/N	Trade #11 and subsequent	61,225	249	-0.160	(0.106)	-0.007	(0.006)
Price - 1/N	With quote information	57,587	201	-0.269**	(0.106)	-0.004	(0.005)
Midpoint (simple) - 1/N	With quote information	57,587	201	-0.348**	(0.170)	-0.010**	(0.004)
Midpoint (arb-free) - 1/N	With quote information	57,587	201	-0.282**	(0.129)	0.012	(0.012)
Price - 1/N	Price inside arb-free spread	15,293	201	-0.205	(0.138)	-0.013	(0.011)

Note: Each row is a regression. Standard errors are heteroskedasticity robust and adjust for clustering of outcomes within markets. Currently quote information is not available for markets from 2007Q2 and 2007Q3, so these are excluded from the bottom panel.

Research Questions

How does information flow in large organizations?

Results - Proximity

Table 10. Geography and trading correlations

Dependent variable: net shares purchased (normalized)

Independent variables: Proximity-weighted normalized sums of colleagues' pre-trade positions

	(1)	(2)	(3)	(4)	(5)	(6)
Geographical proximity						
Same city	0.006	0.000	0.003	-0.001	-0.002	-0.002
	(0.004)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)
Proximity within city		0.010 *	-0.004	-0.014 *	-0.014 *	-0.013
(100ft/distance between buildings, min = 0, max = 1)		(0.006)	(0.007)	(0.008)	(0.008)	(0.008)
Same building			0.022 ***	0.008	-0.001	0.002
			(0.005)	(0.007)	(0.007)	(0.007)
Same floor				0.025 ***	-0.019 *	-0.020 *
				(0.009)	(0.010)	(0.010)
Proximity on floor					0.090 ***	0.053 ***
(10ft/distance between offices, min = 0, max = 1)					(0.015)	(0.017)
Same office						0.055 ***
						(0.016)

Results - Proximity

Table 11. Social and work relationships and correlated trading
Dependent variable: net shares purchased (normalized)
Independent variables: Proximity-weighted normalized sums of colleagues' pre-trade positions

	(1)	(2)	(3)	(4)	(5)	(6)
Social connections						
Self-reported professional relationship?	0.016 *	0.009	0.010	0.012	0.017	0.020 *
	(0.009)	(0.009)	(0.010)	(0.010)	(0.011)	(0.011)
Self-reported friendship?	-0.001	-0.044 **	-0.050 **	-0.050 **	-0.040 *	-0.054 **
	(0.019)	(0.021)	(0.020)	(0.021)	(0.022)	(0.023)
# of overlapping email lists	0.000	-0.001	-0.003	-0.004	-0.005	-0.007
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)
Work history						
Reviewed each other's code		0.028 ***	0.027 ***	0.019 **	0.023 **	0.017 *
		(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Overlapped on project?		0.034 ***	0.010	-0.031 **	-0.050 ***	-0.026
		(0.012)	(0.014)	(0.015)	(0.016)	(0.016)

Results - Evidence for Information Flows

	(1)		(2)		(3)		(4)		(5)	
Topics included	All		Fun		Serious (cols 4+5)		Serious markets: Demand and External news		Serious topics: Performance and Company news	
Proximity										
Same city	0.006		0.000		0.011		0.019	*	0.001	
	(0.006)		(0.008)		(0.007)		(0.010)		(0.007)	
Proximity within city	-0.022	***	-0.012		-0.015	*	-0.024	**	-0.005	
	(0.008)		(0.013)		(0.008)		(0.012)		(0.008)	
Same building	0.003		-0.014		0.009		0.018		0.004	
	(0.007)		(0.017)		(0.006)		(0.011)		(0.007)	
Same floor	-0.021	**	-0.013		-0.011		-0.012		-0.010	
	(0.010)		(0.022)		(0.009)		(0.016)		(0.010)	
Proximity on floor	0.049	***	0.058	*	0.022		0.015		0.022	
	(0.018)		(0.035)		(0.015)		(0.023)		(0.017)	
Same office	0.073	***	0.080	**	0.052	**	0.079	**	0.025	
	(0.020)		(0.036)		(0.022)		(0.033)		(0.025)	
1-2 steps away on org chart	0.073	***	0.083	***	0.074	***	0.092	***	0.048	**

Prediction Markets: Flexibility

Prediction markets = gambling?

ECONOMICS

The Promise of Prediction Markets

Kenneth J. Arrow,[1] Robert Forsythe,[2] Michael Gorham,[3] Robert Hahn,[4*] Robin Hanson,[5] John O. Ledyard,[6] Saul Levmore,[7] Robert Litan,[8] Paul Milgrom,[1] Forrest D. Nelson,[9] George R. Neumann,[9] Marco Ottaviani,[10] Thomas C. Schelling,[11] Robert J. Shiller,[12] Vernon L. Smith,[13] Erik Snowberg,[14] Cass R. Sunstein,[7] Paul C. Tetlock,[15] Philip E. Tetlock,[16] Hal R. Varian,[17] Justin Wolfers,[18] Eric Zitzewitz[19]

The ability of groups of people to make predictions is a potent research tool that should be freed of unnecessary government restrictions.

A Legal Structure for Prediction Markets

- Limitation of recourse
- Limitation of stakes
- Limiting context

Open Questions

- Fee structure?
- Precise legal mechanisms
- Anti-manipulation

Discussion:

- Do you think these policy recommendations to curtail illicit behavior would be effective? If not, how would you change them?
- What are the important things we need to consider when legislating PM's?
- In what ways are PM's similar to gambling? Different?