



Measured Enthusiasm for Prediction Markets

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Prediction Markets

- Historical development of futures: physical commodities, currencies, bonds, & stocks. The range of exchange-traded contracts continues to grow:
- Housing Futures (CME 2006-). Robert Shiller's GDP, "macro" securities.
- Election markets on Iowa Electronic Markets (IEM) (1988-) and Intrade (2002-). Historical presidential betting markets (1868-1940, mainly before 1920) Intrade (www.intrade.com) contracts already cover a great variety of social, economic and political subjects. While we may sometime refer to these as "futures" they are actually binary options that pay 100 if an event occurs and 0 otherwise, so a price of 75 corresponds to a 75% chance of the event occurring.
- Weather (CME, Intrade), hurricanes (Hedgestreet, Intrade), carbon credits (Various)
- Influenza (IEM), health insurance (CBOT 1992-93)
- Catastrophe Risk (Nymex 2007-, CBOT 1992-93)
 - Very sensitive if outcomes can be manipulated. 2003 Policy Analysis Market controversy. "Terrorism" and "assassination" futures. But there are already plenty of more liquid and less conspicuous ways to profit from wrongdoing.
- Parimutuel Economic Derivatives Auctions (2002-2007, technically OTC)

Markets are Relatively Good Predictors: Evidence

List from Robin Hanson:

- Vs. Public Opinion
 - I.E.M. beat presidential election polls 451/596 (Berg et al '01)
 - Re NFL, beat ave., rank 7 vs. 39 of 1947 (Pennock et al '04)
- Vs. Public Experts
 - Racetrack odds beat weighed track experts (Figlewski '79)
 - If anything, track odds weigh experts too much!
 - OJ futures improve weather forecast (Roll '84)
 - Stocks beat Challenger panel (Maloney & Mulherin '03)
 - Gas demand markets beat experts (Spencer '04)
 - Econ stat markets beat experts 2/3 (Wolfers & Zitzewitz '04)
- Vs. Private Experts
 - HP market beat official forecast 6/8 (Plott '00)
 - Eli Lilly markets beat official forecasts 6/9 (Servan-Schreiber '05)
 - Microsoft project markets beat managers (Proebsting '05)

Strictly speaking, there is no conflict between experts and markets.
You can have a market of experts.

Markets are Relatively Good Predictors: Reasons

- No strong incentive to tell the truth in polls.
- Markets offer an incentive to not only report, but also to uncover new information.
- Markets have self-selected participants.
- Experts' predictions are clouded by their risk preferences, which are a function of their career goals. Are they trying to differentiate themselves from other experts by making predictions that are intentionally risky? Or are they trying to limit their downside by making predictions that ignore outlier possibilities because in those cases most other experts would have been wrong as well - so they suffer no real decline in status?
- Markets are more manageable in real-time than polls or expert panels. April 2008 Headline: "AP Poll: More Avoid Buying Homes"!
- Markets present (pseudo-) arbitrage opportunities when similar questions are involved.

Note on event market accuracy: If a market predicts a greater than 50% chance of an event that doesn't actually happen, it doesn't mean that the market was "wrong". You just want to measure its average error over time. Handy way, root mean squared error: $\sqrt{\sum (\text{outcome}_i - \text{prediction}_i)^2 / N}$.

No-one said that markets are perfect

- Erikson and Wlezien (2007) found that extrapolations based on polls outperformed IEM presidential markets between 1998 and 2004.
- Apart from incentives, there is nothing magic about buying and selling. HP's BRAIN is a non-market averaging mechanism that replaces trading budgets with expertise weightings and tries to correct for risk appetites. The same could theoretically be done with trader correlations. This might however lack robustness.
- People actually need to possess information. "Prediction" is a misnomer. These markets actually do more *discounting*. Failure examples: Michael Jackson verdict, Papal selection, Supreme Court nominations, (Obama New Hampshire Primary? Locals didn't have access to market.)
- Madness of crowds, bubbles, manipulations, runs and corners, although binary event contracts are more resistant than perpetuities and futures.
- Prices are distorted by risk appetites, fees, carry, risk premia, taxes and other structural factors like margin requirements. Intermarket "distortions": prices are often as much about what the underlier *isn't* than what it is.
- Things are inherently unpredictable: Black Swans. London bond prices missed the outbreak of World War I, for example. But markets are *relatively* good as seen above.

Conditional Probabilities and Intermarket Relations

- $P(A \text{ given } B) = P(A \text{ and } B) / P(B)$

According to 4/14/08 Intrade prices:

- $P(\text{Clinton Democratic Nominee}) = 19\%$
- $P(\text{Clinton Elected President}) = 13\%$
- $P(\text{Clinton President given Clinton Nomination}) = 13\% / 19\% = 68\%$.
“Electability” ~ implied probability of being elected president if nominated.

- $P(\text{Obama Democratic Nominee}) = 81\%$
- $P(\text{Obama Elected President}) = 46\%$
- Obama’s “electability”: $46\% / 81\% = 57\%$

- Some have noticed that Clinton’s electability so defined seems very high. Inefficiency? Effect of carry and fees? Or something else?

Decision Markets

- Decision markets are conditional markets of the form: “Given B, what will happen to A?” $P(A|B)$, for example, given a certain government policy, what will happen to GDP? Poverty rates? Fertility rates? Global temperatures? etc.
- **Intrade example contract: Democrat Elected President AND National Debt Up Between 9/30/10 and 9/30/11:**
 - Democrat President and National Debt Up = 52% (Expires worthless if a non-Democrat is elected.)
 - $P(\text{Democrat Elected President}) = 59\%$
 - Therefore, the probability of the national debt going up if a democrat is elected is 88%, or $52\% / 59\%$.
 - But the probability of the national debt going up if a non-democrat is elected is 93%, or $38\% / 41\%$. (Could reflect length of Iraq war.)
- Care must be taken with these kinds of interpretations. Justin Wolfers cautioned in January 2007 that although Giuliani had the highest “electability” price among Republican candidates, this did not necessarily mean the Republicans should elect him. It only meant that in a world where Giuliani would have been nominated, the Republicans and all voters in aggregate would have swung from the right (and left) to the center.

Manipulation?

- Manipulation of prices should be kept distinct from feedback trading, self-fulfilling prophecies, manipulation of information and manipulation of outcome. In general, speculative attacks are difficult and require a pre-existing fundamental basis.
- Especially when illiquid, markets are subject to manipulation, but manipulators are ultimately “noise traders” and will tend to lose in the long run and shrink in influence, while they “subsidize” other traders, ultimately increasing liquidity.
- Some papers might take this argument too far though, using models with unrealistic assumptions such as equal trading budgets and no feedback trading.
- These studies also assume that traders will be unable to hedge exposure in larger, more liquid markets. While this might involve a several-fold basis risk, it might be tolerable to a manipulator with other interests. Example?

Municipal Bonds as Prediction Markets

- Slemrod & Greimel (1998) found a “significant” correspondence between the price of Steve Forbes’ 1996 IEM contract and the implied tax rate on 5-year municipal bonds.
- Steve Forbes was in favor of a flat tax, which would eliminate the tax advantage of municipal bonds.
- Following Poterba, the authors used “Prime” GO municipal bonds only, assumed to have no significant risk premium to treasuries. Other studies compare municipals to AAA corporates.
- With that assumption, the implied tax rate of a tax-free bond is one minus the interest rate of the tax-free bond divided by the interest rate of a taxable bond. **Implied tax rate = 1 - tax-free yield / taxable yield.**
- So at the time Forbes’ contract could have been manipulated by taking a bond position? Lots of basis risk, carry and transaction costs.
- The same logic would hold for a candidate who credibly espoused a national sales tax to replace the income tax.
- **But risk premia assumptions do not hold now!** By the 1998 logic, municipal bonds recently “predicted” negative tax rates. (What model might work now?)

Isn't making deductible contributions to a retirement account a bet on taxes?

- Yes, it is like a bet on the spread between the highest marginal individual tax rate and the long-term capital gains rate.
- By making a tax-deductible contribution to a retirement account you are roughly betting that:
 $(1 - \text{your current marginal income tax rate}) >$
 $(1 - \text{your marginal income tax rate on redemption}) * (1 - \text{the long-term capital gains rate at redemption})$
- Even if income taxes go to 50%, with the current max rate at 35%, it still makes sense to contribute unless you think capital gains rates can stay below 24% while income tax goes up so much.

Tax Futures

- Started trading on Intrade in February 2008.
- Will be settled according to the highest single-filer marginal federal tax rate for the given tax year. This was chosen as the most convenient proxy for effective individual tax rates.
- New contracts can be added to address outcomes that will impact effective tax rates, such as social security caps, capital gains rates and AMT legislation. Contracts can be added for corporate tax rates.
- These markets are set-up as a “ladder” of binary options that will each expire at 100 if the tax rate for the given year is greater to *or equal to* the strike price, and 0 otherwise.
- 4/14/08 prices for 2011 tax year contracts:

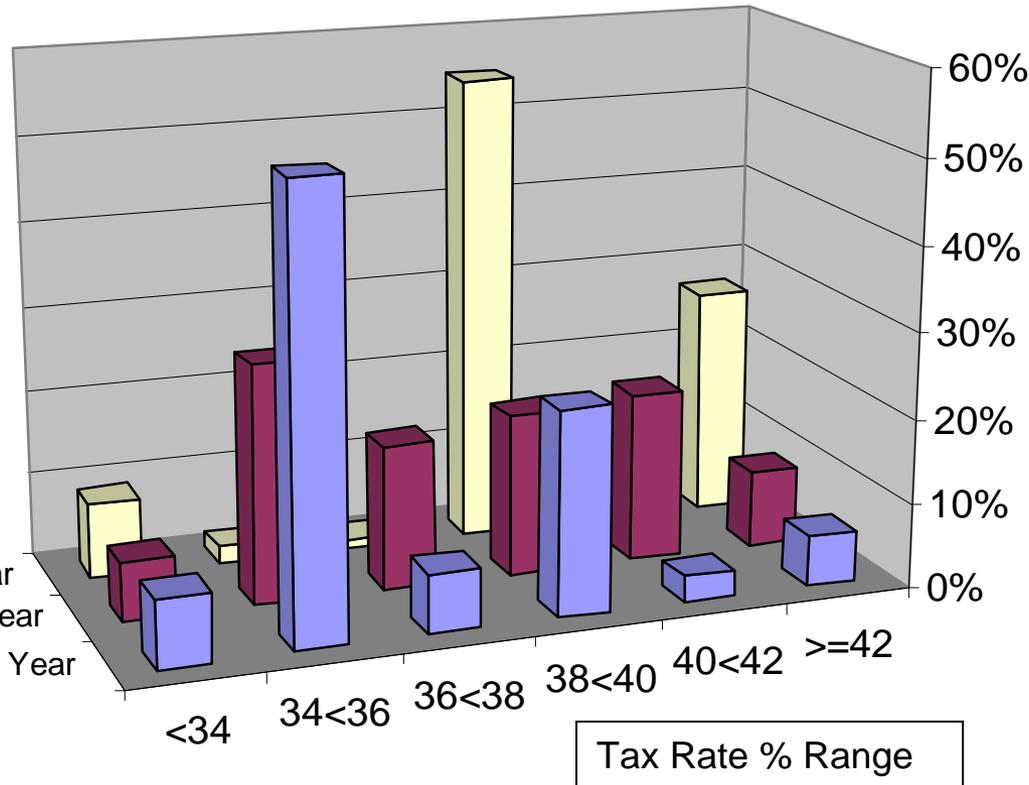
	<u>Contract</u>	B Qty	Bid	Ask	A Qty	Last	Vol	Chge
Trade	<u>2011.INCOME.TAXRATE.>42%</u>	9	25.0	28.0	19	26.5	22	0
Trade	<u>2011.INCOME.TAXRATE.>40%</u>	30	30.0	35.0	50	32.5	2	0
Trade	<u>2011.INCOME.TAXRATE.>38%</u>	9	87.0	88.8	2	87.9	2	0
Trade	<u>2011.INCOME.TAXRATE.>36%</u>	10	88.0	90.0	10	89.0	1	0
Trade	<u>2011.INCOME.TAXRATE.>34%</u>	20	90.0	91.0	9	90.5	2	0

Implied Probability Distribution of Current Tax Futures Prices

Example: There is a 55% chance of the 2011 rate being between 38% and 40% and a 27% chance of it being greater or equal to 42%.

Maturity

2011 Tax Year
2010 Tax Year
2009 Tax Year



Implied Probability of Tax Rate Being in that Range

Tax Rate % Range

Editorial: All of the <34s as well as the 2010 34<36s and 40<42s appear overpriced. I would expect a more bimodal distribution in the 34<36s and 38<40s. There seems to be a good deal of risk premium built in. Consider the 2011 >=42s.

Evidence of Risk Premium using Other Market Prices

	Contract	B Qty	Bid	Ask	A Qty	Last	Vol	Chge
Trade	<i>short</i> <u>2009.INCOME.TAXRATE.>42%</u>	20	5.0	7.0	4	6.0	20	0
Trade	<i>short</i> <u>2009.INCOME.TAXRATE.>40%</u>	10	7.0	10.0	11	8.5	9	0
Trade	<i>short</i> <u>2009.INCOME.TAXRATE.>38%</u>	10	31.0	35.0	13	33.0	24	0
Trade	<i>short</i> <u>2009.INCOME.TAXRATE.>36%</u>	5	38.0	41.0	10	39.5	71	0
Trade	<i>short</i> <u>2009.INCOME.TAXRATE.>34%</u>	1	90.1	95.0	10	92.5	1	0

The current top income tax rate is 35%. It is scheduled to revert to 39% for tax year 2011, but there is a chance that this “sunset” will be accelerated depending on who controls the White House and Congress.

Let’s make two big assumptions. 1) That in order for the 2009 $\geq 38\%$ contract to expire at 100, the Democrats will have to win the White House and the Senate. 2) That these victories are independent events.

- P (Democrat Elected President) = 59%
- P (Democrats Control Senate) = 92%
- P (Democrats Control White House and Senate) = 59% * 92% = 54%
- P (2009 tax rate $\geq 38\%$ given Democrat Control of White House and Senate)
= 33% / 54% = **61%**

Seems high, for 2009 that is.

Dealing with Risk Premia while Providing Positive Carry

The current offer on the 2009 $\geq 34\%$ contracts reflects an annual yield of about 2.3% after fees. Raising this rate by lowering the offer would tend to relieve the risk premium on higher contracts in the ladder.

	B Qty	Bid	Ask	A Qty	Last	Vol	Chge
Trade <i>short</i> <u>2009.INCOME.TAXRATE.>42%</u>	20	 7.0	7.0	4	6.0	20	0
Trade <i>short</i> <u>2009.INCOME.TAXRATE.>40%</u>	10	 10.0	10.0	11	8.5	9	0
Trade <i>short</i> <u>2009.INCOME.TAXRATE.>38%</u>	10	 35.0	35.0	13	33.0	24	0
Trade <i>short</i> <u>2009.INCOME.TAXRATE.>36%</u>	5	 41.0	41.0	10	39.5	71	0
Trade <i>short</i> <u>2009.INCOME.TAXRATE.>34%</u>	1	90.1	 95.0	10	92.5	1	0

Since most Intrade accounts don't pay interest, the relatively low prices for the $\geq 34\%$ contracts, which are near-certainties, represent a discounting of future profits. Offering those contracts represents a carry payment and also would tend to increase the supply of higher contracts on the ladder because margin requirements for sellers will be reduced, counteracting the natural risk premium.

Now, If these markets show risk premia because of tax-hedging, will it be the case that prices for Democratic candidates will be biased high? Haven't seen evidence of this. Not enough data.

What if Tax Futures were liquid?

- More mature versions would provide fiscal hedging with less basis risk than presidential futures.
- Part of a more general type of legislative and public policy markets.
- In addition to their usefulness in revealing information and making decisions, the hedging utility of these markets would have several advantages addressing well-known problems with representative government.

Other Potential Benefits of Tax Futures and Policy Markets

- The typical “special” or concentrated interest problem. Bad legislation is passed because:
 - A few relatively rich individuals would gain heavily by a particular piece of legislation such as an industry subsidy and so will lobby heavily for it.
 - Even if the legislation is wasteful and otherwise not in the public interest, the costs will be distributed over so many tax payers that they will not care to argue against it, and most will not even realize what’s happening. Even the “transaction cost” of organizing is less than their tiny individual implied tax liability or reduction in real purchasing power. (Whether or not the voters are exhibiting rational ignorance or irrationality isn’t too important here.)
- When legislative and public policy markets are in place:
 - The dispersed interests will have the recourse of hedging against wasteful spending or policy they otherwise dislike.
 - Concentrated interests will also have the option of hedging their legislative fortunes, which might lead to an overall reduction in lobbying and the demand for congressional favors.
 - Legislators may find compromises to be easier, since private individuals would be able to voluntarily “meet each other half way”, with price being the arbitrator. This could ease political log-jams, making law-making itself more flexible and efficient. Sensible yet otherwise politically infeasible measures such as unwinding entrenched subsidies could be made viable.
- Compare to Robert Shiller’s risk-sharing ideas such as inequality insurance, which flow more from a Rawlsian perspective. It’s not clear that you can reduce variance in wealth without reducing average or aggregate wealth. That is the Gordian Knot of political philosophy! These markets are more libertarian.

Obstacles to Policy Markets

- Legal ambiguity and regulatory issues! CFTC-like regulation would save these markets from having to navigate national and state gambling laws, but would come at the cost of flexibility. Some contracts would not be approved for political reasons even if they had demonstrable hedging utility and “economic purpose”.
- Market may not materialize because special interests and legislators are too “inside”. A “no-trade” condition.
- Market may not materialize because of insufficient news-flow or lack of risk aversion with respect to taxes.
- Congressional insider trading is already controversial. Such markets might be explicitly outlawed even if initially legal and regulated.
- Legislators might otherwise find ways to void useful operation of markets, with last-minute changes, earmarks, backroom appropriations, etc. Consider that current fed policy and macroeconomic releases are confounding with respect to price action for various reasons: re-statement, guidance, evolving policy tools, etc.
- Might not effectively help the dispersed interests, especially after transaction fees.

Possible Negative Side-Effects of Working Policy Markets

- Might increase tolerance to spending, and the model of Musto & Yilmaz (2003) predicts that the amount of redistribution promised by candidates would increase.
- Musto & Yilmaz also predict that politics would become more ideological, as fiscal matters would be mediated by private interests to a greater extent.
- Might increase inequality.
- Even though existing bills could be hedged against instead of lobbied for, the markets might actually increase demand (lobbying) for **new** bills.
- Might increase campaign spending. Patri Friedman's example: if a race is a toss-up between candidates A and B and candidate A has a campaign budget (risk) of \$2, and B a budget of \$1 then, by hedging, A can maintain a \$2 risk while spending \$4 on campaigning while B can only spend \$2 to maintain a \$1 risk. Thus the existence of a hedging market will tend to increase campaign spending differentials if the candidates are allowed to participate.
- If the candidates are allowed to participate they might then have an incentive to lie or state platforms more strategically. It is possible that elections might be thrown for cash profit.

Evolution of Tax and Policy Markets

- Part of the natural progression of risk-sharing.
- Government policy risk is the largest unhedgeable risk.
- Like nations with relatively low tax rates, nations where taxes and government policy can be legally hedged will attract capital. So these are likely at some point, even if not in the US. Where?
- Evolution often works by way of barriers causing diversity and “experimentation”. If the problems listed begin to manifest themselves, markets could be modified or discontinued. If not, the upside is very large.
- Questions? What do I actually do for a living?