

Manipulating Political Stock Markets: A Field Experiment and a Century of Observational Data*

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Abstract

Political stock markets have a long history in the United States. Organized prediction markets for Presidential elections have operated on Wall Street (1880-1944), the Iowa Electronic Market (1988-present), and TradeSports (2001-present). Such markets claim superior forecasting power to polls because they efficiently aggregate information. An important counterclaim is that such markets may be subject to manipulation and speculative attacks by partisan or large moneyed interests. We analyze this argument by studying alleged and actual manipulations-- speculative attacks not based on changes in fundamentals—in these three markets. We first investigate the speculative attacks on TradeSports market in 2004 when a single trader made a series of large investments in an apparent attempt to make one candidate appear stronger. Next we examine the historical Wall Street markets where political operatives from the contending parties actively and openly bet on city, state and national races, and the record is rife with accusations that parties tried to boost their candidates through investments and wash or phantom bets. Finally we report the results of a field experiment involving a series of planned, random investments-- accounting for two percent of total market volume-- in the Iowa Electronic Market in 2000. In every manipulation that we study there were measurable initial changes in prices. However, these were quickly undone and prices returned close to their previous levels. We find little evidence that political stock markets can be systematically manipulated beyond short time periods.

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I. Introduction

Prediction markets are markets for contracts or shares whose payoffs are explicitly linked to the outcome of future events. Consider, for example, a market on a binary outcome which pays a dollar if a specific event, such as a candidate's victory or an on-time product launch, occurs. An efficient prediction market will have prices which, under certain regularity conditions, are the best estimate of this event's probability. The market thereby provides the best forecast of the event given the participants' beliefs, and in this sense aggregates available information.

Prediction markets are currently the subject of intensive research in fields ranging from economics to political science to computer science (Berg, et al, forthcoming; Hanson, 1999; Pennock, 2004; Wolfers and Zitzewitz, 2004; Ledyard, 2005). There is growing interest among private sector practitioners, with Fortune 5000 companies such as Hewlett-Packard, Google, Microsoft, and Siemens employing internal prediction markets to aid forecasting. Tapping the "Wisdom of Crowds" has also been championed in the popular press (Surowiecki, 2004). The hope is such markets can improve decision-making in economic policy, corporate project selection, influenza vaccination and many other areas.

However, several theoretical challenges to the efficiency and predictive power for these information markets have been advanced. For example Manski (2005) forcefully questions the received wisdom that prices can be interpreted as probabilities. In his model, market prices only provide information about the wide interval in which mean beliefs over probabilities lie.¹ Manski seeks to push back against recent academic efforts to elevate information markets, where expressing opinions involve direct (monetary) consequences, above polls and surveys, where such actions do not.

Another, perhaps more damaging challenge to the forecasting ability of information markets is the possibility that small group of investors could deliberately distort prices away from fundamentals for strategic purposes. Such an action is referred

¹ Manski's paper has provoked a number of responses. Wolfers and Zitzewitz (2005) present an alternative class of models that endogenize the investment decision and lead to market prices are at or close to mean beliefs. See also Gjerstad (2004). Others ask if differences between probabilities and market odds prices exist in the known directions that Manski's analysis indicates, why don't rational investors try to exploit these gaps and, through the market process, compete them away.

to as a manipulation. Stiglitz (2003) criticized the proposed Policy Analysis Market on the grounds that it was “could be subject to manipulation.” As we will document below, there were charges in the heat of the 2004 US Presidential campaign of a series of well-financed, politically-motivated speculative attacks against Bush futures in the *TradeSports* markets aimed at steering the election to Kerry. (*TradeSports* is one of a growing number of providers of matching services for trading futures on sports, entertainment, legal, and political events. Such internet sites have become highly popular in recent years.) As such markets rise in public visibility, one might expect it would become increasingly likely that interested parties would attempt to strategically distort the prices to influence real-world outcomes. Whether manipulation causes important distortions in actual prediction markets is then an open and important empirical question.

This paper investigates whether prediction markets can be easily manipulated in ways undermining their use as forecasting tools. Our testing ground is one of the more familiar and most widely cited versions of prediction markets, political stock markets. We analyze alleged and actual manipulations-- speculative attacks not based on changes in fundamentals—in three markets: the 2004 *TradeSports* market for President; the historical Wall Street betting markets from national, state, and city races; and the 2000 Iowa Electronic Market for President. Our empirical analysis ranges over a wide terrain, including both observational data and field experiments, and evaluates evidence from both contemporary and historical prediction markets. We believe this breadth of approach substantially enhances the robustness of our findings.

The paper has the following form. The next section more precisely defines manipulation and discusses the relationship between our concepts and methods with those employed in the existing literature. The third section documents and investigates charges of manipulation in the 2004 *TradeSports* Market. Section Four extends the analysis back one century by probing the role of manipulation in the large New York election betting markets, wagering on President, Governor, and Mayoral races between 1890 and 1940. Section Five takes us from the position of outside observers to insiders by investigating the results of a field experience involving a planned series of “speculative attacks” (uninformed trades) in the 2000 IEM Presidential markets. The final, concluding section summarizes our findings from this large and diverse set of data.

II. Definitions of Manipulation and Existing Literature

For the purpose of this paper, we define a manipulation as *a speculative attack, unrelated to change in the fundamentals, which seeks to permanently changes the price dynamics*. We discuss below various models that allow this possibility. The reason we focus on market prices, rather than investor profits, stems from the richer set of motives for manipulating prediction markets. While profit seeking is the main objective of manipulation in traditional financial markets, investors in prediction markets may be willing to accept losses if this has large and lasting effects on prices. These manipulators might be primarily interested in the feedback effect of such prices. For example, in political prediction markets an investor could sell shares to lower prices and signal a candidate has weakened. This might influence the choice of undecided voters, either directly or through the media. The manipulator also might be interested in other indirect effects, such as a spillover into other financial markets such as the NYSE. We are agnostic on the exact incentives of the manipulating trader. As long as the manipulator's goal involves a long-term change in prices and there is no new information—a common feature of the objectives listed above-- the market response should be similar.² Our goal is to focus on how markets respond to these attacks. Still they suggest care is needed in the empirical work. For example, rather than focusing on volume-weighted prices (reflecting the typical price a manipulator might get) we might be more interested in a time-weighted price (since an extended period with unusual price might attract attention, even if trading is light).

It is worth noting that the investments we consider will result in losses unless they influence the beliefs of other market participants. Consider the case of a purchase. Since the investment is large, some the shares are purchased at a price exceeding the initial level. If the position is rapidly unwound, no share will sell for more than the initial price

²Some apparent speculative attacks may not be primarily designed to change prices. For example, a trader from another political market might seek to hedge his position (this is referred to as a lay-off bet) or might seek to learn the market's depth / resiliency. Still, these are costly activities and there are often far cheaper ways to obtain these objectives. For example a layoff bettor should try and spread his money across different markets to get the lowest purchase price, while the free TradeSports trading screen reports the top fifteen orders (both price and quantity) in the bid and ask queue.

if beliefs are unchanged and so losses occur. Alternatively if investors believe this purchase reflects more favorable fundamentals then higher prices (and profits) are possible. Models formalizing this intuition are discussed below. It is also important to see if the models would allow long-run changes in prices even when no change in fundamentals.

Our work complements two related papers. Hanson, Oprea, and Porter (2006) find that manipulators are unable to influence the predictive capacity of prices in an experimental prediction market.³ Camerer (1998) conducts a field experiment at the horse-track. At the track a wager on a horse pays-off only if that horse wins the race, so prices can be stated in terms of probabilities. The author simulates manipulation by placing and then removing a large wager on a specific horse. The final price on this horse is virtually identical to that of a control horse, which has similar characteristics but whose price was not manipulated. We built on his innovative work using both observational data and field experiments. The markets we study are sufficiently different to warrant further investigation. For example, the incentives for manipulators may be different, with profit-making paramount at the track and other objectives outlined earlier playing a role in the political market.⁴

Manipulations are traditionally defined as attempt to profit from artificially changing stock prices. Allen and Gale (1992) divide manipulations into three categories: action-based (attempting to influence the fundamentals of the underlying asset), information-based (spreading false information), and trade-based (buying and selling shares). The first two are explicitly outlawed in the Securities and Exchange Act of 1934 and are not considered here. We evaluate several cases of trade-based manipulation, which involve large purchases or sales which are sometimes rapidly unwound in so-

³ Hanson and Opreas (2004) advance a theoretical model arguing that the existence of manipulators increase informational market accuracy.

⁴ While our field experiment for the IEM Presidential contracts is similar to Camerer (1998), there are some key differences relating to timing and incentives. First, the track manipulations occurred far before the race started while a preponderance of the wagers is placed right before post time. Investments are more uniform in political stock markets, and the market is fairly thick even months before the election. Second, the payoff of a winning wager at the track is inversely related to the bet total on that horse. An insider has strong incentive to delay his wager until the last possible moment so as to not draw attention (and potentially additional bets) on his horse. Political stock market participants are more likely to infer that even our earliest price shocks were due to an insider, since there is no incentive to delay an investment (payoffs in these markets are fixed at the time of the wager). Third, our cases include markets where wagering is non-anonymous.

called pump-and-dumps. Allen and Gale (1992) show that the latter can potentially be profitable even in a rational expectations equilibrium, even without bubbles, if other investors believe the manipulator may instead be a well-informed insider. The key point is that the price movements are believed to convey information, and it is the information asymmetry which is central to this and other models discussed later. Various empirical papers have documented the existence of trade-based manipulation in traditional financial markets.⁵

A range of market microstructure models allows such investments to have long-term effects on prices. Rational investors may chase trends in prices, even when the underlying fundamentals are unchanged or only slightly perturbed. A survey of these dynamic models is presented in Brunnermeier (2001) and O'Hara (1995).⁶ Past prices and volume can help forecast future values when there is information asymmetry and investors are learning about one another's private information (Blume, Easley, and O'Hara, 1994). It is sometimes optimal for investors to herd, to repeat the last observed action. In this case bad news may not be fully reflected in current prices, and the herd may be fragile with a small shock leading to a large price change (Bikhchandani, Hirshleifer, and Welch, 1992; Bulow and Klemperer, 1994). Similarly, following Keynes' beauty contest interpretation of financial markets, investors may all collect the same kind of information and ignore others (Froot, Scharfstein, and Stein, 1992). There also may be multiple equilibria in which case large price changes can be triggered by a sunspot, an uninformative public information revelation, or small changes in fundamental parameters (Cass and Shell, 1983; Romer, 1993). And finally if noise traders or other non-rational agents are the marginal traders, investments not based on changing fundamentals can have long-term effects on prices.

A common theme from all of these models is that prices do not serve as a sufficient statistic for public information. This would call into question the predictive capacity of prediction markets.

⁵The more recent empirical evaluations have focused on stock pools during the 1920s (Mahoney, Jiang, Mei, 2005), "pump-and-dumps" of penny stocks (Aggarwal and Wu, 2005) or by brokers making personal trades (Khwaja and Mian, forthcoming), and cornering in futures markets (Merrick, Naik, and Yadav, 2005). For a larger set of experimental and theory papers, see Klarreich, Science News, 2003 summary on KS webpage.

⁶While a bubble would allow prices to exceed an asset's fundamental value, rational bubbles are difficult to sustain when there is a known termination time as with prediction markets.

We now analyze alleged and actual manipulation in three real-world prediction markets. We first investigate the speculative attacks on *TradeSports* market in 2004 when a single trader made a series of large investments in an apparent attempt to make one candidate appear stronger. Next we examine the historical Wall Street markets where political operatives from the contending parties actively and openly bet on city, state and national races, and the record is rife with accusations that parties tried to boost their candidates through investments and wash or phantom bets. Finally we report the results of a field experiment involving a series of planned, random investments in the Iowa Electronic Market in 2000.

III. *TradeSports* 2004 Presidential Market

a. Background

TradeSports operates one of the largest online prediction markets.⁷ It ran the most influential market on the 2004 US Presidential election, which attracted more than \$15M in trade volume. Shares in the main election market paid a fixed amount if Bush won, and the prices were scaled between zero and a hundred to give the usual probability interpretation.

Shortly after 2:30 pm (EDT) on Friday, October 15, 2004, the *TradeSports* odds price on the re-election of President Bush began to fall precipitously. From a plateau of 54 points at 2:30 pm, the price dropped to 40 by 3:33 pm, bounced back to 50 and then dropped to just 10 points moments later. According to the trades in this leading electronic information market, Bush went from a slight favorite to serious underdog. This sharp drop was the most dramatic of a series of trades that *National Review Online* blogger Donald Luskin soon charged were politically-motivated speculative attacks on

⁷*TradeSports* markets are listed at <http://www.tradesports.com>. It is part of the Trade Exchange Network which provides an electronic matching service for trading futures on sports, entertainment, legal, and political events. The company was founded in 2001 and is headquartered in Dublin, Ireland. Shares pay \$10 upon winning but are quoted between 0 and 100. When share prices are between 6 and 94, or exactly 0 or 100, then *TradeSports* charges a commission of 0.04 dollars (about 0.8 percent) per shared trades. Outside that range to the extremes the commission rate is 0.02.

Bush futures “to sway the election towards Kerry.”⁸ Some saw the hand of George Soros behind the October 15 plunge as well as earlier bear raids on Bush. Such rumors gained currency when a *TradeSports* press release, publicized in *Wall Street Journal* and *Time*, confirmed that the large trades of a single investor produced the October 15 price moves.⁹ The press release asserted “Bush contract has become the battle ground of wills between a cadre of large, well financed rogue traders seemingly bent on driving down the Bush re-election contract and a growing list of financial traders who think they can predict the outcome of this election.”

Figure 1 displays the price and volume during September and October when each of the purported manipulations occurred. In addition to the October 15 event, the other episode is a 13-point drop in the price of the “Bush Winner” contract around 12 pm EDT on Monday, September 13¹⁰ (Because these data are reported in GMT, the events appear a four hours earlier than in EDT). Figures 2 and 3 show the manipulation events in greater focus. It is clear that these periods involve the sharpest change in prices during the observation period.

This market appears to quickly incorporate new information. For example, Bush shares fell over five points during the Presidential debate on October 8 (October 9 GMT) which many commentators later argued he handily lost. This suggests that investors are actively monitoring the market, and that placid price periods are not simply due to investor inattention.

Is there a Republican bias in *TradeSports*? One *TradeSports* investor argued “that the *TradeSports* Presidential-election market may be overstating Mr. Bush's chances.

⁸ Donald Luskin, “Who’s Behind the Bush-Futures Attacks?” *National Review Online*, 18 Oct. 2004, 11:32 AM. http://www.nationalreview.com/nrof_luskin/luskin200410181132.asp. See also the 16 Oct. 2004 entry, “Bush Futures Being Manipulated” in Luskin’s own blog, *The Conspiracy to Keep You Poor and Stupid*, http://www.poorandstupid.com/2004_10_10_chronArchive.asp.

⁹ “Bids and Offers,” *Wall Street Journal*, 22 Oct. 2004, p. C4; and “Let’s Make This Vote Interesting, Shall We?” *Time*. 25 Oct. 2004.

¹⁰Two other trades were also reported as manipulation attempts. However, these occurred at a time when news about the candidates was being revealed (during the second and third Presidential debates) and involved relatively modest price changes. We do not include an analysis of these events in the paper, though in each case prices returned to roughly their pre-manipulation level as with the episodes we study.

Figures 1

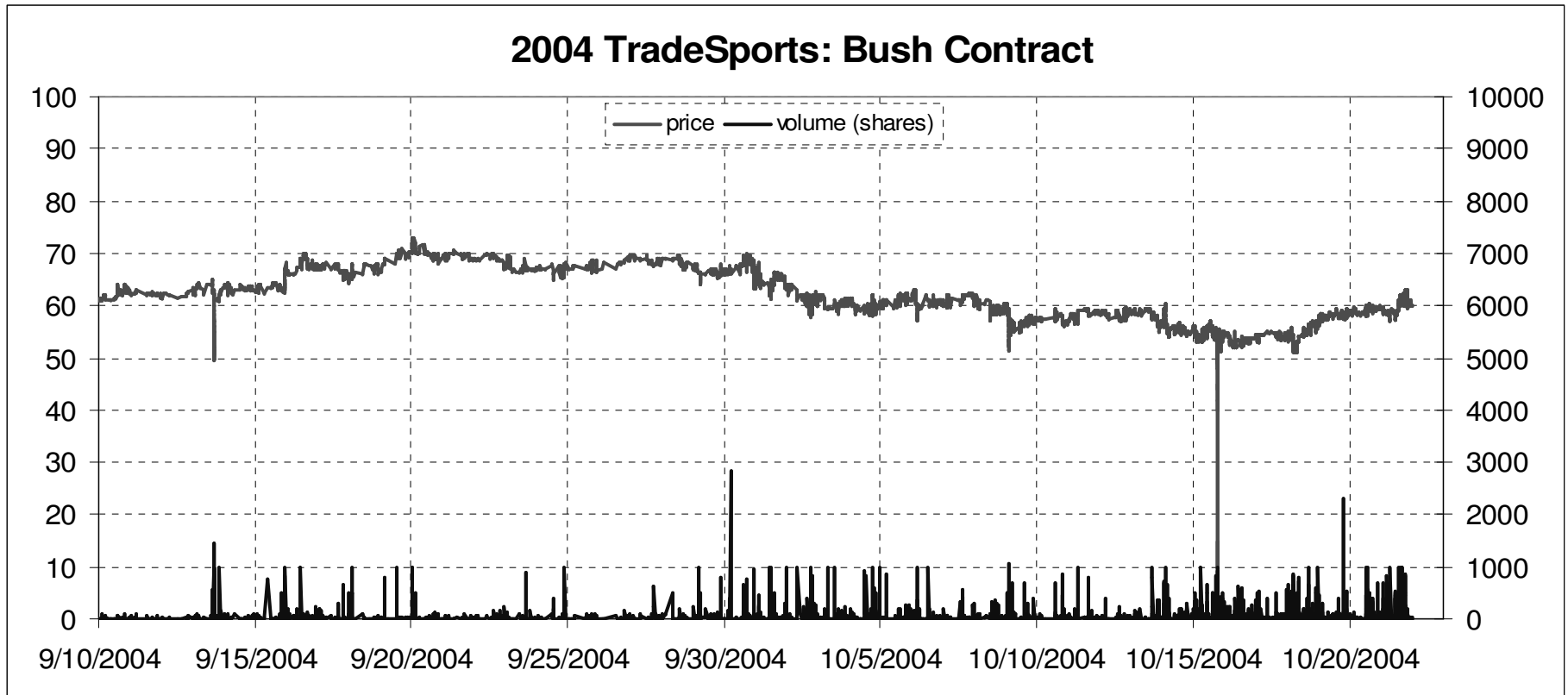


Figure 2

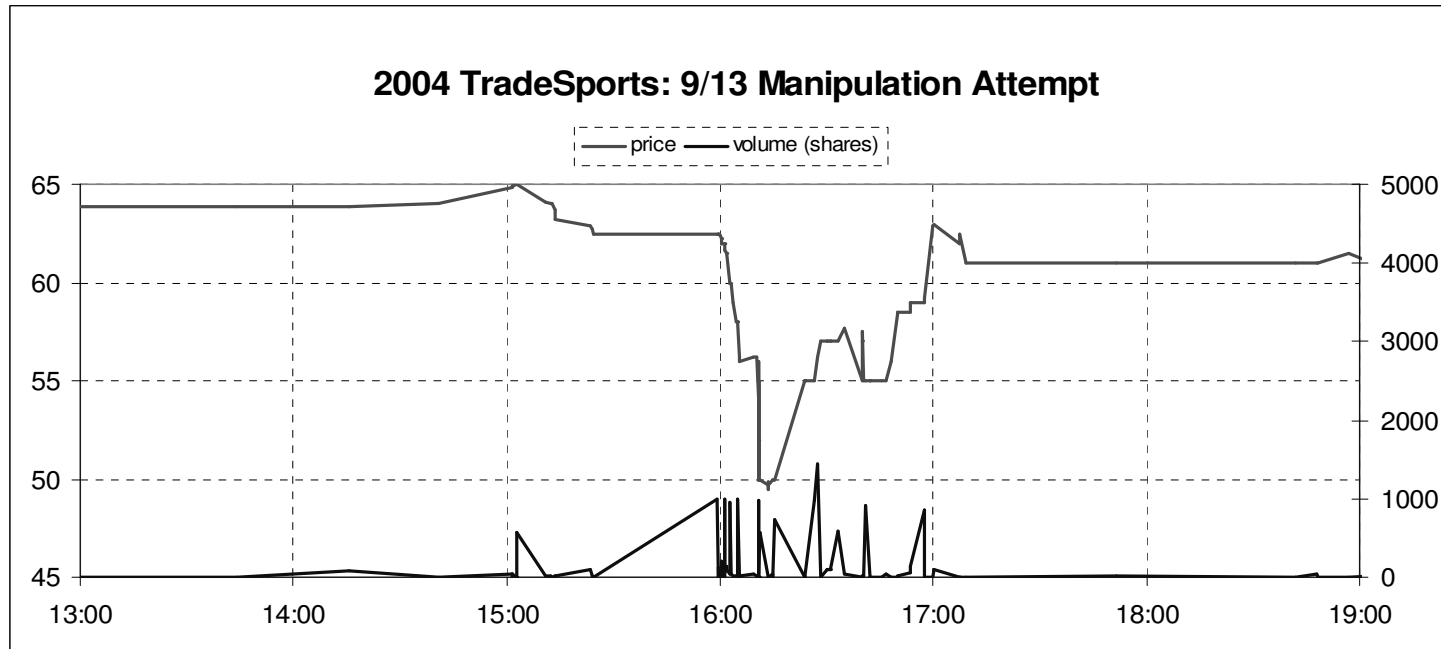
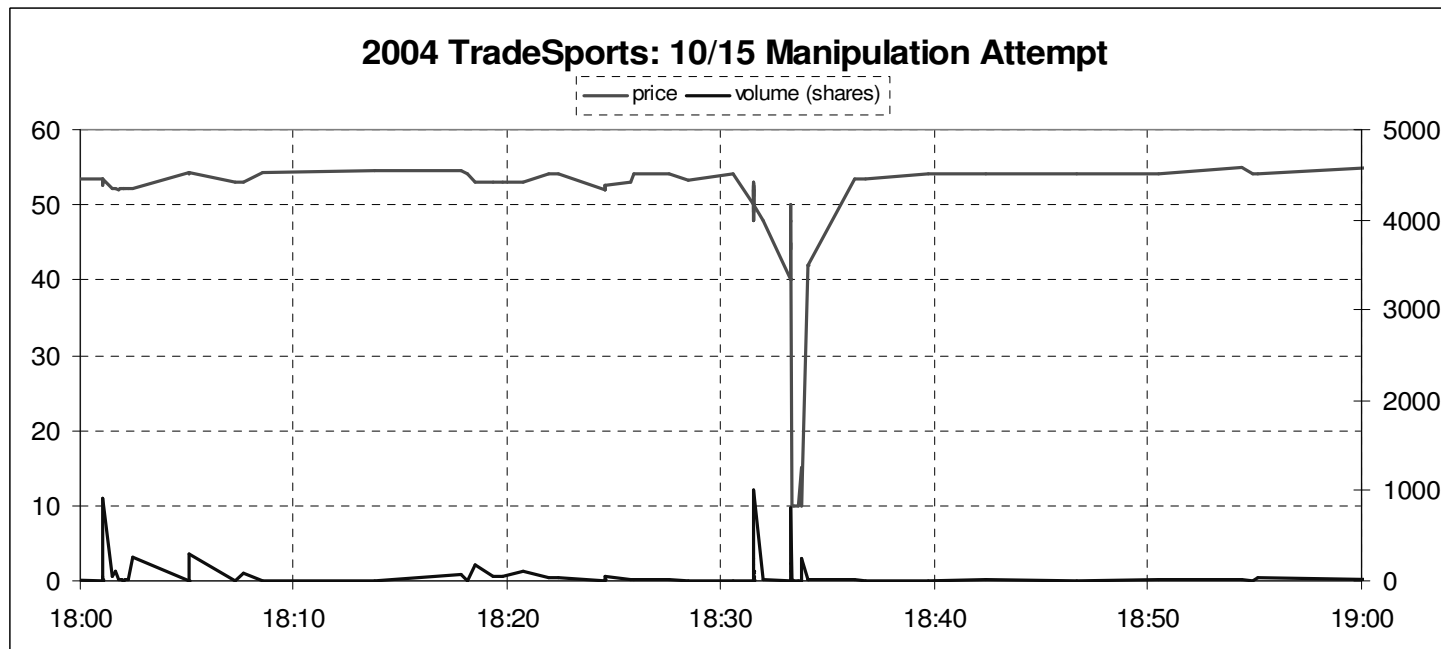


Figure 3



Many *TradeSports* bettors are professional stock traders and portfolio managers -- which is to say they typically share the market's Republican bias. Imagine a futures contract based on the University of Michigan football team's chances of beating Indiana University in this weekend's matchup that only University of Michigan fans have access to, he says. It is probably going to skew the odds too heavily in Michigan's favor"¹¹

b. Results

Through a special agreement with *TradeSports*, we have access to real-time trades. These data include the quantity and price (though not identity of the traders) of every transaction over 10 September – 21 October 2004, a period which includes the two manipulations described above.

An analysis of the attacks using these trade-level data is presented in Table 1. The exact period of the trades is listed in the column headers, and the first four rows summarize the activity during the manipulations. The price declines were far higher than would be typically observed for these short periods: the average price range is 0.07 over three minute intervals (the length of manipulation 2) and 0.25 over fifteen minute intervals (the length of the first manipulation). In fact these two price changes are the largest observed in data and are each about an order of magnitude larger than the 99% percentile of the price change distribution. The volume is also quite heavy, with the share or dollar volumes about a hundred times larger than usual (the average volume per minute is 5.4 shares or \$32.1).

It does not seem likely that these episodes were instigated by unusual market conditions. While they did follow periods of slightly higher than average volume, the prior price volatility was relatively low. Prices changed by only 1.5 in the hour prior to manipulation 1, and not at all in the hour preceding manipulation 4.

Because volume data is available, we can investigate whether the manipulations could have been immediately financially profitable. Row four of Table 1 calculates the net return if the manipulator immediately bought back the shares he had sold, using as data the observed prices following his trades. Recall that if beliefs are unchanged, the

¹¹ *Wall Street Journal*, "Stock Market Quarterly Review -- Essay: Election Mania Overtakes the ABCs of Stocks; Some Investors Forsake Homework on Fundamentals for Futures on Bush v. Kerry", 1 Oct. 2004, p C12 – available on ProQuest, WSJ.

trader will have to buy back shares at the higher, pre-manipulation price and therefore take a loss. This is just what we see for manipulation 2, with trader losing over ten percent of his investment. Manipulation 1, however, allows a four percent gain because prices did not immediately return to their initial level. This value is an upper-bound estimate, because the trader would likely have to re-purchase some of his shares at a price exceeding the observed level (unless he was able to buy all of his shares before those observed makes purchases). Hence in practice even manipulation 1 would not likely be profitable.

The last set of results in Table 1 more precisely tests this intuition. These rows show the minute-by-minute cumulative rate of return following each of these large sales.¹² In both cases the return is large and negative the first few minutes after the manipulation begins (indicated by $t=0$). Within three minutes after the second manipulation ends ($t=2$), the return is no longer significant, as the Z-test in parenthesis indicates. For the first manipulation, the return remains negative and significant for a longer period of about forty-five minutes after the attack ends ($t=14$). As a more general appraisal, we calculate the mean cumulative returns for the two cases. This return is no longer statistically significant twenty-five minutes after the start of the manipulations or about ten minutes after both manipulations end (these numbers are not reported in the interest of brevity).

It is also possible to evaluate whether the manipulations influenced the long-run price dynamics. We estimate Chow tests of the form:

$$(1) \quad \text{ror}_t = \alpha_1 + \beta_1 \times t + \alpha_2 \times I(\text{Post-manipulation})_t + \beta_2 \times t \times I(\text{Post-manipulation})_t + \varepsilon_t$$

where ror_t is the rate of return at minute t and $I(\text{Post Manip})_t$ is an indicator for whether this time occurs after a manipulation. We cannot reject $H_0: \alpha_2, \beta_2 = 0$ for either of the manipulations, which suggests that neither set of trades had a permanent effect on the rates of return

¹²We also calculated the cumulative abnormal using two definitions of normal return: the mean return over the three days prior to the manipulation and the mean return over the prior hour. The cumulative values are quite similar those reported in the table.

Table 1: Analysis of TradeSports 2004 Presidential Election Manipulations

	(9/13: 15:59-16:13) Manipulation 1	(10/15: 18:31-18:33) Manipulation 2
<i>Attack summary</i>		
price change	- 12.8	-44.0
volume (shares)	6887	4416
volume (\$)	\$40,246.76	\$21,000.42
profits (upper bound)	\$1,634.94	-\$2,735.50
<i>Cumulative rate of return (1 minute intervals)</i>		
-1	0.000 (0.00)	0.000 (0.00)
0	-0.160 (-0.20)	-11.765 (-4.62)
1	-0.803 (-0.94)	-11.765 (-4.27)
2	-1.613 (-1.76)	-142.799 (-48.53)
3	-4.082 (-4.21)	-19.722 (-6.32)
4	-5.763 (-5.64)	-19.722 (-5.99)
5	-7.472 (-6.97)	4.362 (1.26)
10	-10.624 (-8.22)	5.292 (1.27)
15	-22.300 (-15.06)	5.292 (1.11)
20	-22.300 (-13.53)	5.292 (1.00)
25	-12.777 (-7.10)	5.292 (0.91)
30	-9.205 (-4.75)	7.127 (1.14)
45	-12.776 (-5.53)	7.490 (1.01)
60	0.643 (0.24)	7.490 (0.89)
75	-2.424 (-0.83)	7.127 (0.76)
90	-2.424 (-0.77)	7.127 (0.70)

Notes:

- All times are GMT
- The profitability calculation presumes that the manipulator immediately unwinds his position through re-purchasing the share he has sold (a “dump-and-pump”). This is the upper-bound of profits since it presumes he can sell at the observed market prices following his manipulation; his actual price will be lower if his orders are executed after the other traders buying shares.
- The cumulative rate of return is based on data which is aggregated into one minute intervals. Since prices shift rapidly their average price is used in calculating the rate of return at time t,

$$ror_t = (price_t - price_{t-1}) \times (0.5(price_t + price_{t-1}))^{-1}$$

Ror_t is expressed in percentage terms. t=0 is the time when the manipulation begins, The cumulative totals begin at t=-5. Z-tests of statistical significance are reported in parentheses below the values. These are calculated from prices during the hour preceding the attack (this is the estimation window).

In total these calculations confirm the visual inspection of the time series graphs. While the manipulations involved extremely high volume and initially moved prices, the prices quickly returned to their prior level and were not financially profitable for the trader. This is consistent with the argument that manipulations did not alter the price dynamics for this market.

IV. The New York Betting Markets, 1880-1940

a. Context

Rhode and Strumpf (2004) documented the existence of large, active betting markets for Presidential candidates between the Civil War and World War Two, with the largest market was centered in New York City.¹³ Here we extend the analysis by showing that by the 1890s and 1900s, extensive wagering also occurred over the outcomes of the state and local races. These markets attracted the active involvement of partisan traders, including the Democratic and Republican political organizations. Although it was at times illegal, election betting was openly conducted, well publicized, and employed standardized contracts, typically but not exclusively involving Winner-Take-All futures. In contests during the 1890s and 1900s, the major New York City papers, including the *Herald*, *Sun*, *Times*, *Tribune*, and *World*, provided nearly daily quotes from early October until Election Day.

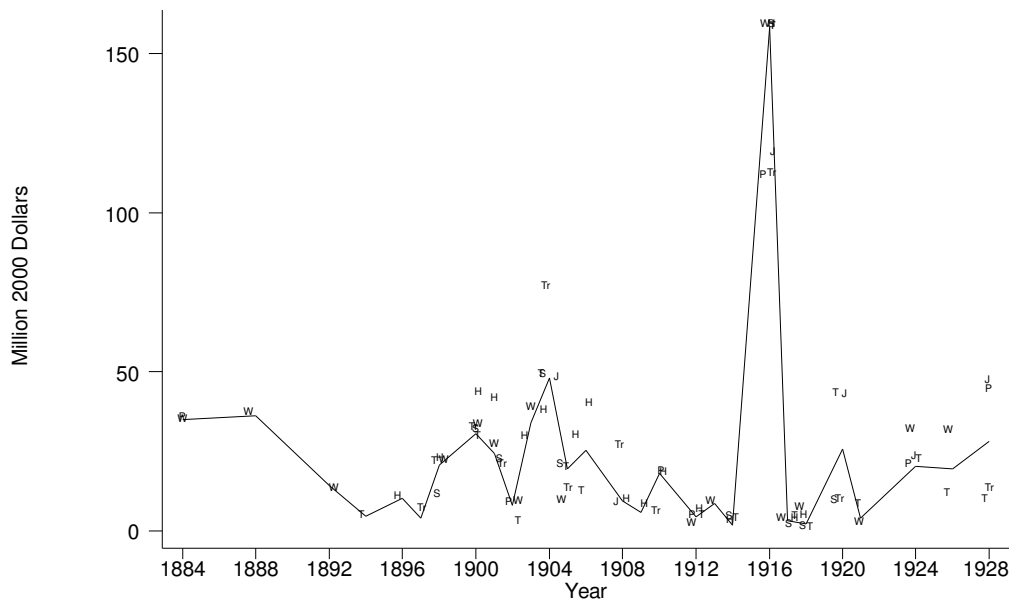
Compared with modern information markets, the betting volume in the historical New York markets was huge. Figure 4 assembles estimates from selected newspapers of the sums wagered in the New York market from 1884 to 1928.¹⁴ All of the dollars are converted in 2000 purchasing power. The betting volume varied depending on whether the race was for President, Governor, or Mayor, the closeness of the contests, enthusiasm

¹³ This work adds to an earlier literature (e.g. Williard, Guinnane, and Rosen (1996)) that uses price movements of currency and financial assets to derive market-based inferences about changes in expectations regarding political and military events. Such studies can provide valuable insights into turning points in expectations and into the direction of change. Quotations about odds prices, where available, allow more straightforward inferences about the levels of subjective probabilities.

¹⁴ The reported totals in most instances represent the volume of money changing hands rather than the total amount staked. 1928 is taken as the end because quotations regarding volume become much more scarce in the 1930s, not because activity appeared in that decade. Scattered evidence indicates volume in 1932 and 1936 was higher than at the end of the 1920s.

for the candidates, and the legal environment. The period of greatest sustained activity was between 1897 and 1906. But the clear peak was the 1916 Wilson-Hughes peak, when \$158 million (2000 dollars) wagered in the organized New York markets. This was more than twice the total spending on the election campaigns. The betting volume tended to be much higher in Presidential years than in years when the NY Governor ran alone or the New York City Mayor was up for election. The ratios were on the order of 100:39:37.¹⁵ That is, there was a large drop off between national and state elections, but only a small further decline for city races. The average of the median bet volumes reported in the 25 elections appearing in the figure was roughly \$22 million (in 2000 purchasing power). As a point of contrast, activity on the IEM for the 1988-2000 elections has been orders of magnitude smaller, with trading volumes that never exceeded \$0.15 million in any one election (see Berg, et al, 2003).

Figure 4: Estimated Volume in New York Election Betting Markets, 1884-1928



Key: J=Wall Street Journal; P= Wash. Post; H=NY Herald; S=NY Sun; T=NY Times; Tr=NY Tribune; W= NY World.

The organization and location of the New York betting market evolved over time. Moving out of pool rooms in the 1880s, activity centered on the Curb Exchange and the

¹⁵ It was estimated that in Presidential years, about two-thirds of the bets were placed on the Presidential races and the remainder on Governor and local races. *New York Times*, 3 Nov. 1924 p. 2.

major Broadway hotels until the mid-1910s. In the 1920s and 1930s, specialist firms of betting commissioners, operating out of offices on Wall Street, took over the trade. These firms were variously viewed as brokerages, bucket shops, or bookie joints. The standard betting and commission structure over most of the period was for the betting commissioner to hold the stakes of both parties and charge a 5 percent commission on the winnings. If the commissioner trusted the credit-worthiness of the bettors, it was not necessary to actually place the stakes and instead the signed memorandum or letter of obligation sufficed.¹⁶

During the heyday of election betting in the late 1890s and early 1900s, the names and four-figure stakes of bettors filled the pages of New York's daily newspapers.¹⁷ Thus, in contrast to the electronic markets of today, these activities were often not anonymous. Such published stories may have served to advertise the political affiliation of the bettors as well as to confirm the existence of the wagers.¹⁸ Among the several hundred names periodically appearing in the newspaper betting stories was a substantial number of New York's financial elite, including members of New York Stock Exchange. The current or future owners of NYSE seats include Jules Bache, Edward Bell, L. L. Benedict, Jno. S. N. Crane, Charles De Witt, Henry J. Dittman, Jacob Field, F. T. Bontecon, Eustace de Cordova, Austin J. Feuchtwanger (Feuchtwanger & Co.), H. P. Fronthingham, Edward Jewett, George Lancon, J. M. Leopold, Charles H. Marshall, Maurice B. Mendham (*), Charles C. Minzesheimer (*), William B. Niven, Daniel O'Dell, George B. Salisbury, F. L. Seligsberg. John M. Shaw, P. N. Sproule, Henry S.

¹⁶ *New York Times*, 10 Nov. 1906, p. 1; 29 May 1924, p. 21; 4 Nov. 1924, p. 2; *Wall Street Journal*, 29 Sept. 1924, p. 13. *New York Times*, 9 Nov. 1916, p. 3. For the long tradition of election betting, see *New York Herald Tribune*, 2 Nov. 1940, p. 23.

¹⁷ By way of contrast, most of the reported wagering in the 1930s involved six-figure amounts advanced by unnamed leaders in the business or entertainment worlds. This shift to increasing anonymity reflects changes in tax laws, New York state anti-gambling legislation, and the public attitudes of the organized financial markets. After passage of the Hart-Agnew of 1908, the Stock Exchanges periodically enacted regulations to limit involvement of their members in election betting. In 1912, the New York Curb Association publicly reminded its members that placing bets was contrary to New York laws. "Any member found betting, placing bets, or reporting alleged bets to the press will be charged with action detrimental to the interest of the association, which may lead to his suspension." *Wall Street Journal*, 8 June 1912, p. 5. In May 1924, both the New York Stock Exchange and the Curb Market passed resolutions barring their members from engaging election gambling. Again in late 1927, both exchanges blocked the use of "when issued" contracts to discourage gambling. *Wall Street Journal*, 23 Dec. 1927, p. 11

¹⁸ Politicians as a matter of loyalty could be expected to bet publicly for their party's candidate, even when they did not favor them. For example, in 1900, Richard Croker made highly publicized bets in favor of William Jennings Bryan against his own strong preferences. *New York Times*, 5 Nov 1916.

Sternberger, E. B. Talcott (*), F. B. Tilghman, Louis Wormser, Jr. (*), and Daniel T. Worden. The names followed by (*) were major players in the New York betting markets.¹⁹

But it would be wrong to create the impression that the Wall Street betting markets was the preserve of NYSE members. The centers of election betting activity were on the Curb on Broad Street and in the uptown hotels, the Hoffman House, Metropole, and Fifth Avenue. The big-money betting commissioners of the era such as Frederick Brooks, “Eddie” Burke, John W. Cavanagh, John Considine, Percy Guard, Orlando Jones, J. J. Judge, “Sol” Lichtenstein, George A. Malarky, E. E. Smathers, Joe Ullman, “Circular Joe” Vendig, and George Wheelock were never, to our knowledge, under consideration for NYSE membership. Rather they owned local pool rooms, were members of the city’s “bookmakers’ club” -- the Metropolitan Turf Association -- or belonged to the crowd of brokers trading on the Consolidated Exchange or on the Curb.²⁰ The newspaper stories also highlighted the activities of stalwarts such as Henry C. Swords and future NY Governor, Benjamin B. O’Dell, Jr., as well as many of the leading Tammany tigers-- Richard Croker, Timothy D. Sullivan, Patrick H. McCarren—among other politicians.²¹ Tammany Hall was said to have a special war chest to finance its betting gambits.

We can gain a much fuller picture of the participants in these turn-of-the-century betting markets by matching the persons mentioned in the newspapers with Population Census and other genealogical records. This task is made vastly easier by the availability of *ancestry.com*. In our preliminary matching exercise, 72 bettors mentioned in the *Wall Street Journal*, *New York Herald*, *New York Sun*, *New York Times*, *New York Tribune*, or

¹⁹ We thank Petra Moser for making her membership records for the NYSE available to us. The articles make frequent reference to anonymous “Stock Exchange members.”

²⁰ The Curb Market remained more tolerant of election betting than NYSE. Some of its early publicity such as Weil and Fabb (1908) was co-written by a man, Richard C. Fabb, who would become a leading betting commissioner in the interwar period. It was generally considered that the stock brokers were republicans and the leading book makers were Democrats (cite evidence from canvass in 1896 and quote from 1890s).

²¹ Regarding the participation of politicians, see *New York Tribune*, 2 Oct. 1884, p. 4; 16 Oct. 1888, p. 2; 9 Nov. 1894, p. 3; 5 Aug 1896, p. 1; 31 27 Oct. 1896, p. 5; 24 Oct. 1897, p. 6; 5 Sept 1900, p. 14; 18 Sept 1900, p. 2; 30 Sept. 1900, p. 5, 12 Oct 1900 p. 3; 20 Oct 1900, p. 3; 8 Nov 1904, p.1; *New York Herald Tribune*, 6 Nov. 1928, p. 3; *New York Times*, 27 Oct. 1896, p. 3; 30 Oct. 1896, p. 1; 1 Nov 1896, p. 8; 8 Nov. 1900, p.5, 23 July 1936, p. 8; 24 July 1936, p. 8; 25 July 1936, p. 6; 29 July 1936, p. 6; 9 Aug. 1936, p. 29; *Wall Street Journal*, 31 Oct 1916, p. 8; 27 Oct 1920, p. 1; 29 July 1936, p. 1.

New York World --there is great commonality in reporting across these papers-- were matched to the Census of Population for 1900.²² Figure 5 compares the occupational distribution of the matched sample with the city of New York at this year. (Note all of the listed bettors were males; to improve comparability the general occupational distribution is for males only as well.) The differences are stark. Whereas 0.6 percent of the male labor force in New York City was a “banker or broker” in 1900, 44 percent of the matched bettors belonged to this category.²³ “Government officials” comprised 0.4 percent of the city’s labor force but 5.6 percent of the bettors; hotel keepers made up 0.3 percent of the labor force but 4.2 percent of the bettors. Even the “other” category hides further great differences. Not one of the matched election bettors performed the type of blue-collar job in manufacturing, transportation, or domestic servant that occupied the vast majority of the 1.1 million males workers in New York City. Indeed, the stakes reported in the press were well in excess of the average earnings of the typical wage-earner in New York during this period.²⁴ In summary, the participants listed in the newspaper stories were a highly unrepresentative sample of the population (or electorate) and included persons of varied backgrounds whose living depended on taking well-reasoned but large gambles on political and financial outcomes.²⁵

²² We make no claim that our preliminary list of matched bettors represents a random sample of the names appearing in the newspaper betting stories over the 1897-1906 period. Definitively linking persons with common names proved difficult in a city as large as New York. And in some cases, the published names appear to be “betting handles” used by no one reporting to the Census in 1900. In others (e.g. Richard Croker), the participant was out of the country at the time of enumeration. A search of the 1880 and 1910 censuses located some persons missing from the 1900 tally. Newspaper coverage—some names are listed many, many times whereas other bettors go nameless—also raises issues regarding how representative our sample is of the typical participant. Nonetheless, we are confident that the differences between the characteristics of our matched sample and the general NYC population are not solely or even chiefly due to biases in our matching strategy.

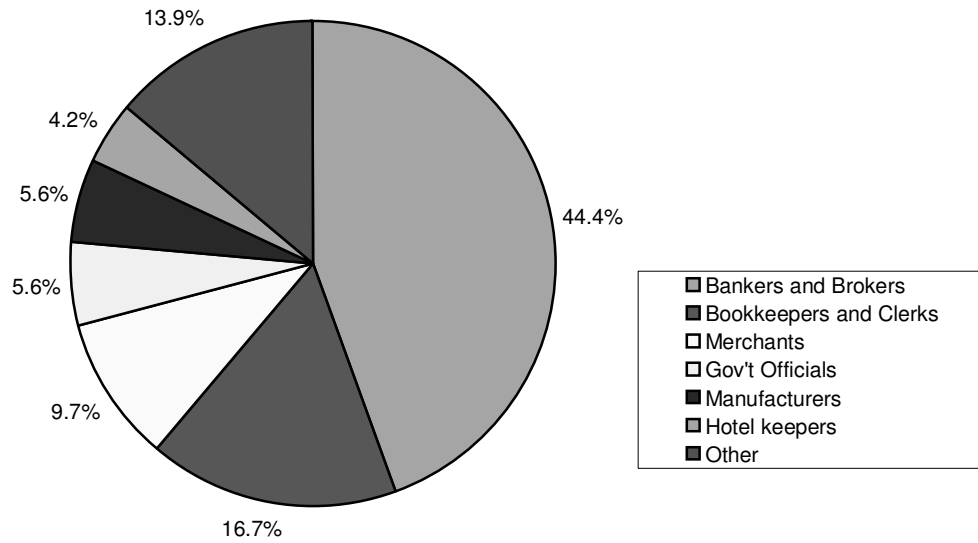
²³ U.S. Bureau of the Census (1904), 456-59.

²⁴ Even for those who could not afford to bet such stakes, election betting was a cherished ritual. In this era, it was widely asserted that one should be prepared to “back one’s beliefs.” *New York World* 14 Nov. 1876 p. 4. Making freak bets – where the losing bettor literally ate crow, pushed the winner around in a wheelbarrow, or engaged in similar public displays– was highly popular. Gilliams (1901) p. 186 stated as “a moderate estimate” in the 1900 election “there were fully a half-million such bets—about one for every thirty voters.” During this period, election nights were social events comparable to New Year’s Eve or major football games. In large cities, crowds filled restaurants, hotels, and sidewalks in downtown areas where the leading newspapers would flash signals by searchlights to relay the latest returns and interested parties would wager on the coming news. For weeks after Election Day, newspapers would run stories of unfortunate losers performing ridiculous stunts to meet their election wagers.

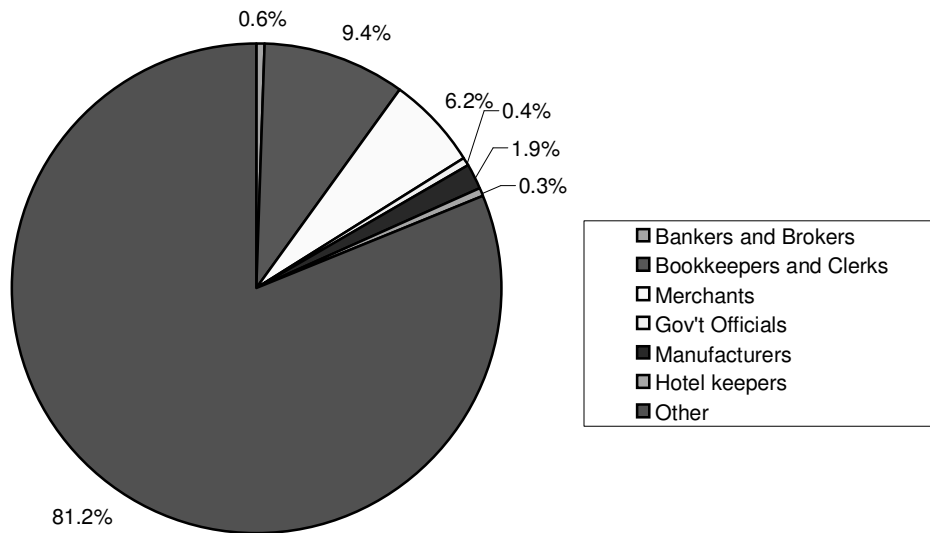
²⁵ The mean year of birth of the 64 matched bettors was 1859.12 and the standard deviation was 12.98. The median was 1859 and the mode, 1876.

Figure 5: Comparing the 1900 Occupation Structure of Bettors with the New York City Male Labor Force

Matched Election Bettors



New York City Males, aged 10 and over



The public wagering of large sums by prominent individuals is all the more notable because organized election betting was of questionable legality. Under New York state laws, it was always legal for private individuals to make casual wagers, although the courts were reluctant to use their powers to enforce such dealings and betting on elections did nominally disqualified the participants from voting in the contest but this prohibition was rarely if ever exercised in practice. In the aftermath of the cancellation of the 1876 election pools, New York outlawed against pool-selling. A more lasting change came under the Hart-Agnew act passed by the New York legislature in the summer 1908. This act outlawed in professional bookmaking employing written bets of 1908, and was extended to cover oral bets in 1910. The prohibition was directed primarily against horse racing (and its Tammany devotees), but also worked to reduce betting on the elections immediately after its passage. The betting commissioners in the financial district initially responded by revising their contract form – creating a memorandum between “friends” to transfer money conditional on the election outcome—and by raising the commission rates to reflect their increased legal exposure. And there was some talk of moving operations to New Jersey and many commissioners reduced or stopped keeping book.²⁶ When the heat came off after a few years, election betting revived. Ironically, in the 1916 contest between President Wilson and Charles Hughes, who as New York Governor had signed the Hart-Agnew act into law, election betting on Wall Street reached its peak.

As the center of national wagering, the Wall Street betting markets were widely recognized for their remarkable ability to predict election outcomes. The *New York Times* put it, the “old axiom in the financial district [is] that Wall Street betting odds are ‘never wrong’.”²⁷ As noted in our earlier paper, the contemporary press noted that the Wall Street betting favorite for President almost always won, with the only exception being in 1916. The ability of the betting market to aggregate information is all the more remarkable given the absence of scientific polls before the mid-1930s. The *Wall Street Journal* contended that the accuracy of betting odds held not only for “national elections

²⁶ *New York Tribune*, 30 Oct. 1908, p. 1. See also *New York Times*, 22 Oct. 1909, p. 1; 11 July 1912, p. 10; 18 July 1912, p. 1. Regarding changes in commission rates, see the *New York Tribune*, 30 Oct 1908 p. 1
²⁷ *New York Times*, 28 Sept 1924, p. E1. See also 30 Oct. 1916, p. 4; 7 Nov 1916, p. 1; 7 Oct 1924, p. 18; 6 Nov 1928, p. 46, 8 Nov. 1932 p. 33; 2 Nov. 1936, p. 20.

but applies equally to state and local races.”²⁸ The odds were “generally considered the *best forecasters* of Presidential elections (emphasis ours),” as well as “good indicators of probable results in gubernatorial and Mayoralty results.”²⁹

Contrary to these sanguine assessments were the frequent assertions that active partisan involvement, especially by Tammany Hall, systematically distorted the betting odds and, in selected instances, speculative attacks and manipulation sought to change the momentum of the races and influence voter turnout. As one example, in closing days of 1926 race for the NY Governor, the campaign of Republican Ogden Mills vocally charged that Al Smith’s backers were resorting to the old Tammany trick of using election wagers as “indirect propaganda.”³⁰ But Tammany was not alone in possessing a betting war chest. Republicans, especially those on Wall Street, purportedly organized funds to finance speculative attacks. As another example, the *New York Times* on 28 Oct. 1904 charged the GOP of manipulating the betting odds in favor of T. Roosevelt in the Presidential race. The historical record is rife with such charges, almost all levied against partisans supporting the favorite. As an example, in 1916, Democrats charged “the money was being sent to Wall street to force the betting odds to Wilson’s disadvantage, for the effect of wider odds would have, especially on up-State farmers, who is the past have been influenced by wagers reported here from below Fulton street. ‘Already,’ one prominent Democrat said, ‘we are hearing that many up-State farmers are struggling between their conscience and fear that Hughes will be elected and it might be found out that they voted for Wilson’”³¹

b. Our Data and Their Implications

To analyze the potential for manipulation and to assess the information-aggregation properties of the New York betting markets in light of such challenges, we have collected betting odds in the New York market on the Presidential, gubernatorial, and Mayoral races over the 1890s to the 1930s. Our sample is drawn from the following

²⁸ *Wall Street Journal*, 27 July 1920, p. 11.

²⁹ *Wall Street Journal*, 17 Aug. 1925, p. 5. See also 27 July 1920, p. 11; 29 Sept. 1924, p. 13. The 1925 article added the betting odds were less accurate guide for offices below Mayor because less attention was devoted to studies the contests for minor offices and little money was wagered,

³⁰ *New York Times*, 17 Oct. 1926, p. XX10.

³¹ *Washington Post* 5 Nov. 1916 p. 1.

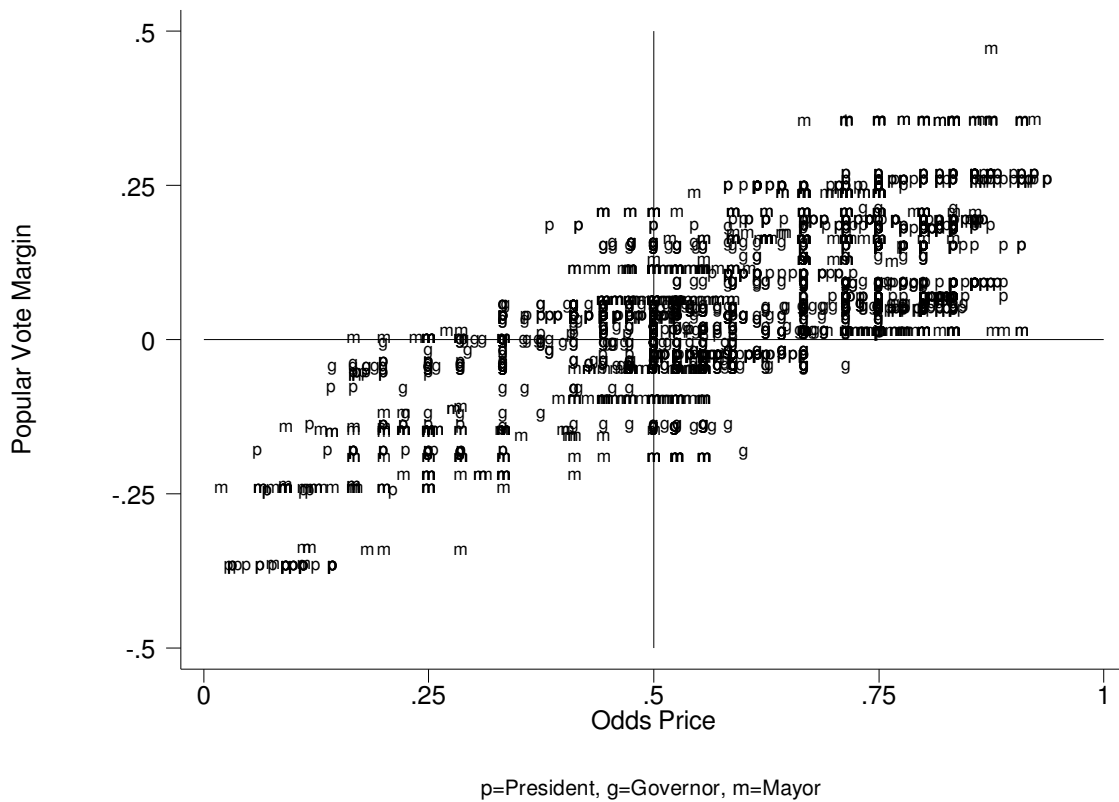
newspapers: *Brooklyn Eagle*, *Chicago Tribune*, *Christian Science Monitor*, *Los Angeles Times*, *New York American*, *New York Evening Journal*, *New York Herald*, *New York Sun*, *New York Times*, *New York Tribune*, *New York World*, *St. Louis Post Dispatch*, *Wall Street Journal*, and the *Washington Post*. Our sample currently includes 3106 daily odds prices for 103 candidate-race-year triplets (that is, a given candidate running for a given office in a given year). The unit of observation is one daily odds price from each newspaper article.³² The sample covers 15 Presidential elections (1880-1940); 21 Gubernatorial elections (which basically occur biennially from 1890 to 1936), and 13 Mayoral races (1890-1937). For those who do not know the players with the program, we survey the NY Mayoral and gubernatorial elections of the 1890-1937 period in Appendix B. With only a few exceptions (1929, 1930), we have observations from most major candidates in every election. One caveat should be borne in mind. We began our sampling with a focus on Presidential election where it was feasible and more efficient in most contests to record the odds price for only one of the two major party candidates. The odds price were typically reported only on the favorite with the underdog's odds, when reported, were simply the inverse of those on the favorite. This practice was not suitable for races for New York Mayor, where having three or more candidates was the rule. For the state and city races, we adopted the conventions of recording all available odds prices.

The market odds price did possess considerable predictive power as the data displayed in Figure 6 indicate. It graphs the popular vote margin received by each of the 108 candidates against the odds prices quoted in the New York market in the 90 days before the relevant Election Day. (For a theoretical justification of this relationship between the odds price and the vote share, see equation A5.) There are multiple observations for candidates because the odds price quotes appeared in multiple newspapers and over many days during the campaign. As we observed early for the Presidential odds prices, holding outcomes constant, the odds prices were generally more

³² That is, we may have several different observations on a candidate's odds price on a given day from different newspapers (or more rarely, from different articles in the same paper.) If a single article reports several wagers, we average to derive that day's single observation. We have made no attempt to eliminate duplication resulting from multiple publications of the same article in different newspapers, as might happen if a wire service ran a story on the state of NY betting markets. We have been careful, however, to date the odds price to the day the betting took place rather than the day of the article and to focus on actual bets rather than mere offers.

definitive, that is, further from 0.5, two weeks before Election Day than four weeks before Election Day. The odds presaged the election outcomes in the vast majority of cases. Ignoring the even-money bets for a moment, 59.6 percent of the quotes were in the northeast quadrant (favorite and popular vote winner), 14.3 percent in the southeast (favorite and loser), 10.1 percent in the northwest (underdog and winner) and 16.0 percent in the southwest (underdog and loser).³³ By this crude measure, in approximately three-fourths of the quotes the market correctly categorized the candidate.

Figure 6: Popular Vote Margin and Odds Price in New York Betting Market



Indeed, if the betting market suffered from imperfections it was the existence of a long-shot bias, a strong tendency to undervalue the favorite candidate.³⁴ This can be illustrated in several ways. First, we can bin the betting observations (from the period 90

³³ The exercise is partially clouded by event such as the 1888 election when Cleveland won the popular vote but Harrison won the Electoral College vote and became President.

³⁴ This is consistent with the finding of a favorite-long shot bias in racetrack pari-mutuels. Richard Thaler and William Ziemba (1988). "Parimutuel Betting Markets: Racetracks and Lotteries." *Journal of Economic Perspectives*. Spring (2:2), 161-174.

days before the election) into intervals and compare the mean odds price with the outcomes.³⁵ These results, which appear in Table 2, show any bet made at an odds price above 0.7 were virtually certain to win and any bet made below 0.3 was virtually certain to lose. Even those bets made in the intermediate ranges of (0.6 to 0.7) and (0.3 to 0.4) appear slightly mispriced. But note there is an inversion in the intervals around 0.5 where those who are slightly favored (think Hughes in 1916 or Herrick in 1904) lose and those who are slight underdogs (Wilson and Higgins, respectively) win.³⁶ The race for NY Mayor, where one would expect Tammany influence was greatest, is the one contest without this inversion at nearly even odds. This analysis needs to be treated with care due to the clustering of the outcomes and the particular way the odds were collected for the Presidential races. The high rate of success of the Presidential candidates in the 0.3-0.4 and 0.4-0.5 bins is chiefly the result of the success of Wilson in the 1916 race.

Second, we can evaluate the *ex post* profitability of employing selected betting strategies. These include either (a) buying contract at the odds prices or (b) betting a dollar on the favorite at every observation in our sample in the 90 days before the election. Note that strategy (a) more closely mirrors the market where as strategy (b) involves greater risks as one is investing relatively more in long-shots. These results are reported in Table 3. The average *ex post* payoffs were positive and large in the races for Governor and, especially, for Mayor, even after subtracting a 5% commission on winnings. The standard errors on individual bets were large and the possibilities for diversifying these risks in a given race were obviously limited. But the impression that the market undervalued the favorite stands. This is pertinent to the discussion of

³⁵ This approach treats each newspaper story as a separate observation. Using daily odds (averaged across the newspapers) yields qualitatively similar findings. The inversion around even odds is slightly muted in the daily average data compared with the disaggregated sample. The betting volume estimates, reported in Figure 4, are more highly correlated with the number of individual stories (correl. coeff. = 0.70, N=28) than with the number of days in which stories appear (0.54). We take this as justification for treating each story as the unit of observation and further note using daily data likely will not change the results presented. Two side notes: (1) in the sample years, the correlation between numbers of stories and days is 0.92; and (2) the number of stories per day tends to rise as Election Day approaches and betting accelerates.

³⁶ One interpretation is that supporters of candidates are willing to “pay too much” to attain the status of front-runner in a close race as well as to make someone with little or no chance appear viable. It is easy to see the enormous payoff in an election of pushing one’s vote share from 49 percent to 51 percent, it is more difficult to understand the value of raising one’s chance of winning from 49 to 51 percent (as opposed to raising it from 54 to 56 percent). It appears being the narrow front-runner is associated with reduced chances of success.

manipulation because most of the discussion of this activity in the historical record suggests it involved over-valuing favorites.

Despite these pricing discrepancies, the odds prices remain highly informative. Adding the log of the odds price in logistic regressions of the candidates' election outcomes substantially increases the explanatory power beyond simply including ex ante observable variables such as the candidate's party and incumbent status. Table 4 reports these results for races for the President, Governor, and Mayor separately. Given the differences in our data collection procedures, it is not meaningful to combine together the races of the different offices. (Note in these regressions, incumbent status is coded as 1 if the candidate is the incumbent for the office, -1 if he is challenging the incumbent, and 0 if there is no incumbent in the race.) The results indicate that the odds prices are informative, if not completely so. Under an efficient markets assumption, the odds prices should capture all commonly available information and, in this case, result in zero coefficients for party and incumbent status. To the contrary, these two variables remain statistically significant in all of the regressions.

c. Studying Charges of Manipulation

We now turn to evaluating whether purported speculative attacks, or more correctly episodes associated public charges of manipulations, induced long-lasting prices movements unwarranted by the fundamentals. Given the available information about the activities of the market agents, we can not state whether intentional manipulation actually occurred, rather only what happened during an episode in which manipulation was publicly charged in the leading papers of the day. In this historical investigation, we are in the same position as being outside observers as in the 2004 *TradeSports* episodes. One difference is that we do know in the historical markets that partisans were actively trading.

To identify the relevant events, we have surveyed the leading New York daily newspapers (with special emphasis on the *Times*) and classified the "manipulation" stories into three categories: (a) charges of intentional manipulation with investors betting to drive odds prices away from the levels justified by fundamentals; (b) charges of wash

Table 2: Comparing Odds Price and Outcomes

Odds Price Range	All Races			President			Governor			Mayor		
	Mean Odds Price	Prob. of Electoral Success	No. of Obs.	Mean Odds Price	Prob. of Electoral Success	No. of Obs.	Mean Odds Price	Prob. of Electoral Success	No. of Obs.	Mean Odds Price	Prob. of Electoral Success	No. of Obs.
90 < x <= 100	0.913	1.000	21	0.914	1.000	16	na	na	0	0.909	1.000	5
80 < x <= 90	0.824	0.994	485	0.826	1.000	410	0.809	1.000	30	0.826	1.000	42
70 < x <= 80	0.740	0.994	510	0.743	1.000	284	0.739	0.990	97	0.736	0.992	128
60 < x <= 70	0.651	0.831	366	0.646	0.722	151	0.654	0.856	139	0.657	1.000	76
50 < x <= 60	0.551	0.374	532	0.550	0.162	198	0.556	0.469	207	0.544	0.551	127
50 = x = 50	0.500	0.574	301	0.500	0.653	124	0.500	0.504	107	0.500	0.543	70
40 <= x < 50	0.448	0.639	291	0.447	0.949	98	0.447	0.519	108	0.452	0.435	85
30 <= x < 40	0.343	0.275	120	0.354	0.920	25	0.342	0.149	67	0.333	0.000	28
20 <= x < 30	0.248	0.000	137	0.231	0.000	28	0.264	0.000	38	0.246	0.000	71
10 <= x < 20	0.144	0.000	73	0.138	0.000	35	0.173	0.000	5	0.147	0.000	33
0 <= x < 10	0.073	0.000	54	0.067	0.000	17	na	na	0	0.076	0.000	37
Total			2890			1386			798			702
Democrat												
90 < x <= 100	0.909	1.000	6	0.909	1.000	1	na	na	0	0.909	1.000	5
80 < x <= 90	0.819	0.970	98	0.841	1.000	53	0.811	1.000	12	0.828	1.000	33
70 < x <= 80	0.738	0.991	224	0.741	1.000	68	0.739	0.976	42	0.735	0.991	114
60 < x <= 70	0.651	0.952	207	0.643	1.000	75	0.651	0.851	67	0.659	1.000	65
50 < x <= 60	0.554	0.380	242	0.545	0.596	52	0.564	0.198	116	0.547	0.514	74
50 = x = 50	0.500	0.525	198	0.500	0.721	111	0.500	0.157	51	0.500	0.444	36
40 <= x < 50	0.449	0.591	198	0.446	0.949	98	0.452	0.140	57	0.452	0.372	43
30 <= x < 40	0.343	0.257	109	0.345	0.411	56	0.341	0.083	48	0.340	0.200	5
20 <= x < 30	0.239	0.012	335	0.237	0.003	307	0.260	0.150	20	0.247	0	8
10 <= x < 20	0.159	0.007	273	0.159	0.008	266	0.173	0	5	0.167	0	2
0 <= x < 10	0.067	0.043	46	0.067	0.043	46	na	na	0	na	na	0
Total			1936			1133			418			385

Table 3: Ex Post Net Winnings of Selected Betting Strategies

		Bet Odds Price		Bet A Dollar		No. of Obs.
		No Vig	Vig	No Vig	Vig	
Betting on the Favorite						
All Races	mean	0.0982	0.0586	0.1106	0.055	1910
	st. err.	0.3518	0.3322	0.598	0.5681	
President	mean	0.0758	0.0356	0.0616	0.0085	1059
	st. err.	0.3274	0.3082	0.5444	0.5172	
Governor	mean	0.0843	0.0482	0.1088	0.0534	473
	st. err.	0.4149	0.3929	0.7089	0.6734	
Mayor	mean	0.1784	0.1362	0.2501	0.1875	378
	st. err.	0.3194	0.3022	0.5689	0.5404	
Betting on the Democrat						
All Races	mean	0.0001	-0.0224	-0.2207	-0.2597	1936
	st. err.	0.3718	0.3492	1.0188	0.9679	
President	mean	0.0187	-0.0002	-0.2798	-0.3158	1133
	st. err.	0.3355	0.3131	1.1324	1.0758	
Governor	mean	-0.1617	-0.1803	-0.3890	-0.4195	418
	st. err.	0.4172	0.3940	0.8450	0.8028	
Mayor	mean	0.1208	0.0834	0.1358	0.0791	385
	st. err.	0.3627	0.3420	0.0791	0.6757	

Note: The Vig is calculated as 5 percent of winning bets

Table 4: Logit Regressions Explaining Electoral Outcomes by Race

Dependent Variable: Victory or Defeat of a Candidate in a Contest

		President		Governor		Mayor	
		(1)	(2)	(3)	(4)	(5)	(6)
Constant	Coeff.	1.028	-1.404	1.361	1.583	-0.764	2.940
	St. Error	0.064	0.139	0.133	0.173	0.118	0.380
Democrat	Coeff.	0.536	2.197	-1.840	-2.876	1.869	-5.088
	St. Error	0.19	0.254	0.166	0.277	0.165	0.670
Incumbent	Coeff.	1.530	1.621	0.491	-0.610	0.374	-4.586
	St. Error	0.109	0.129	0.154	0.234	0.090	0.612
Log (Odds Price)	Coeff.	--	3.652	--	3.134	--	10.738
	St. Error	--	0.174	--	0.312	--	1.249
Log Likelihood		-666.2	-328.4	-461.3	-335.8	-427.9	-118.0
Pseudo R2		0.220	0.616	0.166	0.393	0.140	0.763
No. of Obs.		1560	1560	815	815	727	727
Summary Statistics							
Outcome	Mean	0.762		0.585		0.567	
	St. Dev.	0.425		0.493		0.496	
Democrat	Mean	0.374		0.524		0.552	
	St. Dev.	0.484		0.499		0.498	
Incumbent	Mean	0.232		0.107		0.139	
	St. Dev.	0.810		0.588		0.685	
Log (Odds Price)	Mean	0.659		0.206		0.023	
	St. Dev.	0.908		0.623		1.053	

Notes:

Standard Errors are robust; In eq. (6), 44 failures and 5 successes are completely determined.

bets, that is, of bets made between confederates at non-market odds for publicity purposes; and (c) charges of bluffs, that is, offers to make bets at non-market odds which are withdrawn when the offer is accepted. In this exercise, we have employed both computer keywords searches using Proquest.com and extensive reviews of thousands of printed newspaper stories by the authors and their disinterested RAs. We do not record episodes of partisan involvement, which are as noted commonplace. We do record the direction of the “manipulation” (i.e. in favor of the Republican’s or Democrat’s odds) but not the sources of the activities or of the charges. In 1916, for example, stories circulated charging a politically unaffiliated financial agent of manipulating the Presidential odds for purposes of influencing asset prices. Charges were advanced by participants in the betting markets, those in related financial markets, by newspaper writers, as well as the supporters of the electoral campaigns involved.

One might think that such charges are “cheap talk” and would be as ubiquitous as stories of partisan involvement or stories of voting fraud. But there were not. Rather such charges were relatively rare, with only about 2 percent of days with reported betting odds include charges of intentional manipulation. One reason that charges were not made more frequently is that the election cycles represented repeated games and the making unsubstantiated charges of manipulation would adversely affect one’s reputation and the credibility of one’s future charges.

Our investigation finds there were charges of 36 manipulation/wash sale/bluffing events during our sample period, spread out over 48 days. Of these alleged events, 11 days involved full-blown manipulation of the odds in favor of the Democrats and 9 manipulations in favor of the GOP. There were 5 days of wash sales and bluffs in favor of the GOP and 23 in favor of the Democrats. (Of these minor charges regarding the Democrat odds, 18 were bluff betting, the so-called “Old Tammany Trick.”) 11 of the days involved the Mayoral race; 15 the Governor’s race; and 22 the Presidential race. Most of the alleged events occurred in the month before Election Day--the mean was 10.7 days before voting began. One accusation was 103 days before Election Day; the median event was 6 days, that is, in the final week of the campaign. The average odds price on the candidate whose prices was driven up were marginally above even odds..

Given the nature of the historical data and the alleged manipulation events, we must make several adjustments to the event-study methodology employed in the *TradeSports* section. First, our historical observations are of lower frequency but from multiple sources. Our data will be the daily odds prices quoted in the available newspapers. The rate of return data will be based on changes in the daily averages.³⁷ Second, the alleged historical manipulations do not all occur for a single candidate nor do they all push in the same direction. Our approach will to investigate the separate effects of the Republican and Democratic “attacks” on the “Democrat’s price.” Given data availability and a desire to avoid duplication, we will use the price quotes for the favorite candidate in each race. Where the favorite is the Democrat, the prices will be used directly; where the favorite is not the Democrat, we will define the “Democrat’s price” as one minus the favorite’s price. (Only in the 1924 race does this procedure create any problems.) Third, to control for such issues as well as the drift in prices predicted by the model in the appendix, we add race-specific dummy variables in the regressions predicating the daily rates of return. Inclusion of these variables implies that the measured effects of manipulation apply only to a short post-event window. Given that many of the alleged manipulations occurred in the last week of the campaign, the window must be narrow in any case. We will analyze the course of returns over the week after the charges are made. Finally, given that some of the events have overlapping effects, we must structure the pre-event and post-event windows appropriately. If a new manipulation event occurs within the window of an existing event, we model the new event as absorbing all of the latter effects. But we also drop the days before the new event from estimation of the pre-event horizon do prevent contamination by the prior manipulation.

For the purposes of this paper, we will focus on the full-scale charges of manipulation. Our analysis examines these effects for the Presidential race and for all

³⁷ We have no effort made at this preliminary stage in the analysis to control from differences or biases in the newspaper sources. Previous analysis, not reported here, suggests the partisanship of the newspapers is revealed primarily in whether they publish betting market stories not in the odds prices quoted in the stories they do publish.

For a day when the average daily price is available, we calculate the daily rate of return as $(\text{daily odds price} - \text{last available daily odds price}) * 2 / ((\text{daily odds price} + \text{last available daily odds price}) * (\text{days between quotes}))$. In the period around the alleged manipulation events, prices are typically available every day except Sunday.

races combined. (The complete absence of charges of manipulation in favor of the GOP for the Mayoral races and the paucity of charges in favor of the Democrat for Governor creates difficulties for investigating the races for each office separating.) Table 5 reports the results for the “democrat” rate of return regressions while Table 6 reports those for price level regressions. The effects may be more easily interpreted using the associated Figure 7 shows the movements in the “democrat” odds prices, which includes the error bounds.

One preliminary note about timing: A purported attack is typically dated to occur one day before the newspaper allegation is published. This places it in line with the odds published on that day. As will become apparent, the price moves associated with an allegation may precede publication by more than one day. And we cannot rule out the possibility that a genuine information shock drove the price movements. It is important to note, however, that the story containing the allegations was written before the prices of the current day were revealed.

The effects associated with a charge of a “Republican attack” on the President market may be described as follows. The Democrat price over days -7 to -2 was below the baseline, but is generally flat. In the day before alleged event, the odds price fell by over 3 points and on the day of the event they fall another 2.5 points. The prices remained at the level the following day and the difference from the level earlier in the week is statistically significant. On days 2 and 3, however, the Democrat price recovered. These were the two days immediately following publication of the charges. Prices fell back into the range that can be statistically distinguished from the pre-event prices. Over the remainder of the week, the Democrat price trended back down. The effects associated with a charge of “Democrat attack” in the Presidential market were somewhat different. Prices were more volatile in the period before the charges. Over the day of the alleged attack and the next day, prices jumped about 12 points. But they fell back down by day 2 and in the in the week following were not consistently outside of the range prevailing over the week before the attack. Examining the effects of Democratic attacks on the Presidential market is made more difficult because charges are few in number and often less than definitive in terms of timing.

Table 5: Effect of Manipulation Charges on Daily Democratic Rate of Return and Odds Prices

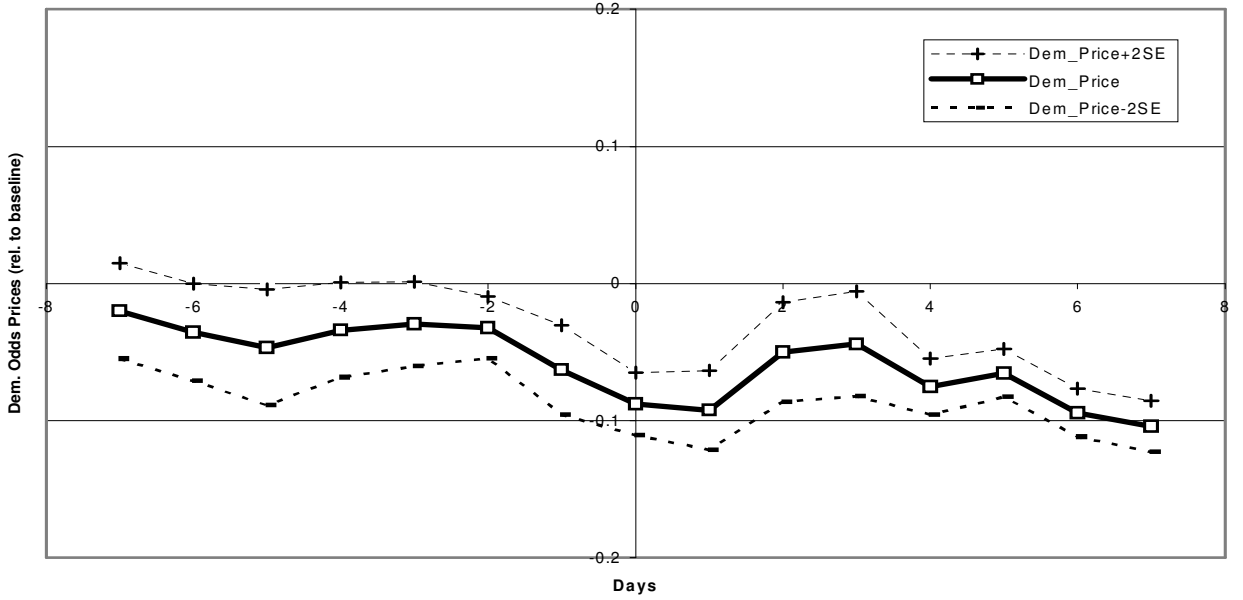
Event Alleged "Occurs" at Day 0

Days Until Charge		Daily Rate of Return				Daily Odds Prices			
		Presidential Races		All Races		Presidential Races		All Races	
		Rep.	Dem.	Rep.	Dem.	Rep.	Dem.	Rep.	Dem.
-7 Days	Coeff.	-0.066	0.077	-0.046	0.029	-0.020	0.090	-0.014	-0.005
	St. Err.	0.033	0.005	0.031	0.018	0.017	0.028	0.017	0.027
-6 Days	Coeff.	-0.036	-0.071	-0.020	-0.025	-0.036	-0.116	-0.021	-0.033
	St. Err.	0.028	0.010	0.027	0.019	0.018	0.009	0.017	0.017
-5 Days	Coeff.	-0.024	0.027	-0.013	0.029	-0.047	0.010	-0.023	0.003
	St. Err.	0.016	0.043	0.015	0.033	0.021	0.031	0.022	0.017
-4 Days	Coeff.	-0.056	-0.024	-0.052	-0.020	-0.034	-0.040	-0.022	-0.034
	St. Err.	0.062	0.015	0.050	0.013	0.017	0.032	0.017	0.014
-3 Days	Coeff.	-0.042	0.011	-0.051	-0.021	-0.029	-0.008	-0.020	-0.039
	St. Err.	0.019	0.007	0.017	0.024	0.015	0.034	0.014	0.016
-2 Days	Coeff.	0.000	-0.023	-0.013	0.032	-0.032	0.065	-0.023	-0.013
	St. Err.	0.033	0.005	0.028	0.039	0.011	0.022	0.010	0.023
-1 Days	Coeff.	0.007	0.012	0.002	0.013	-0.063	-0.036	-0.056	-0.032
	St. Err.	0.029	0.016	0.023	0.038	0.016	0.023	0.016	0.013
Day 0	Coeff.	-0.090	0.026	-0.087	-0.003	-0.088	0.045	-0.081	0.001
	St. Err.	0.045	0.031	0.041	0.029	0.011	0.030	0.011	0.014
1 Days	Coeff.	0.042	-0.004	0.043	0.027	-0.092	0.114	-0.090	0.044
	St. Err.	0.076	0.020	0.076	0.029	0.014	0.036	0.014	0.023
2 Days	Coeff.	-0.010	0.007	-0.009	0.021	-0.050	0.024	-0.047	0.035
	St. Err.	0.043	0.016	0.043	0.017	0.018	0.035	0.018	0.019
3 Days	Coeff.	0.034	-0.022	0.035	-0.001	-0.044	0.050	-0.041	0.044
	St. Err.	0.016	0.009	0.016	0.013	0.019	0.029	0.019	0.021
4 Days	Coeff.	0.006	-0.007	0.007	0.017	-0.075	0.040	-0.072	0.043
	St. Err.	0.012	0.020	0.012	0.024	0.010	0.028	0.010	0.023
5 Days	Coeff.	0.061	-0.021	0.062	-0.017	-0.065	-0.002	-0.062	0.001
	St. Err.	0.012	0.010	0.012	0.009	0.009	0.012	0.009	0.010
6 Days	Coeff.	-0.148	-0.035	-0.147	-0.023	-0.094	-0.010	-0.091	-0.006
	St. Err.	0.012	0.010	0.012	0.012	0.009	0.010	0.009	0.008
7 Days	Coeff.	-0.051	0.016	-0.050	-0.011	-0.104	0.006	-0.101	0.001
	St. Err.	0.012	0.010	0.012	0.023	0.009	0.014	0.009	0.012
No. of Obs.		610		1031		1328		2221	
R2		0.067		0.059		0.0887		0.0898	

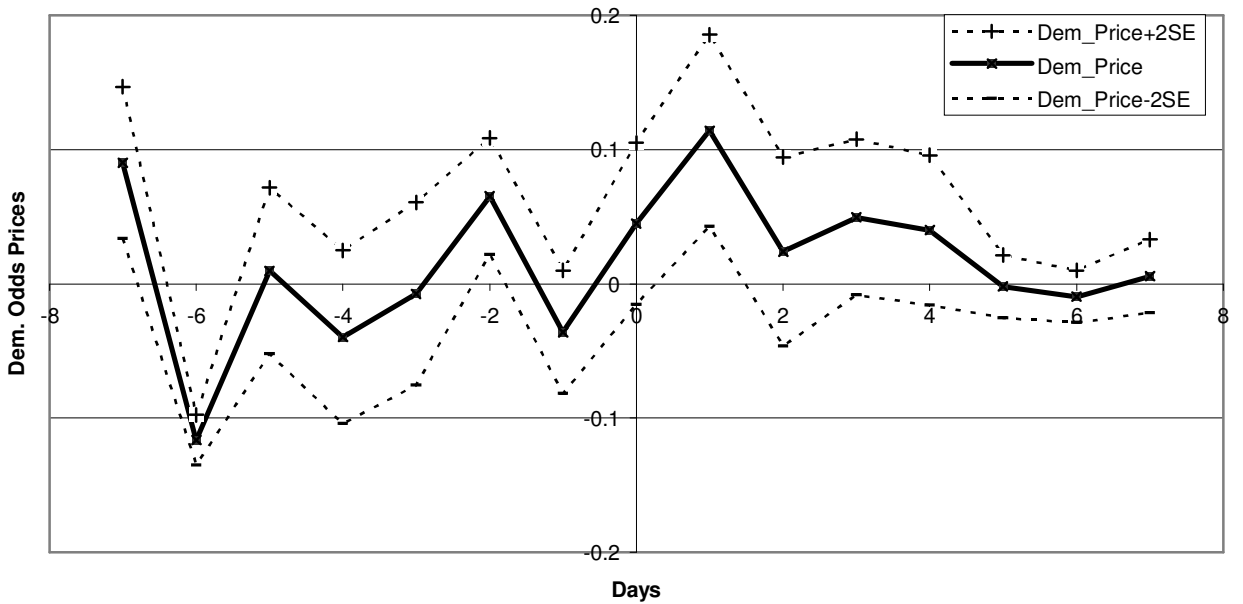
Notes: Standard Errors are robust. Regressions include campaign-specific dummy variables which are not displayed.

Figure 7: Timepaths of Price Effects of "Speculative Attacks" on Presidential and All Races

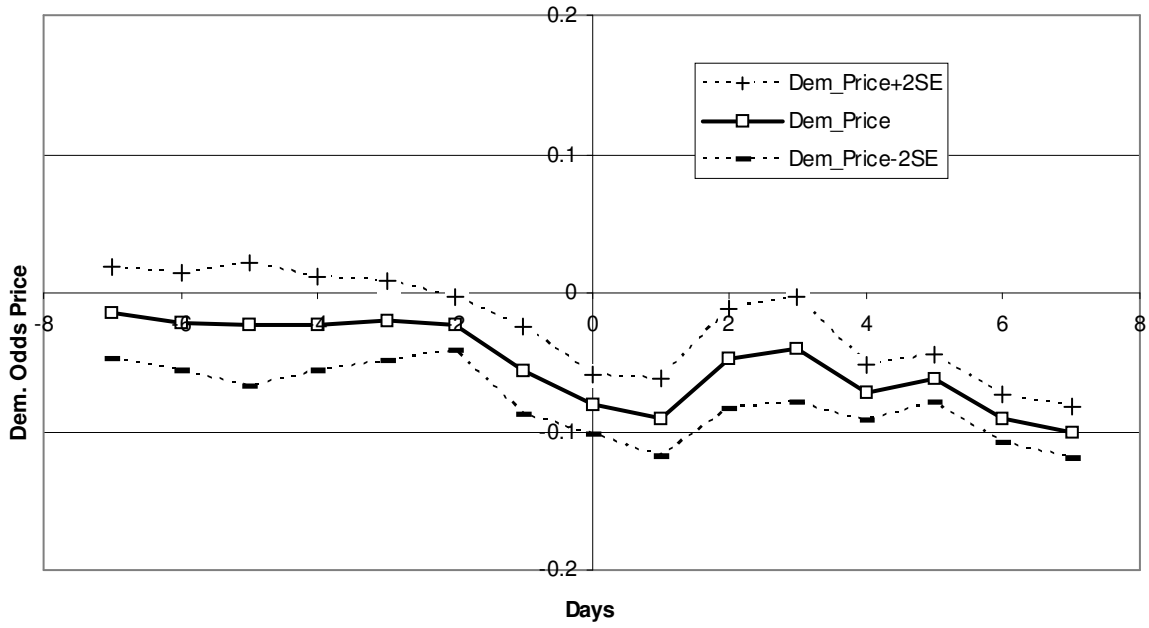
Price Effects of "Republican Manipulation," Presidential Races Only



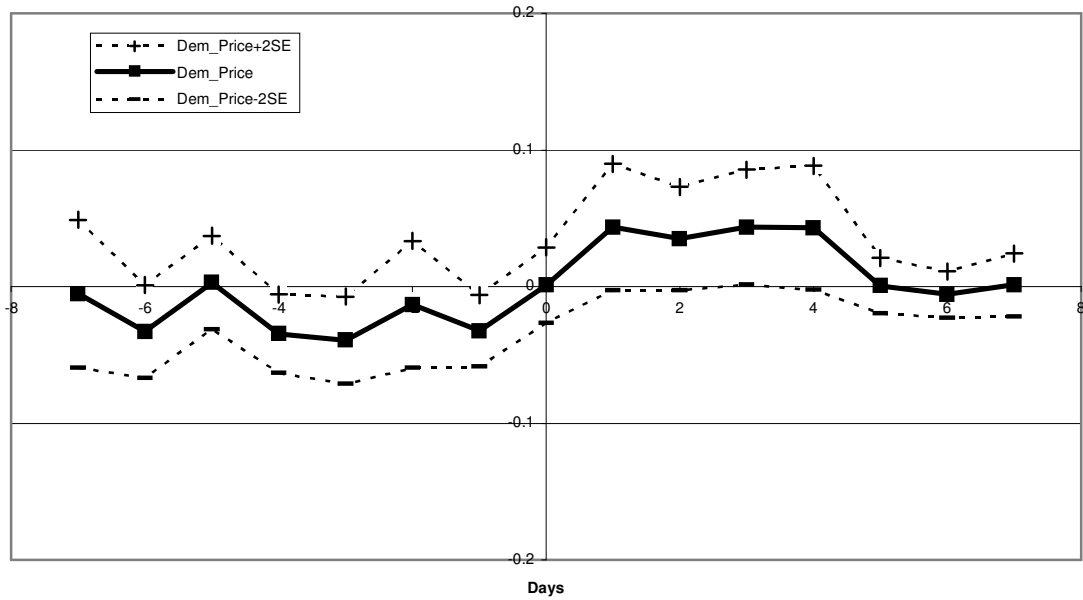
Price Effects of "Democratic Manipulation," Presidential Races Only



Price Effects of "Republican Manipulation," All Races



Price Effects of "Democratic Manipulation," All Races



Turning to an examination of “attacks” in all races may remedy this problem because allegations of Democratic attacks in the Mayoral and gubernatorial races are far more common. The pattern for Republican attacks in all races is similar to that in Presidential races. Prices were low but stable up until the day before the charge, then jumped down over the three days around the event and then bounced back up. The pattern for Democrat attacks is smoother than for the Presidential races alone. Again there is a rise over the day of the “attack” and day 1. Prices remained up, above the range in the following week through day 4 and then fell back into this range. Nothing in these patterns suggests that manipulation events led to large, irreversible changes in prices. Examining the effects of charges of bluffs and wash bets may counter, of course, these findings.

As a summary, our analysis of the historical record indicates that: (1) A large betting market could operate despite (because of) the active participation of partisans. The betting odds in this market possess considerable predictive power; (2) The prediction markets were not fully efficient. There is evidence of a long-shot bias and of subtle pricing discrepancies around even odds; and finally (3) events tied to public charges of manipulations were not associated with significant unwarranted changes in the odds prices.

Our analysis of manipulation in the *TradeSports* futures and the historical New York betting markets is limited because we are in the position of outside observers. We do not know the motivations of the investors who are affecting the price shifts. A field experiment conducting in the Iowa Electronic Market (IEM) in 2000, however, offers us the unique perspective of being insiders with knowledge about the timing and magnitude of a series of trades being made for reasons unrelated to changes in the fundamentals.

V. Iowa Electronic Market (IEM): Field Experiment

a. Background

The IEM is a real-money futures market operated by the Henry B. Tippie College at the University of Iowa.³⁸ It is currently the sole legal site in the US to trade in political information futures. Its operations differ from either *TradeSports* or the New York betting markets because participants are limited to relatively modest stakes (\$5 to \$500). The IEM's clientele tends to be a select group: highly educated, youngish, predominately male, employed with academic or research job (Oliven and Rietz, 2004).

In the IEM Presidential markets, there were two forms of contracts: Winner-Take-All (WTA) and vote share (VS) contracts. Both assets were available for the Democratic candidate (DEM), the Republican (GOP), and the Reform party (REF). The VS contract was akin to a point-spread wager in sports betting and paid conditional on the size of the candidate's plurality of the vote. The IEM WTA contract was like a win-loss contract in sports betting but with one important difference. It paid off for the candidate who received the largest absolute vote, not the candidate who was actually elected president.

This created much confusion on election night 2000 when the popular vote went for Gore but the Electoral College vote was projected for Bush. Figure 8 charts the gyrations of the IEM WTA contract on the night of 7 Nov. 2000 and morning of 8 Nov. According to the IEM definitions, Gore won the 2000 contest for both the VS and WTA contracts. Yet when the major networks proclaimed that Bush had won the Electoral College at 1:20AM CST, the price of his shares rose to near a dollar. At this point it was already apparent that Bush was going to lose the popular vote (he was slightly behind in the VS market at midnight of 11/8), and he fell behind in the official aggregate vote tallies between 3:30 and 4:20AM CST. At this point, there was little uncertainty with regard to the IEM contracts and yet the prices were the exact opposite of where they should be. This is consistent with traders incorrectly believing the WTA contract was based on the Electoral College. The market slowly reversed itself and (the day after the election) the correct price was offered.

³⁸<http://www.biz.uiowa.edu/iem/>

This definition of the IEM WTA contract differs from that “Winner-Take-All” contracts prevailing in the historical markets and in *TradeSports* 2004 presidential futures markets. It does create the useful analytical feature that both the VS and WTA prices are linked directly to the same fundamental variable, the final vote share. This implies there exists an equilibrium relationship between the prices under efficient markets and that one price can serve as “control” for the other.³⁹

b. Experiment

During the summer and fall 2000, one of the authors engaged in a series of controlled uninformative trades, “manipulative attacks,” in IEM presidential markets. The trades followed a formalized protocol.⁴⁰ The attacks involved randomly investing real money in one or both of the WTA and VS contracts, with the side -- DEM or GOP -- determined based on hundredth digit of Dow day before. There were 11 planned “attacks,” roughly 10 days apart, starting 110 days before the election. The trades were typically executed in 15-30 minutes in a trading window time running between 8 pm and 11:15pm CST. These times are late in the day when volume is relatively light and few traders are likely to be actively monitoring the market. Since prices may stay distorted until the next morning when more traders come online, the experiment errs towards finding evidence of manipulation.

The dates of the trades are displayed in the text table below.

WTA	7/20	8/28	10/3	11/4
VS	{7/30}	{9/11}	10/14	
WTA+VS	8/10	9/20	10/23	
Sell All Holdings	10/28	(\$566 sold)		

As the table indicates, the experimental design involved three types of trades, investing in the WTA contract alone; the VS contact alone; and in both the WTA and VS contracts.

³⁹The Appendix shows this relationship is,

$$\text{price}_t^* = \text{price}_t^{\text{VS}} / \sigma_{vt}$$

where “*” indicates an inverse normal transformation and is σ_{vt} is a measure of uncertainty t periods before the election. In previous IEM markets a rough measure is $\sigma_{vt} = 0.05 + 0.007 \times t^{0.5}$.

⁴⁰ The procedures are codified in official trade strategy document, *iowa.strategy.2b.doc*, which is available on the author’s web page There was also an outside board which received this document prior to the execution of any trades.

The idea was that a trader with fresh inside information would likely invest in both markets whereas, perhaps, a non-financially motivated trader might invest just in one.⁴¹ The two markets also help us distinguish between three leading hypotheses about the market response that are summarized in the table below.

	Markets Not Monitored	Hypotheses	
		Beliefs Change Markets Monitored	Beliefs Unchanged Markets Monitored
Attack Market M_1	(↑,0)	(↑,↑)	(↑↓,0)
Attack Markets M_1 and M_2	(↑,↑)	(↑,↑)	(↑↓,↑↓)

Hypotheses Regarding Market Participant Behavior: Field Experiment

The cells are predicted responses in markets (M_1, M_2) following the speculative (purchase) attack listed in the left-most column. “↑” indicates an increase in asset price, “0” indicates prices do not change, and “↑↓” indicates an increase followed by decrease in asset price.

As the cells indicate, the price movements in the two markets allow us to distinguish between the hypotheses using simply a one-market attack. Recall that both the VS and WTA markets are linked to the same fundamental (final vote shares), so under efficient markets there should be an equilibrium relationship between the markets. If the attacks alter market beliefs, then when only one market is attacked prices in the unaltered market (the control market) should also move. If beliefs are altered (or if markets not monitored) than the control market should be unaffected. While attacking both the markets does not provide a clean test, this case is still interesting since as we mentioned it may more realistically depict the investment of an insider with private information.

The investments were made as follows. For WTA contracts, if it was randomly determined (by the Dow) to buy GOP, then an initial investment of \$160 was used to purchase this contract at market prices. (The strategy also allowed the alternative of buying the entire slate and shorting DEM if that was cheaper.) In addition, supporting limit orders were placed for \$80 to buy GOP at \$.006 below last Ask and \$80 to sell DEM at \$.006 above last Bid. (These expired in some cases.) If the trade involved a VS contract, the procedure was identical but for one-half the amount.

⁴¹The one exception is an event which creates greater uncertainty but does not favor one candidate or the other. In this case the price of the favorite should decline in the WTA market but not the VS (see the model in the Appendix).

Given the nature of the IEM, the size of these investments was large relative to total trade volume. This meant that they had the potential to alter prices. An aggregate sum of \$3116 was wagered, which equaled 2 percent of total IEM trade volume. The largest trade of a VS contract was 3 percent of the current market cap while that of the WTA contract was 2.7 percent. Note that the relative size of fixed-sum trades declined over time as the market expanded. The individual trades were large relative to daily trading volume. The trades represented 181 percent ($=\$120/\66) of average daily volume in the VS market and 28 percent ($=\$240/\870) in the WTA market.

The initial price changes after the trades were generally large, comparable to daily range of trading. To provide perspective, the average *intraday* price range was 0.5 cents for the VS contracts and 3.8 cents for WTA and the average price range in hour before trades were about 0 cents for VS contracts and 0.5 cents for the WTA. The price changes 30 minutes after the controlled trades were 0.3 cents for the VS and 2.5 cents for the WTA. That is, the changes were much larger than in the prior hour and roughly 60 percent of the intraday range. As an example, Figure 9 illustrates the time path of prices following the 10/28 manipulation. Note, however, that two of the trades, the VS investments on 7/30 and 9/11, did not noticeably change prices, and these cases will not be considered in the main analysis.

The data collection was collected from trader accounts, which provide basic statistics on each asset at any time: last, bid, ask, high, low. The web page updates the information every 15 minutes. Information was collected for one hour or more before the trades and for several hours after trade. Joyce Berg has kindly shared with us additional IEM data to supplement this investigation.

c. Results

We aggregate the data into fifteen-minute periods (the frequency at which the price screen is refreshed in the IEM trading screen). The two attacks (7/30 and 9/11) which had a negligible effect on prices are omitted, leaving nine attempted manipulations to analyze. When the attack called for shares to be sold, we take the negative of prices. This ensures the attacks are aligned, with each case seeking to increase prices.

We begin the analysis by focusing on the markets that are attacked (rather than the control market). Rates of return are calculated based on the last traded price in each period. These are used to generate cumulative returns (CR) beginning six periods (an hour and a half) prior to the start of each manipulation. Mean values for the attacked contracts are presented in Figures 10 - 13 and Table 6. Figure 10 shows the values for the full sample of successful attacks. There is little trend in the return prior to the attack ($t=0$), which suggests the attacks were not reinforcing some pre-existing price trend. CR's spike up in the first period, reflecting the large change in prices associated with attacks. There is about a five percent rate of return in the half hour following the attack ($t=0$ and $t=1$). The return is large and positive in the second period ($t=1$), since some of the manipulations took more than fifteen minutes to execute. About forty-five minutes ($t=3$) after the attacks began, the cumulative returns began to decline. This continues for the next three hours (until $t=15$) at which point the CR has nearly returned to its pre-attack level. Table 7 uses the formula for the standard error of CR to show that there is a statistically significant effect only for the first two periods. The relatively rapid unwinding of the attacks is impressive given that they occur during low volume periods, as discussed earlier.

The other figures consider various subsets of attacks. Figure 11 shows the average CR for the first four attacks when market capitalization was much smaller.⁴² There is a more muted initial effect in these attacks, since the largest attack on 10/28 is omitted. The returns also drift up for a full after the attack (until $t=4$), which partly reflects the slower execution of all of our trades in these thinner markets. Still the CR rapidly drops off and returns to its pre-manipulation level in a little over two hours ($t=9$). Figure 12 has mean CR for the four WTA-only attacks. The returns spike up even more sharply following the attack, with a seven percent return in the first half hour. The mean CR stays at an elevated level for about two hours (until $t=8$), at which point there is a large reversion. As with the overall sample of attacks, the attack is basically fully undone within four hours ($t=15$). The one case where the attacks seem to have a lasting effect is when both markets are attacked. The CR remains one and a half points above its initial

⁴²In the WTA market, the capitalization was 9103 just prior to the first attack (7/20) and 71521 prior to the last attack (11/4).

level even four hours after the attack, and Table 6 shows it remains elevated a day later ($t=90$). This makes sense, since we have already argued that an insider would prefer to attack both markets if he really knew there was a change in the fundamentals. Hence market participants would lend more credence to this sort of attack, though a caveat is that the CR is statistically significant only until $t=3$.

A final piece of evidence supports the notion that investors realized that the attacks were non-informative. Recall that prices in non-attacked control market should not move if market beliefs are unchanged. Figure 14 and Table 6 show the mean CR for these control markets. While there is a small response in the period *after* the attacks, the price change is not statistically or economically significant (it increases less than one percent). Moreover, the CR becomes negative (and still small) within forty-five minutes ($t=3$) at which point we have already seen the returns are still positive in the attack market. In general there is little price change in the control markets which is consistent with the claim that the attacks did not move beliefs.

Table 7 presents these numbers in another way. It considers the per period rate of return at various points. The regression is,

$$(2) \quad R_{mt} = \sum_{s \in [-6, 75]} \alpha_s I(t_m=s) + \varepsilon_m$$

where R_{mt} is the rate of return t periods after manipulation m starts and $I(t_m=s)$ are period dummies. The α_s parameters give the typical rate of return, s periods following the manipulation. In very case the action is concentrated in the first few periods. There are positive and significant returns in the first half hour ($t=0$ and $t=1$), which are offset with negative returns over the next few hours. These estimates reinforce the earlier discussion.

The field experiment involving the IEM 2000 election provides a unique opportunity to investigate the market responses to uninformative trading. Eleven large trades were made at times and in directions unrelated to changes in fundamentals and nine had a significant initial impact on the IEM prices. But over a short period of time, all of these attempted manipulations were largely undone by other traders. The changes in the WTA may be partial exception, because they were never fully undone. In total, these results suggest that the long-term market dynamics were not influenced by uninformative trading.

Table 6: Mean Cumulative Return, By 15-Minute Intervals After Manipulation

	Successful Manips	Early	WTA Only	Both Markets	Control Markets
σ	1.332	0.865	0.982	0.845	0.453
t:					
-1	0.568	1.884	1.064*	0.083	0.043
0	3.815*	1.864*	4.141*	3.854*	0.061
1	5.221*	3.561*	6.845*	4.201*	0.576
2	5.338*	3.466*	6.856*	4.425*	0.784
3	4.611	3.680*	6.278*	3.478*	-0.661
4	4.748	3.774*	6.466*	3.588	-0.695
5	3.792	3.058	5.567*	2.462	-0.703
6	3.642	2.817	5.224*	2.462	-1.135
7	3.600	2.829	5.121	2.473	-0.830
8	3.372	2.629	4.806	2.299	-0.828
9	2.710	1.438	3.501	2.122	-0.825
10	2.499	1.424	3.013	2.133	-0.797
15	1.507	1.293	1.355	1.628	-0.737
30	1.854	1.473	2.204	1.665	-0.579
45	2.138	1.195	3.261	1.347	-0.423
60	1.451	0.797	1.978	1.330	0.505
90	-0.085	0.977	-1.603	0.950	1.203

Notes: Returns are calculated in percentage terms. The cumulative return (CR) is started at $t=-6$ where $t=0$ is the beginning of the manipulation. σ is the per period standard error for ROR while the standard error for CR_t is $(t+1)^{-0.5}\sigma$. “*” indicate statistical significance at the 95% confidence level.

The column headers indicate the sample:

- “Successful Manips” excludes the two attacks (7/30/2000 and 9/11/2000) where there was little initial price change. The nine remaining attacks are included.
- “Early” includes the first four successful manipulations (7/20/2000, 8/10/2000, 8/28/2000, 9/20/2000).
- “WTA Only” restricts the sample to the four cases where WTA only was attacked (7/20/2000, 8/28/2000, 10/3/2000, 11/4/2000)..
- “Both Markets” includes the four manipulations where both markets were attacked (8/10/2000, 9/20/2000, 10/23/2000, 10/28/2000).
- “Control Markets” include the non-attacked market in the successful manipulations (7/20/2000—VS, 8/28/2000-VS, 9/11/2000-WTA, 10/3/2000—VS, 10/14/2000—WTA, 11/4/2000-VS).

Table 7: Mean Rate of Return Regression, 15-Minute Intervals

	Successful Manips	Early	WTA Only	Both Markets
α_{-5}	0.051 (0.372)	0.107 (0.114)	0.102 (0.760)	0.036 (0.128)
α_{-4}	0.030 (0.372)	0.105 (0.114)	0.101 (0.760)	-0.011 (0.128)
α_{-3}	0.029 (0.372)	0.105 (0.114)	0.099 (0.760)	-0.011 (0.128)
α_{-2}	-0.393 (0.372)	0.105 (0.114)	-0.746 (0.760)	-0.011 (0.128)
α_{-1}	-0.257 (0.372)	0.078 (0.114)	-0.471 (0.760)	-0.015 (0.128)
α_0	3.287* (0.372)	0.058 (0.114)	3.060* (0.760)	3.777* (0.128)
α_1	1.376* (0.372)	1.776* (0.114)	2.686* (0.760)	0.331* (0.128)
α_2	0.087 (0.372)	-0.016 (0.114)	-0.006 (0.760)	0.210 (0.128)
α_3	-0.757* (0.372)	0.292* (0.114)	-0.596 (0.760)	-0.963* (0.128)
α_4	0.107 (0.372)	0.173 (0.114)	0.171 (0.760)	0.094 (0.128)
α_5	-0.986* (0.372)	-0.638* (0.114)	-0.916 (0.760)	-1.140* (0.128)
α_6	-0.181 (0.372)	-0.162 (0.114)	-0.360 (0.760)	-0.015 (0.128)
α_7	-0.073 (0.372)	0.091 (0.114)	-0.119 (0.760)	-0.004 (0.128)
α_8	-0.258 (0.372)	-0.123 (0.114)	-0.333 (0.760)	-0.189 (0.128)
α_9	-0.692 (0.372)	-1.112* (0.114)	-1.322 (0.760)	-0.192 (0.128)
α_{10}	-0.241 (0.372)	0.064 (0.114)	-0.505 (0.760)	-0.004 (0.128)
α_{15}	-0.453 (0.372)	0.091 (0.114)	-0.730 (0.760)	-0.230 (0.128)
α_{30}	0.008 (0.372)	0.107 (0.114)	0.058 (0.760)	0.001 (0.128)
α_{45}	-0.183 (0.372)	-0.323* (0.114)	-0.013 (0.760)	-0.325 (0.128)
α_{60}	-0.641 (0.372)	-0.029 (0.114)	-1.724* (0.760)	-0.016 (0.128)
α_{75}	-0.398 (0.372)	0.078 (0.114)	-0.912 (0.760)	-0.093 (0.128)

Notes: This is an estimate of equation (2) where the dependent variable is the rate of return. Standard errors are listed in parentheses below the estimates. “*” indicate statistical significance at the 95% confidence level.

Figure 8: IEM 2000 WTA Market: Day After Election (time in CST)

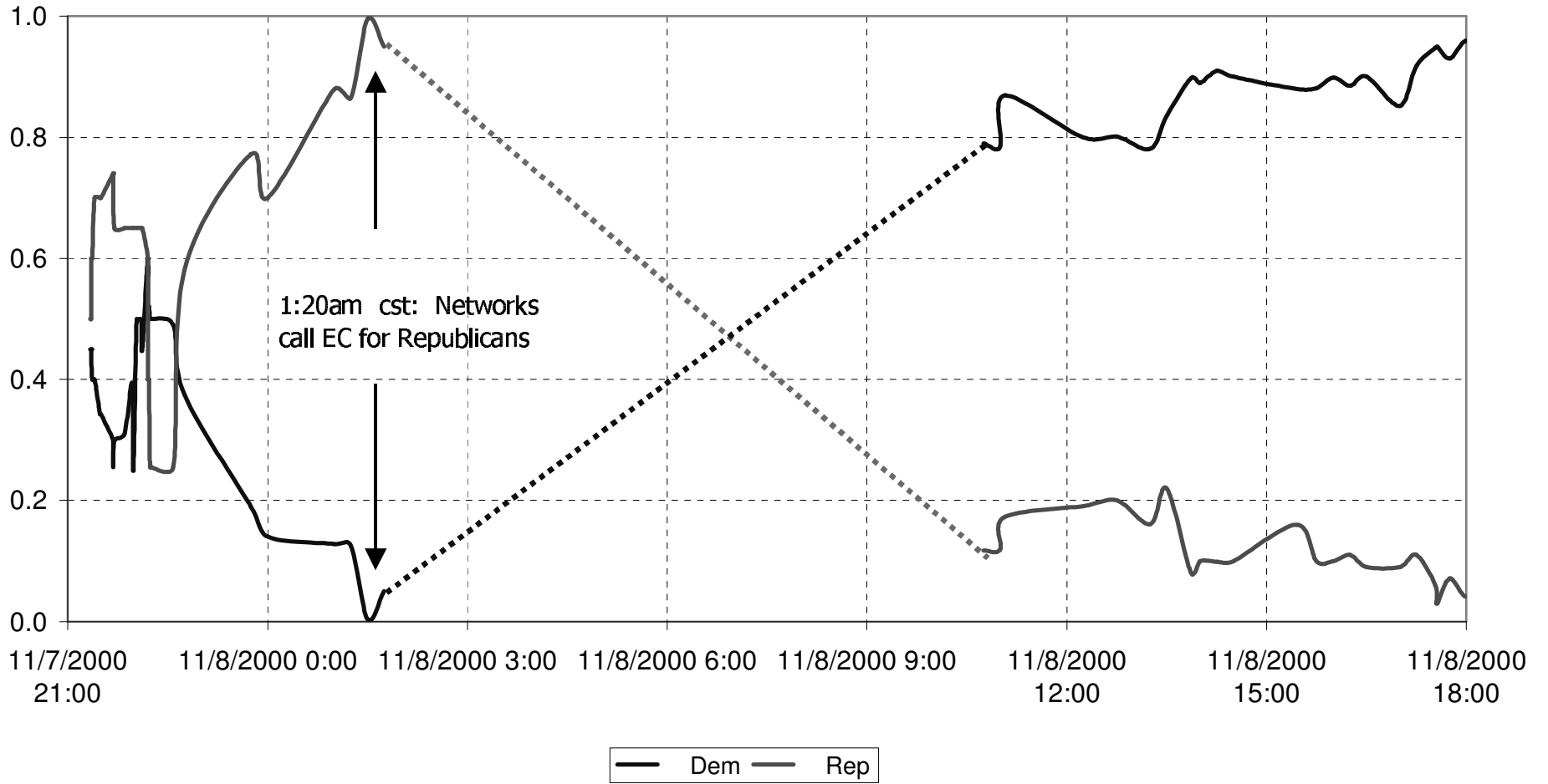


Figure 9: IEM 2000: 10/28/00 Manipulation (Sell Democrats in WTA+VS)

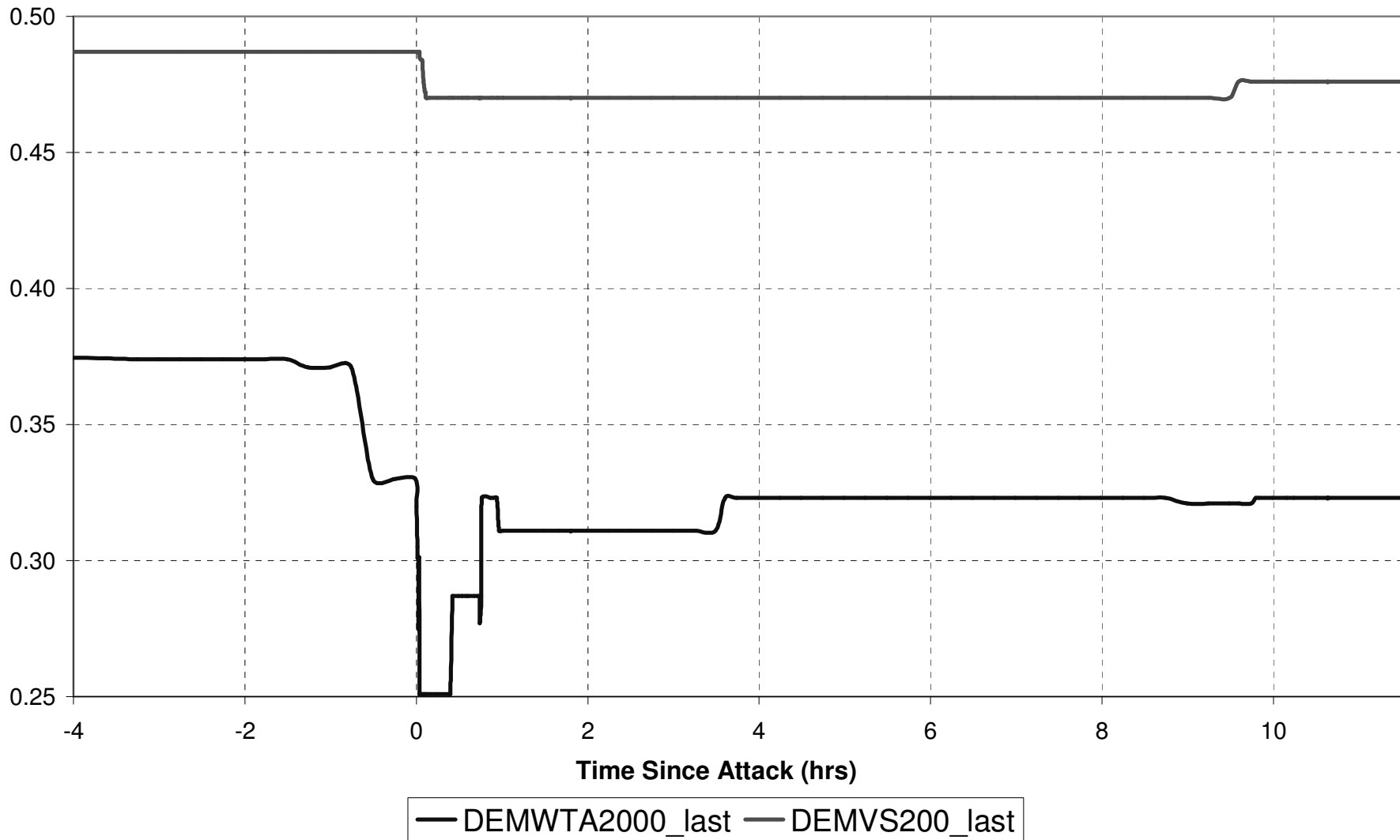
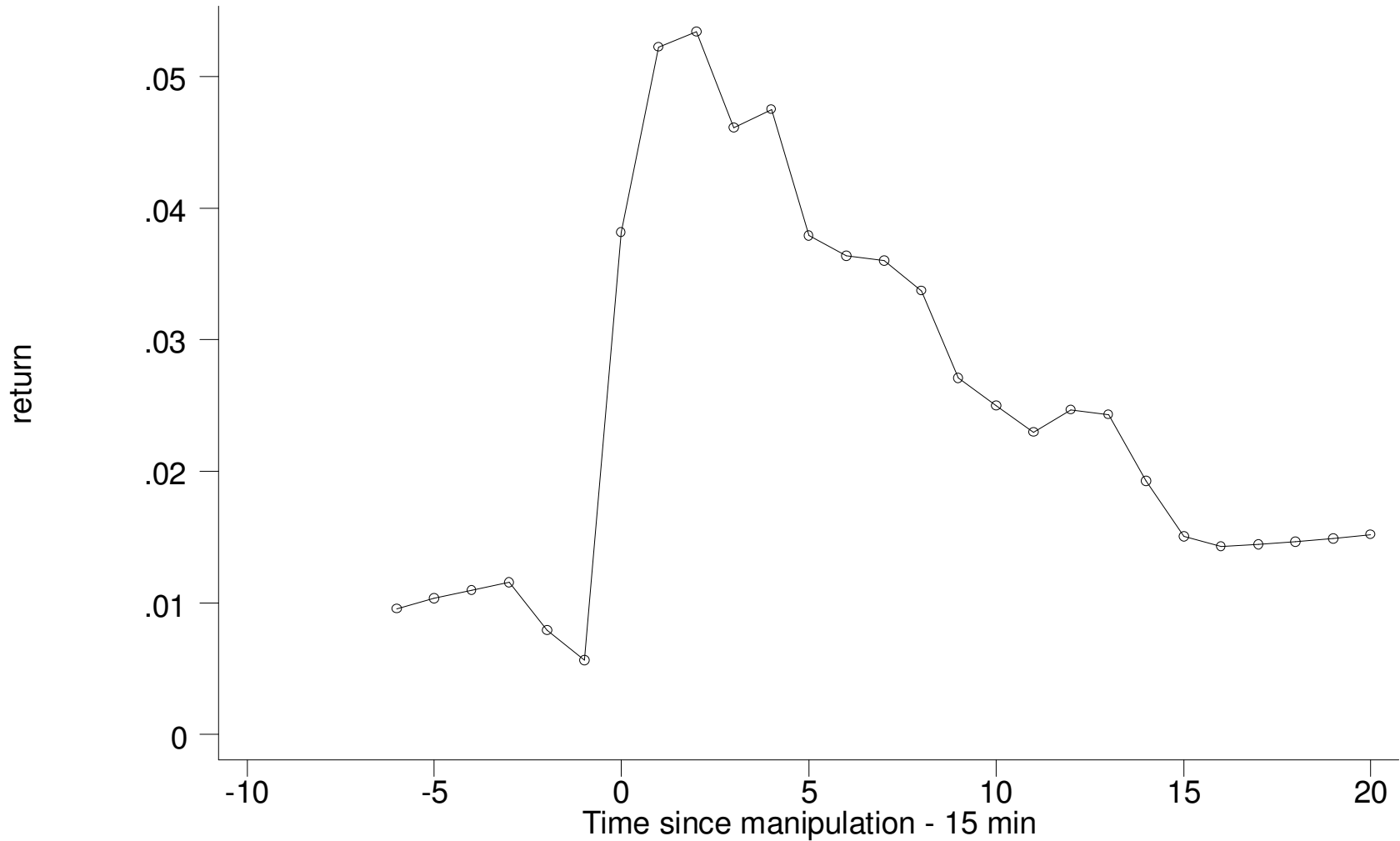
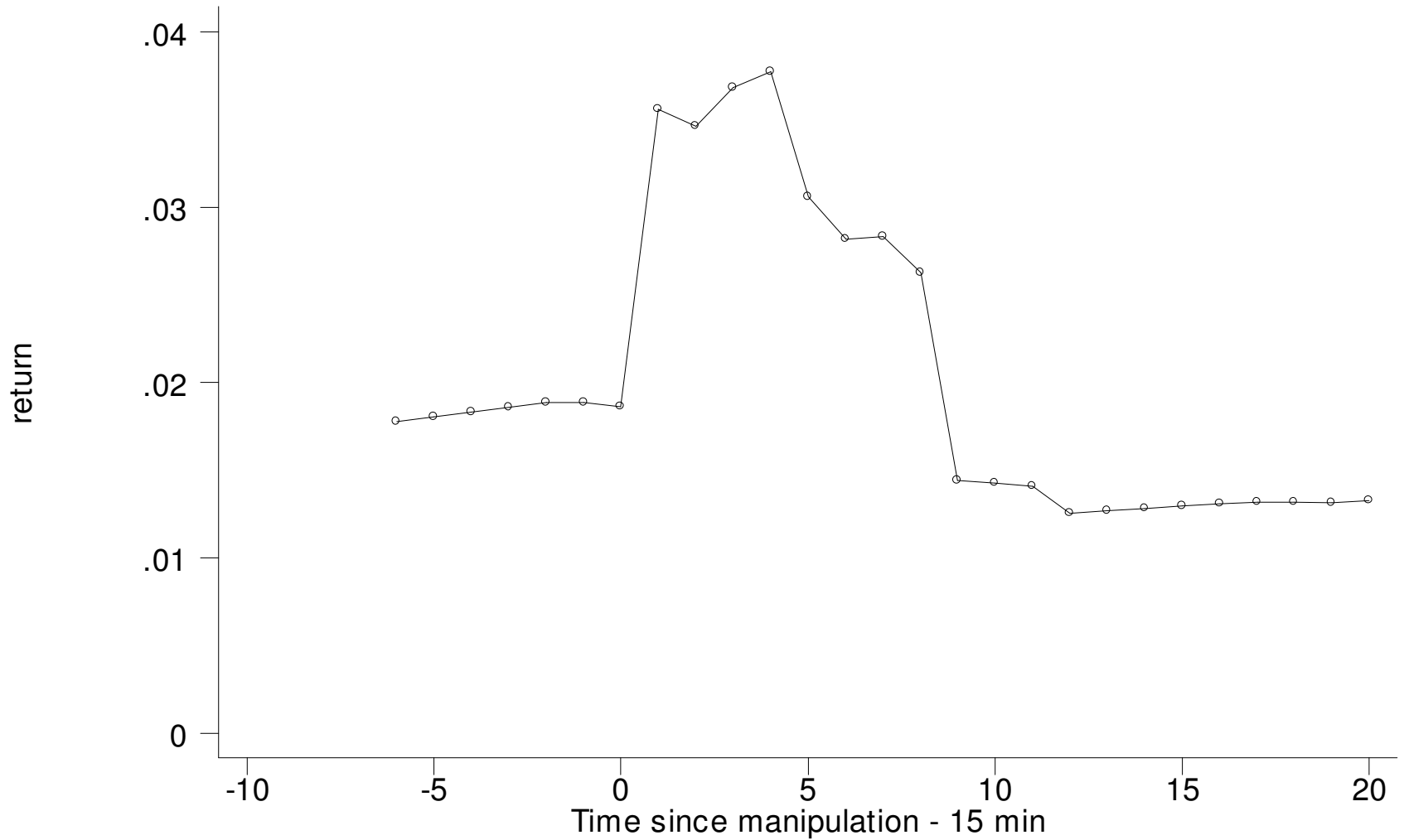


Figure 10: IEM 2000: Mean CR for Nine Successful Attacks



Mean Cumul. Return Since Manipulation - Exclude 2 Unsucc. Trials

Figure 11: IEM 2000: Mean CR for Four Early Attacks



Mean Cumulative Return Since Manipulation -- July-Sept trials only

Figure 12: IEM 2000: Mean CR for Four Attacks Only Involving WTA

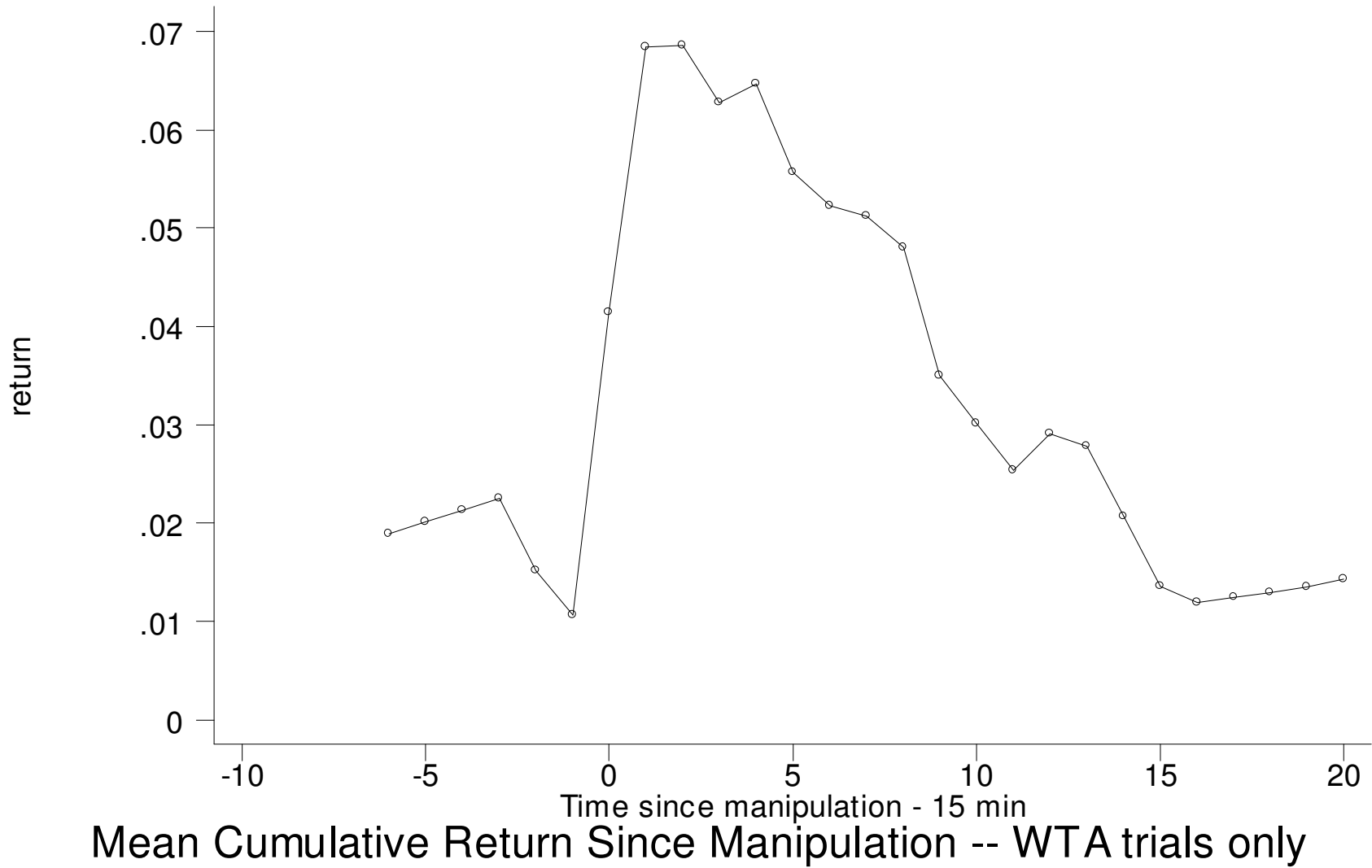
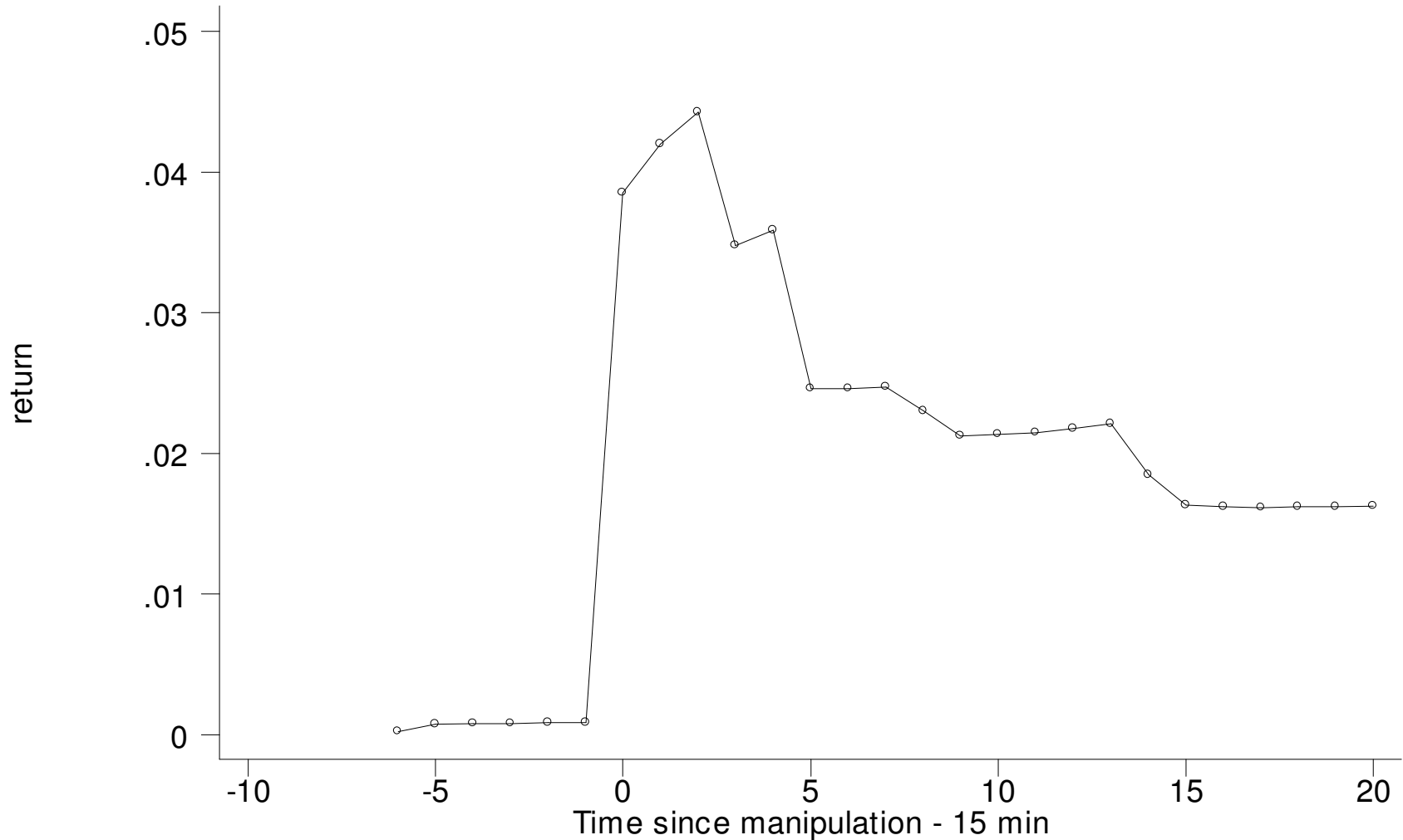
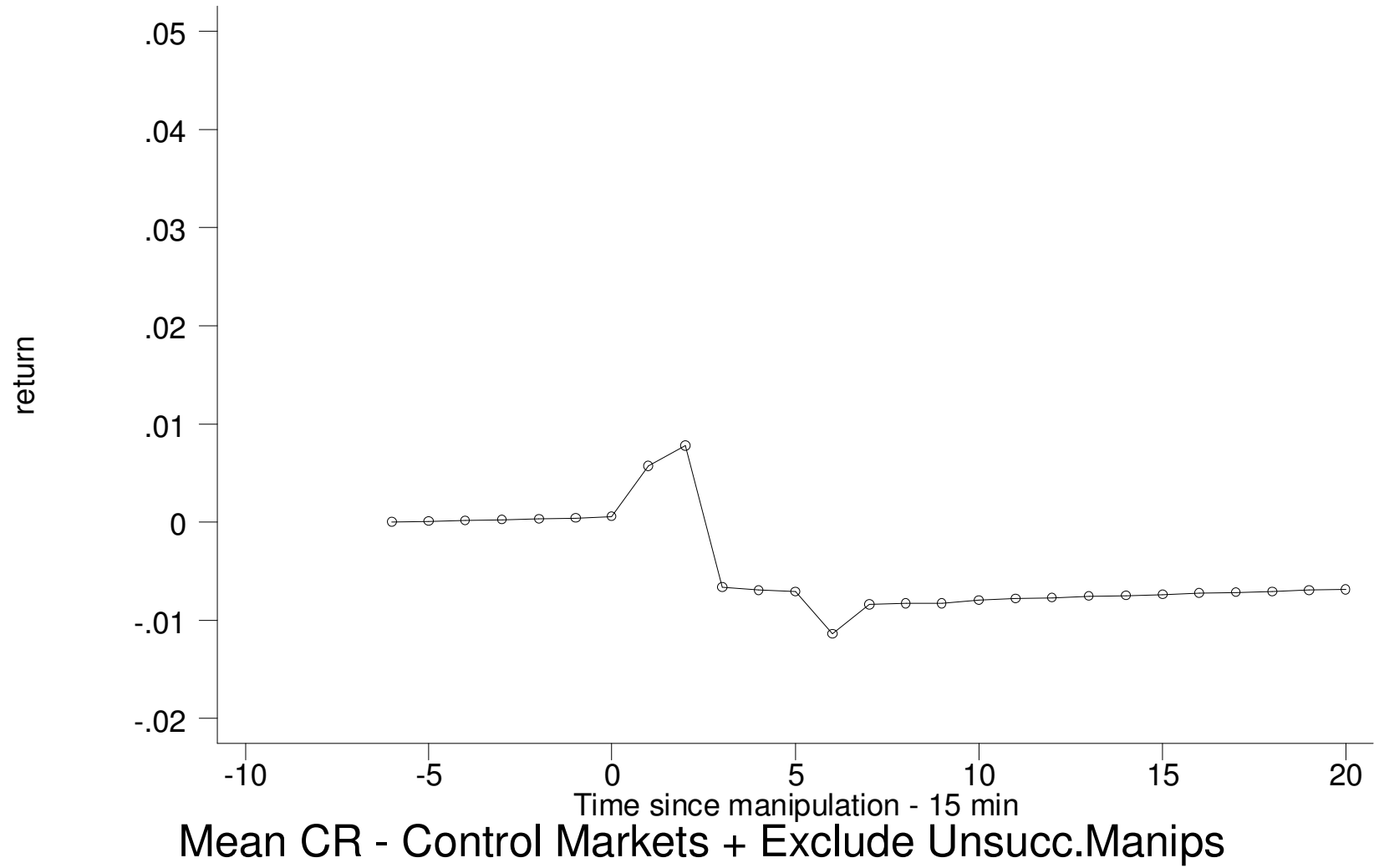


Figure 13: IEM 2000: Mean CR for Four Attacks Involving Both Markets



Mean Cumulative Return Since Manipulation -- Both Mkts trials only

Figure 14: IEM 2000: Mean CR for Control Markets



VI. Conclusion

The promise of improving decision-making by tapping the “Wisdom of Crowds” through the use of prediction markets has attracted great interest in recent years. An important challenge to utilizing such markets is the possibility of manipulation and speculative attacks by partisan or large moneyed interests. To assess this challenge, the paper has analyzed alleged and actual manipulations-- speculative attacks not based on changes in fundamentals—in three markets: the 2004 *TradeSports* market for President, the historical Wall Street betting markets, and the Iowa Electronic Market in 2000. In almost every manipulation that we study there were measurable initial changes in prices. However, these were quickly undone and prices returned close to their previous levels. Our investigation of evidence from field experiments and contemporary as well as historical observational data suggests it is difficult and expensive to manipulate political stock markets beyond short periods. And the period appears to become shorter over time—from days (New York Markets) to hours (IEM) to minutes (*TradeSports*).

Among the questions for future research are: do these results hold for other prediction markets? What are the key characteristics that ensure markets are not easily manipulated? We have shown that certain characteristics are not crucial, because there is variation across the markets we study. For example, having public or anonymous markets does not seem to matter. But there are other traits that are common to all of our markets: large and thick market; small number of possible outcomes; and presence of diversity of opinions. In identifying which are the essential characteristics we might gain a better understanding of why certain of these markets work so well at making accurate predictions.

Appendix A: Efficiency in the Presidential Betting Market

Winner-Take-All Market

The efficient markets test can be applied to time series data, e.g. daily contracts for the winner of the overall election. The key feature of such data is that the uncertainty should systematically decrease as we approach the election date. We present a model related to the analysis of futures markets in Samuelson (1965).

Suppose that time is discrete and in each period some news about the candidates arrives. For concreteness we focus on the Democrat's electoral prospects, and presume there is a latent level of Democrat support (two party vote share) each period. The Democrat's latent support evolves according to,

$$(A1) \quad \text{VoteShare}_t^* = \text{VoteShare}_{t-1}^* + \varepsilon_t$$

where VoteShare_t is the latent support at day t , VoteShare_{t-1} is the latent support on the prior day, and $\varepsilon_t \sim \mathcal{N}(0, \sigma_t^2)$ is the independent across time news shock. The zero mean implies the news does not systematically favor any candidate, while the independence assumption precludes trends in the news. The star superscript indicates an inverse normal transform, $x^* \equiv \Phi^{-1}(x)$ where $\Phi(\cdot)$ is the standard normal distribution function. This transform insures the range of the VoteShare variables is the entire real line like with the ε_t term. This equation can be iterated forward to yield,

$$(A2) \quad \text{VoteShare}_T^* = \text{VoteShare}_t^* + v_t$$

where T is the election day, VoteShare_T is the election day latent support (presumed to be the actual election outcome), and $v_t \equiv \varepsilon_t + \varepsilon_{t+1} + \dots + \varepsilon_T$.

Presuming that VoteShare_t is in the time t information set Ω_t , the best guess about the transformed election outcome is normally distributed, $\text{VoteShare}_T^* | \Omega_t \sim \mathcal{N}(\text{VoteShare}_t^*, \sigma_{vt}^2)$ where $\sigma_{vt}^2 \equiv \sigma_t^2 + \sigma_{t+1}^2 + \dots + \sigma_T^2$. This means the time t prediction about the Democrat's election probability is,

$$(A3) \quad \Pr(\text{Win}) | \Omega_t \equiv \Pr(\text{VoteShare}_T^* > 0) | \Omega_t = \Phi(\text{VoteShare}_t^* / \sigma_{vt})$$

Inverting equation (A3) and using equation (A2) this can be re-written as,

$$(A4) \quad \text{VoteShare}_T^* = \sigma_{vt} \times (\Pr(\text{Win}) | \Omega_t)^* + v_t$$

Under the efficient capital markets hypothesis, the price of a contract paying a unit if Democrat's win the election should equal $\Pr(\text{Win}) | \Omega_t$: $\text{price}_t = \Pr(\text{Win}) | \Omega_t$, where price_t is the market price (odds) of the contract. Substituting this into the equation gives,

$$(A5) \quad \text{VoteShare}_T^* = \sigma_{vt} \times \text{price}_t^* + v_t$$

When equation (A5) is estimated, it is possible to interpret the constant term: a positive (negative) constant indicates that prices have indicates unfavorable (favorable) bias for the Democrats.⁴³ A transformation of equation (A5) shows that the (efficient market) price at any time is the probability the candidate *actually* wins,

⁴³To see this, suppose the contract price is set as, $\text{price}_t = a + \Pr(\text{Win}) | \Omega_t$ where $a > 0$ ($a < 0$) indicates favorable (unfavorable) bias for the Democrats and $a = 0$ indicates efficient markets. Substituting this into equation (A4) and taking a linear expansion (which is valid for a close election, $\text{VoteShare}_T^* \approx 0$) yields,

$$(A6) \quad \text{price}_t = \Pr(\text{VoteShare}_T^* > 0) \equiv \Pr(\text{Win})$$

Since equation (A6) is not conditioned on any information set, it can be directly tested using every observation. After grouping the data into price ranges, the proportion of candidates which eventually win should match the midpoint of the price range.

Imposing some additional structure on σ_{vt} give additional equations which can be estimated. The weak-form efficiency equation considers a time differenced version of (A5),

$$(A7) \quad \text{price}_t^* = ((T-t)/(T-t-1))^{0.5} \times \text{price}_{t-1}^* + \varepsilon_t$$

where we presume for simplicity that the standard errors are equal, $\sigma_s = \sigma \forall s$ (this is necessary to ensure the equation estimated in the text is concave in the parameters; a more general version is considered next). The semi-strong form efficiency equation is,

$$(A8) \quad \text{VoteShare}_T^* = (s_1^2(T-t) + s_2^2)^{0.5} \times \text{price}_t^* + v_t$$

where we presume $\sigma_s = s_1 \forall t \neq 0$ and $\sigma_T = s_2$ (so $\sigma_{vt} = (s_1^2(T-t) + s_2^2)^{0.5}$). In this more general error form, the s_1 term represents the time-varying uncertainty (presumed to be *a priori* identical across days), and s_2 is time-invariant uncertainty (say uncertainty about the voters' preferences). Notice that both of the equations (A6) and (A7) are estimable using observed data. Because we treat the s_i terms as parameters to be estimated, equation (A7) must be estimated using NLLS. Also, since v_t is heteroscedastic and autocorrelated, we use bootstrapped standard errors.

As an aside, notice that the main equations (A7) and (A8) also roughly hold in a linear form which omits the starred superscripts (the inverse normal transform). Suppose that the elections are competitive so $\text{VoteShare}_T^* \approx 0$ (the untransformed values are near one half). In this case a linear Taylor series is valid, and using the properties of the normal distribution we have the approximations,

$$(A7') \quad \text{price}_t \approx 0.5(1 - ((T-t)/(T-t-1))^{0.5}) + ((T-t)/(T-t-1))^{0.5} \times \text{price}_{t-1} + e_t$$

where $e_t \equiv \phi(0)\varepsilon_t$ with $\phi(\cdot)$ as the standard normal density and,

$$(A8') \quad \text{VoteShare}_T \approx 0.5(1 - (\sigma_1^2(T-t) + \sigma_2^2)^{0.5}) + (s_1^2(T-t) + s_2^2)^{0.5} \times \text{price}_{t-1} + v_t$$

where $v_t \equiv \phi(0)v_t$.

Vote Share Market

Equation (A2) gives the law of motion for vote shares. Under efficient markets a market for vote shares should be priced based on the best current estimate of the final vote totals, $\text{price}_t^{\text{VS}} = E(\text{VoteShare}_T | \Omega_t)$. Using equation (A2) this means $\text{price}_t^{\text{VS}} = \text{VoteShare}_t$. This can be used to determine the relationship between efficient prices in a winner take all and vote share market. Applying equations (A2) and (A5) yields,

$$(A8) \quad \text{price}_t^* = \text{price}_t^{\text{VS}} / \sigma_{vt}$$

$\text{VoteShare}_T^* = -(a\sigma_{vt} / \phi(0)) + \sigma_{vt} \times \text{price}_t^* + \varepsilon_t$
 where $\phi(\cdot)$ is the standard normal density. Since $\sigma > 0$, if the constant is positive (negative) then $a < 0$ ($a > 0$). If the constant is zero, then efficient markets holds.

Appendix B: A Brief History of the NY Races

Table B1 lists the election outcomes of the races for Mayor of New York City from the creation of the office in 1897 to 1937. In the fourteen races over this period, Tammany Hall won nine contests. Before La Guardia's victories in 1933 and 1937, no candidate running as chiefly on the Republican platform ever won. La Guardia ran under the City Fusion, American Labor, and other labels as well as a Republican. (And even La Guardia ran under the City Fusion, American Labor, and other party banners as well as a Republican.) Tammany tended to fare well, winning with a plurality but not an absolute majority, when the opposition was divided between two or more major candidates. Only by running on a Fusion platform did a candidate defeat Tammany in the Mayor's race. Election lore has Tammany losing power to reformers after serious scandals broke out but then the reformers lost once the electorate tired of the puritanical programs (such as enforcing blue laws to close beer gardens on Sundays.) A constant theme in the anti-Tammany campaigns was to attempt to coordinate on the one candidate who could win and not to "waste" voters on the others. To the extent that the betting odds signaled which opposition candidate stood the best chance (e.g. Low versus Tracy in 1897), the betting markets could play an important role in the elections. Incumbency did not offer a huge advantage. In races where the incumbent major ran for re-election, this candidate won four of the races and lost three.

Table B2 shows the outcomes for the races for Governor of New York State. These races were in many ways simpler than the races for New York Mayor because both the Democratic and Republican parties were always in the contest and third parties rarely played a pivotal role. One complication was that the races occurred every two years, and turnouts and outcomes could be affected by the Presidential races. Note that the total voting turnout was significantly, roughly 20 percent, higher in years with Presidential elections than in years without. While the gubernatorial races were at times close in the early part of the sample, the Republican candidate won every race between 1898 and 1908. For the next decade, the two parties traded the office. But after 1922, the Democrats dominated. One might venture the claim that the Republicans did best upstate when Tammany was strongest in the City. The Incumbent ran in 12 of the 23 Governor's races and won 8 times.

One note to temper and enlighten discussions about the relative performance of New York market in aggregating information from city, state, and national race. Before speculating about whether from New York City it was easier to predict who would be the next Mayor, Governor, or President, it is important to note the pivotal role that the state of New York played in national elections during this period. New York was the largest state and possessed nearly one-fifth of the Electoral College votes a candidate needed to be elected President. According to Cherny (1997) p. 47, winning New York was key for the Democrats in the late nineteenth century. "In 1880, 1884, and 1888, the electoral votes of New York state were cast for the winning candidate. Had the other candidate carried New York in any of those contests, he would have won—and New York was very closely balanced between the two major parties. In those three elections, the winner and loser were, in effect, separated by only 1 or 2 percent of the New York state vote." To win, the Democrats needed to add to their base, New York and one of other swing state. "Such arithmetic makes it clear why the Democrats nominated New Yorkers for their

Presidential candidates four times out of five between 1872 and 1888.” Indeed of the 13 Democratic places at the head of the ticket between 1892-1940, eight spots were filled by New Yorker and two by New Jersey’s W. Wilson. Several Republican nominees, including T. Roosevelt and C. Hughes, were also from New York. The Wall Street betting market would then have significant insider knowledge about qualities and secret lives of the candidates. The background helps explain why the Presidential prediction market did so well and why the 1916 outcome was such a surprise. New York went for Hughes as expected—and should have given him the lock -- but for the anomalous defection of California. As Tip O’Neil wisely put it, “All politics is local.”

The nature of the political races – including very close votes, charges of fraud, the death of a candidate – created a number of contingencies that forced betting commissioners to address issues of contract interpretation. It is useful to review these events in this appendix. In the 1876 Hayes-Tilden contest, the election was essentially a draw with the political parties charging each other with fraudulently manufacturing votes. The House of Representative eventually decided this highly contested election. The acrimony spilled over into the betting market, where John Morrissey, the leading New York pool-seller (pari-mutuel betting), opted to cancel the pools, returning the stakes minus his commission. This solution left many unsatisfied, contributing to the push in the next session of the New York legislature to outlaw pool-selling. *New York Times*, 11 Dec. 1876, p. 1; 25 April 1877, p. 4. In later years, betting commissioners handled contested elections by specifying the contract to be contingent on whomever actually took office and withholding payment until one side officially conceded. In the close 1884 election, betting lasted until the Friday after the election. *New York Times*, 9 Nov. 1884, p. 1. There were charges that Jay Gould used his control of the Associated Press wires to transmit false post-election results of voting results to take advantage of misinformed agents in the financial markets. In the 1888 contest, when Harrison won the electoral college vote outright (233-168) and yet Cleveland very narrowly won the popular vote, settlement in favor of Harrison bettors occurred without a hitch.

In the inaugural race for Mayor of the unified City of New York in 1897, the independent candidate, Henry George, died in the last week of the campaign, throwing his supporters to the others. Several, but not all, of the betting commissioners, cancelled all of the existing bets upon this event, and then reopened a new round of betting. “A committee selected unofficially to decide on bets made before the death of Henry George has decided that all such bets stand except those which stipulated that all the candidates should remain in the field.” *New York Times* 2 Nov. 1897, p. 3. Eventually his son, Henry George, Jr., ran in his stead. In the interim, the betting markets might have guided the anti-Tammany voters to the most viable contender. Another noteworthy episode was the 1905 contest when the margin of votes separating McClellan and W. R. Hearst was surprising narrow. Hearst, charging vote fraud, demanded a recount. Betting activity continued briefly after Election Day. The election was not finally settled until mid-December and the election bets were not paid until January. *Washington Post*, Jan. 1905. In closely Presidential race of 1916, the leading betting commissioners refused to settle until November 23, almost two week after the polls closed. *Wall Street Journal*, 11 Nov. 1916, p. 2; *New York Times*, 23 Nov. 1916, p. 1.

Table B1: Outcomes of New York Mayor’s Race, 1897-1937

Party: Year	Democrat	Republican	Fusion	Independent	Socialist	Other	Total	Notes
1897	Van Wyck 233,997	Tracy 101,863		Low 151,540		44,230	531,630	H. George dies
1901	Shephard 265,177		Low 296,813				561,990	
1903		McClellan	Low 252,086			28,417	595,285	
1905	McClellan 228,397	Ivins 137,193		Hearst 224,929		15,676	606,195	Hearst demands recount.
1909	Gaynor 250,378		Bannard 177,304	Hearst 154,187		22,198	604,067	Term becomes four year
1913	McCall 233,919		Mitchel 358,217			34,991	627,127	Gaynor resigned in disgrace in past year
1917	Hylan 313,956	Bennett 56,458	Mitchel 155,497		Hillquit 145,332	20,586	691,809	
1921	Hylan 750,247	Curran 332,846			Panken 82,607	31,242	1,196,942	
1925	Walker 748,687		Waterman		Thomas 39,574	26,272	1,161,097	Walker beats Hylan in primary
1929	Walker 867,522		La Guardia		Thomas 175,697	53,795	1,464,649	
1932	O'Brien 1,056,115	Pounds 443,901		McKee 234,372	Hillquit 249,887	269,585	2,253,860	Walker resigned due to scandal
1933	O'Brien 586,672		La Guardia	McKee 609,053	Solomon 59,846	81,309	2,205,402	
1937	Mahoney 890,756		La Guardia			64,834	2,300,220	
		1,344,630						

Notes: Winner is in Bold.

Source: “Mayoralty” entry in Kenneth T. Jackson, ed., *Encyclopedia of New York City* (New Haven, CT: Yale University Press, 1995) pp. 736-39.

Table B2: Races for New York Governor, 1891-1936 (Bold wins)

Party: Year	Democrat	Republican	Other	Total
1891	Flower 582,893	Fassett 534,956		1,162,853
1894	Hill	Morton		
1896	Black 774,253	Porter 561,361		1,409,171
1898	Van Wyck 643,921	T Roosevelt 661,707		1,359,190
1900	Stanchfield 693,733	Odell 804,859		1,558,520
1902	Coler 655,398	Odell 665,150		1,389,799
1904	Herrick 732,704	Higgins 813,264		1,625,907
1906	Hearst 673,268	Hughes 749,002		1,492,219
1908	Chanler 735,189	Hughes 804,651		1,653,856
1910	Dix 689,700	Stimson 622,299		1,445,249
1912	Sulzer 649,559	Hedges 444,105	Straus <i>380,000</i>	1,611,672
1914	Glynn 470,206	Whitman 686,701		1,486,875
1916	Seabury 686,862	Whitman 835,862		1,715,768
1918	Smith 1,009,936	Whitman 956,034		2,192,970
1920	Smith 1,261,812	Miller 1,335,878		2,962,645
1922	Smith 1,397,657	Miller 1,011,725		2,588,961
1924	Smith 1,627,111	T Roosevelt, Jr. 1,518,552		3,355,625
1926	Smith 1,523,813	Mills 1,276,137		2,977,900
1928	F Roosevelt 2,130,193	Ottinger 2,104,629		4,471,426
1930	F Roosevelt 1,770,342	Tuttle 1,045,341		3,220,282
1932	Lehman 2,659,519	Donovan 1,812,080		4,816,054
1934	Lehman 2,201,729	Moses 1,393,638		3,937,199
1936	Lehman 2,970,574	Bleakley 2,450,104		5,690,093

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