The Vicious Cycle: Fundraising and Perceived Viability in US Presidential Primaries[*]

James J. Feigenbaum[1] and Cameron A. Shelton[2]

[1]*Department of Economics, Harvard University; jfeigenb@fas.harvard.edu*
[2]*Robert Day School of Economics and Finance, Claremont McKenna College; cshelton@cmc.edu*

ABSTRACT

Scholars of presidential primaries have long posited a dynamic positive feedback loop between fundraising and electoral success. Yet existing work on both directions of this feedback remains inconclusive and is often explicitly cross-sectional, ignoring the dynamic aspect of the hypothesis. Pairing high-frequency FEC data on contributions and expenditures with Iowa Electronic Markets data on perceived probability of victory, we examine the bidirectional feedback between contributions and viability. We find robust, significant positive feedback in both directions. This might suggest multiple equilibria: a candidate initially anointed as the front-runner able to sustain such status solely by the fundraising advantage conferred despite possessing no advantage in quality. However, simulations suggest the feedback loop cannot,

by itself, sustain advantage. Given the observed durability of front-runners, it would thus seem there is either some other feedback at work and/or the process by which the initial front-runner is identified is informative of candidate quality.

Keywords: Campaign finance; vicious cycle; Presidential primary; fund-raising

JEL Codes: D72

1 Which Came First: The Money or the Voters?

The conventional wisdom among campaign managers and the popular press is that money in politics is a vicious cycle. Candidates need to raise money to prove they are viable; and they need to be viable candidates to effectively raise money. In September 2007, *Newsweek* reported that former Arkansas Governor and Republican presidential candidate Mike Huckabee seemed to be a perfect fit for the GOP base. However, the article continued, "Huckabee is stuck in a familiar political trap: is he having trouble raising money because no one thinks he can win, or does no one think he can win because he's having trouble raising money?"[1]

Logically, this is the classic chicken-and-egg quandary. If such a positive-feedback loop exists, it carries at least two important implications for our system of representation and public choice. First, the positive question: how are the initial front-runners — who are then favored to become the nominees via the reinforcement process at work — selected? And second, the normative question: is the selection method desirable in the sense of selecting the best representative for the electorate? But it remains to be established that the conventional wisdom is correct; that positive-feedback between fundraising and viability exists in both directions and is of sufficient strength to constitute a vicious cycle. As we will discuss in the next section, earlier work has not been conclusive. In this paper, we document the existence of this feedback loop in US Presidential primaries but show that it is too weak to constitute a sole explanation for the observed durability of the front-runner.

Our investigation consists of three complimentary empirical exercises followed by simulations. The first exercise estimates an ARIMA model for

---

[1] Holly Bailey, "Perfect Stranger," *Newsweek*, September 3, 2007.

campaign fundraising, including Iowa Electronic Markets (IEM) prices as an independent variable to capture the possibility of feedback from perceived chance of victory to fundraising success. The results clearly show that candidates' receipts respond to changes in their electoral fortunes with magnitudes that are both economically and statistically significant. In fact, increases in IEM price have an *increasing marginal effect* on campaign finances until a candidate is the established front-runner. Our second analysis shows that a candidate appearance increases local receipts, and, crucially, that this increase is larger when the candidate is doing well in the IEM markets. This further suggests that fundraising is subject to bandwagoning. Finally, turning to the other direction of the feedback loop, we conduct a panel analysis of the effects of spending on vote share during the campaign. Because we have panel data, we can use fixed-effects to control for omitted candidate-specific effects without having to limit our sample of candidates and thus without fear of selection limiting out-of-sample prediction. We find that IEM share price responds strongly to changes in both one's own spending and the spending of one's opponents, but that there are decreasing returns to these effects, as expected. Having established the existence of both directions of the feedback loop, we then conduct calibrated simulations to illustrate the strength of the feedback loop under conditions approximating Presidential primaries. We look at whether the vicious cycle can sustain a front-runner advantage gifted to one of two equal candidates. We find that the feedback loop is not strong enough to constitute a sole explanation for the phenomenon of interest. The durability of front-runner advantage must rest on more than the fund-raising advantage provided by this status.

The common thread is the dynamic nature of our study. We analyze both directions of the feedback loop with a consistent set of elections, a consistent source of data, and a dynamic framework thus enabling us to evaluate the causal system.

2   Unraveling the Causal Knot: Past Work on the Connection between Money and Electoral Success[2]

Ever since the McGovern–Fraser reforms opened the delegate-selection process to ordinary voters thus requiring candidates to raise money and

---

[2]   There exists a well developed literature modeling the transmission of information in sequential voting contests such as Presidential primaries (Dekel and Piccione, 2000; Klumpp and Polborn,

campaign broadly to garner widespread attention, scholars have puzzled over the workings of the modern Presidential nomination process. Many of the salient questions are explicitly dynamic. What explains the durability of front-runners (Mayer, 2003)? How does a foremost challenger emerge from the pack (Bartels, 1988)? What role does the sequencing and spacing of the primaries play (Mayer and Busch, 2004)? When do candidates choose to withdraw (Norrander, 2000, 2006)? Other critical issues such as the proper regulation of campaign finance and the relative importance of ordinary citizens vs. party elites in selecting the nominee also depend on an understanding of campaign dynamics.

As the article on Huckabee's plight suggests, candidates, media, and the public frequently assert that money drives all. Certainly, candidates must raise money to support a campaign that can both determine what the electorate wants and reach them to demonstrate the candidate can meet those demands (Brown, *et al.* 1995). Indeed, prominent academic models of presidential primaries suggest that the final delegate shares of the candidates can be predicted using only the polls and the cash-on-hand at the end of the primary season (Mayer, 1996; Steger, 2000; Adkins and Dowdle, 2000). But such models are cross-sectional rather than dynamic, drawing only on the candidates' relative positions at the end of the invisible primary without explaining the dynamics that led to those positions.[3]

In addition to fundraising, two other independent factors have received scholarly attention. A number of authors, including Bartels (1988), Mutz

---

2006; Ali and Kartik, 2008; Callander, 2007; Knight and Schiff, 2010). These models postulate that candidates are differentiated by a hidden valence characteristic that voters wish to discover so as to choose correctly. Voters receive noisy signals — either exogenously, or by paying a cost of discovery, or via campaign efforts — of this candidate quality. Voters in later primaries may observe the results of early primaries and use the information to update their priors about candidate quality. The literature is concerned with whether sequential voting leads to more efficient discovery and aggregation of information and thence to more efficient candidate selection. Later voters may benefit from additional information beyond that which would be available was voting to take place simultaneously. Or later voters may choose to free-ride and simply "bandwagon" rather than acquiring and acting on their own information. While this is an elegant and interesting literature, it has thus far not touched on fundraising and campaign expenditures as a channel of feedback. As such, it is understandably mute on our subject of interest, the money primary taking place before any votes are cast.

[3] Intriguingly, Adkins and Dowdle (2005) use the same variables from the beginning of the invisible primary and argue that there is little loss in predictive power, suggesting that very little is revealed or determined during the invisible primary. This concurs with recent scholarship emphasizing the durability of front-runner advantage (2008 notwithstanding). But this only makes it more important to understand the dynamics of the invisible primary to understand why front-runner advantage is so durable.

(1995a,b), Damore (1997), and Steger (2000) have emphasized media coverage — both the amount and the slant — and have looked at the sources and effects of such coverage. Steger (2000) and Cohen *et al.* (2008) both emphasize the importance of endorsements by party elites. Clearly there is interplay between each of the intermediate measures of success: fundraising enables spending which begets media attention and voter support; fundraising, media attention, and voter support may signal viability and thereby garner endorsements by party elites; endorsements lead to voter approval both directly, by serving as a trusted seal of approval, and indirectly, by placing fundraising networks and skilled operatives at the candidate's disposal.

To a large extent, understanding the nomination process is to understand the interplay between insider endorsements, free-media, poll standing, and fundraising. Indeed, Steger notes *"A major question for future research involves unraveling the causal arrows between these factors [endorsements, money, and poll support]. Do candidates like Bob Dole receive more endorsements because they have higher polling numbers and more money, or do the endorsements come first? ... Future research will need to focus more on the temporal sequencing between endorsements and fund-raising, media-coverage, and poll position."* (Steger, 2000; p. 17 quoted in Cohen *et al.*, 2008; pp. 282–283.) Nonetheless, over a decade later there remains relatively little formal empirical work measuring these causal relationships *as a dynamic system.*

By collecting data on endorsements, and media coverage as well as fundraising and poll standing, Cohen *et al.* make the most complete effort towards quantifying the interplay between each of the aspects of the system. Unfortunately, measuring all four factors comes at a cost. Their empirical work is low frequency, comparing only two points in the invisible primary, which necessarily limits their conclusions. Perhaps as a result, they find an especially small role for money, noting that it "stands out for its relative lack of connection to everything else." (Cohen *et al.*, p. 264) By contrast, we find that money is not only very strongly determined by perceived viability, but in turn has a significant effect on perceived viability. Nonetheless, their approach represents an advance over previous investigations which have typically considered one of the causal arrows in isolation and are often solely cross-sectional.

Our paper constitutes the first analysis of the interplay between primary factors in a high-frequency analysis. Specifically, we use daily data on fundraising and the estimated probability of a candidate capturing the

nomination. The former is measured by the FEC, the latter by the IEM. We do not separately include endorsements and free media attention because we do not have daily data on these factors and we wish to maintain the high-frequency analysis. Instead, we can think of the IEM price as simultaneously capturing a mix of three fundamental factors: voter approval, elite endorsements, and media attention. We refer to this catchall market-assessment as *viability*. Given our focus on a two-variable system — fundraising and viability — we pay special attention to the prior literature on the determinants and effectiveness of fundraising. While the simultaneous causation between money and other measures of electoral success is widely recognized, in general each causal direction has been investigated separately.

2.1   Can Elections be Bought?

Springing from the seminal paper by Jacobson (1978), one literature asks whether candidates who raise more money garner more votes. Rather than as a phenomenon of interest in itself, this literature has approached simultaneity as an econometric obstacle to correctly estimating the effect of spending on vote-share. The baseline econometric method involves a cross-sectional regression of vote shares on the end-of-campaign spending totals of the challenger and the incumbent in US Congressional elections.[4] The literature can be read as a series of refinements of Jacobson's original measurement and estimation techniques to address the econometric concern. Green and Krasno (1988) instrument for incumbent spending and control for challenger quality (wealth, previous office, etc.). Gerber (1998) instruments for challenger as well as incumbent spending. Erikson and Palfrey (1998) estimate a system of three equations for incumbent spending, challenger spending, and vote share. Taking a different approach, Levitt (1994) addresses all candidate-specific omitted factors (e.g., candidate quality) by considering only races with repeat challengers and taking the first difference between the first and second runs of the same matchup. Erikson and Palfrey (2000) argue that the simultaneity problem can be solved by looking only

---

[4]   While the effect of spending in a Presidential primary, the parameter of interest in this paper, has received less attention in the literature, we feel the underlying dynamics must be similar in any mass election: candidates must mobilize endorsements from key elites and interests, must compete for favorable free media coverage, and must raise money to pay for campaigning and mass media to reach voters. At the same time, the analyst faces many of the same econometrics challenges in both cases. Hence we feel this literature, while focused predominantly on Congressional races, remains relevant.

at close races. Other papers are dedicated to controlling for variation in the productivity of spending from other omitted variables such as differential effectiveness of spending. Ansolabehere *et al.* (2001) use a more precise measure of spending based on communication with voters rather than raw expenditures. Stratmann (2007) corrects for the difference in the price of purchasing advertising in different TV markets so as to achieve a measure of effective spending. Each econometric approach admits a slightly different sample and delivers a different estimate of coefficient magnitudes.[5]

Naturally, uncertainty over the proper econometric method translates into uncertainty over the magnitude of this cross-sectional effect and considerable disagreement about how to read the pattern of results. Given his own results, Levitt (1994) understandably concludes that the marginal productivity of spending is trivial; previously estimated magnitudes are inflated due to omitted variables bias. Nonetheless, this is a troubling conclusion in that it implies that candidates — all of whom spend enormous effort to raise and spend money — grossly misunderstand campaign dynamics. Stratmann (2005) expresses the central paradox. ''While incumbents and challengers spend much time on fund-raising and appear to believe that money is an important ingredient for winning elections, academic researchers for the most part have trouble establishing a causal and quantitatively important connection between spending and vote shares.''

We feel that Jacobson's (1978) original viewpoint fits the evidence quite well. Campaign spending serves primarily to familiarize voters with a candidate's brand. As such, it is subject to diminishing returns due to saturation. Thus, incumbents, who begin a campaign with an established brand, receive less bang-for-their-buck than challengers (Jacobson, 1978; Green and Krasno, 1988; Gerber, 1998) and senior incumbents receive less bang-for-their-buck than junior incumbents (Erickson and Palfrey, 1998). Levitt's seemingly puzzling finding that both incumbent and challenger spending are extremely ineffective is simply a function of the sample that his econometric method selects. If candidates use spending to build a brand, it is likely in these cases of repeat challenges when spending matters least as both candidates have already built brand recognition. We feel the range of estimates may be most usefully interpreted as estimates of the declining marginal productivity of candidate spending as a candidate's name recognition improves.

---

[5] See Gerber (2004) for a swift summary of the development of econometric approaches in this literature.

Nonetheless, the econometric approach of this literature is static and thus unable to address the issue of positive feedback during a campaign. A positive correlation between money spent and votes garnered, even if it is causal, is consistent with, but does not necessarily imply, the kind of vicious cycle that constitutes Huckabee's "familiar political trap." Demonstration of the vicious cycle requires testing the dynamic feedback rather than simply looking at the end-of-campaign totals.

2.2   *Who Gives How Much to Whom? And Why?*

The literature on the determinants of campaign contributions is also well-developed, though the role of a candidate's electoral prospects — the crucial point for the issue at hand — is less consistently considered. In Presidential primaries, small individual contributions, rather than PAC money, are the average and the marginal contribution and constitute the bulk of money raised by candidates (Norrander, 1996; Francia *et al.*, 1999; Ansolabehere *et al.*, 2003). When considering the motive of the giver, these contributions should be seen as consumption — a desire to participate in the campaign and associate with the others doing so — rather than investment — an attempt to influence future policy (Ansolabehere *et al.*, 2003; Verba *et al.*, 1995).[6] While contributors do care about the policy position of the candidate, they are often motivated even more strongly by personal connections and the excitement of participating in the campaign (Brown *et al.*, 1995). In sum, candidates must work primarily to attract individual contributions and they must do so by offering an attractive package of associative benefits. Because potential contributors find greater value in associating with successful campaigns, the possibility exists for strong momentum effects whereby a campaign enjoying good news and favorable prospects attracts a greater flow of donations.

Unfortunately, the two most explicitly dynamic empirical studies of the fund-raising process in Presidential primaries come to opposite conclusions regarding the momentum hypothesis. Damore (1997) finds that electoral success in primary contests has a huge impact on the fund-raising of long-shot candidates (though an insignificant effect on the finances of

---

[6]   Concerning Congressional races, there is some debate about whether PAC money affects representatives' votes (Stratmann, 1991, 1998, 2002, 2005) or simply serves to elect politicians who are already like-minded (Bronars and Lott, 1997; Ansolabehere *et al.*, 2003). For the presidential primaries we study, PAC money is far less important.

established candidates). On the other hand, Hinckley and Green (1996) fit an ARIMA process to each candidate's fundraising and include measures of both campaign events and standing in the polls. They conclude that newsworthy events have little effect on fundraising and see no evidence of momentum.

Other studies are similarly split on the strength of this feedback loop. Hagen and Mayer (2000), Ansolabehere *et al.* (2003) and Verba *et al.* (1995) stress that widespread recognition, positive public image, and explicit campaign successes increase willingness to contribute. However, Goff (2004) rebuffs the concept of momentum finance in modern Presidential primaries: "[candidates] relying upon their success in these open contests to generate additional support for the ensuing contests inevitably will be disappointed as their campaigns are overwhelmed by competing candidates who have entered the formal nomination process financially prepared." The essential question — whether feedback from campaign conditions to fund-raising is strong enough to contribute to the hypothesized vicious cycle — remains an open question.

3   Data: sources and description

3.1   Campaign Contributions

We use data on campaign contributions from the Federal Elections Commission (FEC).[7] For each contribution made by any individual or PAC to a political campaign, the dataset records the date, donor's address and occupation, and the amount. The information is compiled by candidates and their campaigns and submitted to the FEC quarterly in the year before a general election and monthly in the year of the general election. The FEC requires candidates, parties, and PACs to document only donations from individuals or organizations who cumulatively give $200 or more. This means donations of less than $200 are not part of our dataset and constitute an important potential source of measurement error.[8]

We have aggregated the contributions by candidate so that we have contribution schedules including the total number and amount of contributions for each candidate during each day of the campaign. The relevant

---

[7]   Data are available at http://www.fec.gov/finance/disclosure/ftpdet.shtml.
[8]   Though unrecorded by the FEC, campaigns keep track of these smaller donations so that they can report total fundraising numbers each quarter.
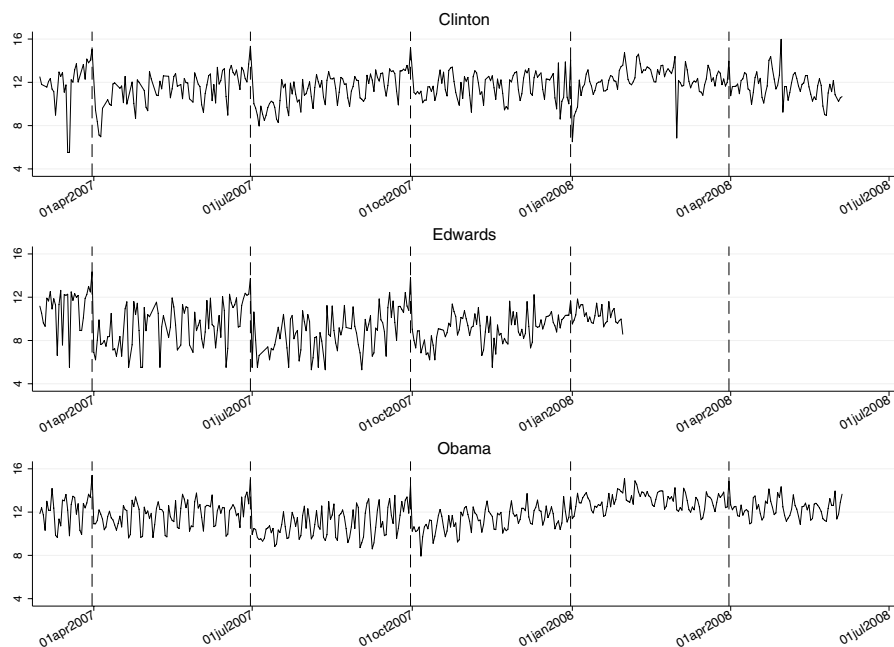
Figure 1. Log of total daily contributions 2008, Democratic presidential primary.

histograms show the series is distributed approximately log-normally[9] so we use a log-transformation. The logged contributions data display seasonality along three dimensions. We have presented data from the 2008 democratic presidential primary to illustrate these patterns in Figure 1. First, there is a clear day-of-the-week effect: candidates raise significantly fewer donations on weekends, with Sundays being even lighter than Saturdays. Mondays tend to be somewhat lighter than Tuesday through Friday, which are statistically indistinguishable from each other. Second, there is a strong quarterly seasonality, with fundraising tending to increase as the quarter progresses. Finally, there is a large spike on the final day of each quarter. The spike is less severe for earlier campaigns and seems to affect only the contributions from individuals to campaigns, not the data for PACs. Discussions with political insiders have led us to a potential explanation for this spike. To begin with, campaign staffers do not specialize: the staffers making calls soliciting

---

[9]   There is a slight left skewness due to the low totals on weekends.

donations are also responsible for filing reports with the FEC. These reports, submitted quarterly, are due 10 days after the end of the reporting period. It seems that early in the quarter, staffers both solicit and log donations. However, as the quarter comes to a close, resources are shifted to solicitation because there is a drive to report as large a quarterly number as possible. When the quarter ends, resources are moved back to logging donations and, as a result, campaigns may record most checks that have come in the past weeks as coming in on the final day of the quarter. It has also been suggested that staff workers, during solicitation calls, stress the last day of the quarter to potential donors, which may lead donors to date their checks for this day. The autocorrelation and partial autocorrelation functions of the log-transformed series indicate that, once seasonality has been removed, the data are best modeled as an ARIMA(1,0,1) process.[10]

3.2   Campaign Expenditures

The FEC also collects budget statements from the candidates (and other political organizations) on a regular basis.[11] The statements, which are reported quarterly in the year before the general election and monthly in the year of, detail campaign expenses and receipts. Spending is nominally broken down into four broad categories: operating expenditures, fundraising disbursements, legal/accounting disbursements, and other expenses. The receipt information includes totals of contributions from individuals and PACs, as well as loans from the candidate, transfers from previous campaigns, and federal matching funds.

There are two main issues with this data. First, it is of much lower frequency. In order to obtain a consistent frequency, the monthly data from the year of the general election must be aggregated to the quarterly level and, because most primary contests in our sample are decided by late March or early April, there are at most five quarterly data points per candidate. Second, the reported composition of expenditures is clearly untrustworthy. According to data provided to the FEC in 2004, President George Bush's

---

[10]   Hinkley and Green (1996) chose to aggregate the FEC data to a weekly time series so as to avoid day-of-the-week effects. We choose to remain at the daily level because we are mindful of Rossana and Seater's (1995) finding that "temporal aggregation systematically alters the time series properties of the data so that even the [low frequency] variation in the underlying data is totally lost. Moreover, the aggregated data have excessive long-term persistence" (p. 450). Luckily, day-of-the-week effects can be stripped with dummy variables.

[11]   Data are available at http://www.fec.gov/press/bkgnd/pres_cf/pres_cf.shtml.

re-election campaign did not spend a single dollar on fundraising expenses, despite raising a record $258 million. Similarly, his Democratic challenger, Senator John Kerry reported spending only $1.6 million on fundraising, all before October 2003. Most campaigns in our sample report spending the vast majority of their funds on operating expenses. While it is not clear whether this is a deliberate obfuscation by campaigns seeking to conceal their budget decisions or merely oversimplified accounting, it means that only the total expenditure figures are usable.

3.3   Likelihood of Victory

To measure the probability of victory, we use share prices on winner-take-all contracts traded on the Iowa Electronic Market (IEM). There is by now a large literature discussing the IEM's protocols (Forsythe *et al.*, 1999; Berg *et al.*, 2000) and establishing its efficiency (Rhode and Strumpf, 2007; Oliven and Reitz, 2004; Wolfers and Zitzewitz, 2007). There are a number of reasons why prediction market data work better than polling data for our project. To begin with, the frequency is much greater. While some polls are taken daily close to election day, it is difficult to find such high-frequency polls more than a year before the nominating convention, especially for earlier primaries. In addition, the question answered explicitly by those polled and the one answered implicitly by IEM participants are different. As Berg *et al.* (2000) note, the Iowa Markets (and other electronic markets) ask traders whom they think will win. Polls ask whom the subject personally supports. Wolfers and Zitzewitz (2007) argue that market prices on winner-take-all contracts on prediction markets represent probabilities of victory. Given this assumption, the prediction markets provide precisely the required data for this project whereas poll data would be an imperfect substitute requiring a difficult translation.[12] But it is not simply a measure of convenience. Given that the general public does not closely follow the primary until much later, using the IEM as a market calculator of political enthusiasts processing all available information, including that which will garner public attention only later and/or indirectly, gives us a better window into viability than would polls. While prediction markets may be less accurate than the proper sophisticated reading of the polls (Erikson and Wlezien, 2008), they are considerably more accurate than a naïve reading of the polls (Berg *et al.*, 2000).

---

[12]   See Erikson and Wliezen (2008) or Nate Silver's work, www.fivethirtyeight.com, to see exactly how complex this translation can be.

In sum, IEM prices constitute a high quality, easily interpreted measure which is consistently available throughout our sample.

We use data from six presidential nomination contests: the Republican primaries of 1996, 2000, and 2008 and the Democratic primaries of 2000, 2004, and 2008.[13] Contracts were also traded on a handful of candidates who never entered the race (e.g., Colin Powell in 1996 or Hilary Clinton in 2004). As these candidates never reported contributions to the FEC, they do not enter our sample. We are left with 26 candidates. We follow each candidate from the beginning of their listing on the IEM until they drop out of the race. To avoid including the dead period during which the presumptive victor prepares for the general election, we cut the victor's sample at the point at which the last challenger has dropped out.

Not surprisingly, as they are asset prices, daily IEM data follow a near random walk (ARIMA(0,1,0)).[14,15] The presence of a unit root cannot be rejected at the 10% level for 20 of the 26 candidates and the estimated autoregressive coefficient is in excess of 0.98 for 20 of the 26 candidates. The series also exhibit non-stationary variance. In general, prices from the period before the Iowa Caucus display a much higher variance than prices during the voting season.[16] Box–Cox estimation shows that a log-transformation of these prices stabilizes the variance for most candidates.[17]

In addition to the winner-take-all contracts, we make use of a number of complementary securities traded on the IEM. As we will explain later, we use these to control for party-level momentum. These series are drawn from various IEM contracts such as the probability that a Republican wins the White House (1996, 2008) or the probability that Republicans win control of the House of Representatives (2000).

---

[13] IEM data on the Democratic campaign of 1992 begins too late in the primary season for our purposes.

[14] However, Ljung–Box statistics show the autocorrelations are highly significant at certain lags for several candidates. Investigation shows this to be due to extremely large shocks from the first few primaries. These outlying shocks then drive a few autocorrelations at lag lengths chosen randomly by the electoral calendar. As such, the autocorrelations are not a persistent feature of the data generating process. ARIMA(0,1,0) remains the best characterization of the underlying process.

[15] The IEM score of any given candidates will evolve during the campaign from some intermediate starting value to either 0 (loser) or 1 (winner). Thus the ex-post existence of a single winner and multiple losers generates the appearance of a trend despite the underlying random walk.

[16] This variance echoes the findings for poll data of Erikson and Wlezien (2008). Their results show that the variance in primary season polling data is much lower once voting begins and that variance declines in general as the election date approaches.

[17] Not all series were stabilized by the log transformation but in the interest of cross-estimation comparison we standardize this transformation.

3.4   Candidate Appearances

The final dataset of which we make use is a list of appearances for each candidate during the 2008 Republican and Democratic primaries. This data was collected by the Washington Post and displayed on their website during the campaign. An entry lists the candidate, location (city and state), and date, and frequently includes time of day and often the type of event (e.g., fundraiser, house party, speech, debate). Across both the primary and the general election, the dataset includes 7234 events for 17 candidates. The Washington Post describes their data as follows:

> washingtonpost.com's Presidential Campaign Tracker uses information from campaigns, media reports and other sources to compile a listing of events involving presidential candidates and their spouses. The tracker covers events since January 2007. It does not include every event — particularly fundraisers, which often are unannounced. Some events will be added retroactively as more details become available

As they are careful to point out, it is an incomplete list. Nonetheless, it represents a thorough compiling of available public information. In preparation for the analysis in the section on productivity of campaign expenditures, we restrict to just the primary season and count multiple events on the same day only once, reducing the dataset to 2559 entries.[18]

4   The Battle for the Bucks

Our first goal is to analyze the determinants of campaign contributions. Given our focus on a possible feedback loop, we are particularly interested in the effect of perceived electoral viability on a candidate's ability to elicit contributions. At the same time, our review of the literature suggests two additional variables of interest. First, whether the general political climate is favorable to a candidate's party may enter the strategic calculus of a potential donor for many of the same reasons as those pertaining to the particular fortunes of the candidate in question. Namely, the likelihood of a candidate capturing the White House depends not only on his or her ability to capture

---

[18]   Two appearances by the same candidate on the same day in different states are treated as two appearances, one in each state.

the nomination but also to succeed in the general election. Furthermore, the psychological associative benefits likely depend on the broader popularity of the party. Second, because it takes time to develop the fund-raising networks and because voters and contributors increasingly tune in to the campaign as the convention approaches, there is a natural growth in funds raised, independent of the aforementioned factors. Hence we include a control for the number of days until the appropriate party convention.

We have run both a pooled sample with candidate fixed-effects and separate regressions for each candidate in each year's nomination process. Each of these regressions shares a common specification:

$$(1 - \varphi_1 L)C_t = \beta_1 V_{t-1} + \beta_2 P_{t-1} + \beta_3 D_{t-1}$$

$$+ \sum_{k=1}^{K} \alpha_k (V_{t-k} - V_{t-k-1}) + \Gamma' S + \varepsilon_t \qquad (1)$$

L is the lag operator so the models are estimated with an AR(1) term for the dependent variable (C, the natural log of weekly contributions from individuals) and the one-day lag of three independent variables: the natural log of the probability of victory (V), the control for party popularity (P), and days until the convention (D). For reasons explained below, we also include $K = 7$ lags of the change in the natural log of the probability of victory. The error term, ε_t, is MA(1). Finally, we add a vector **S** of dummy variables for the day of the week, week of the quarter, and the last day of the quarter to capture the seasonalities discussed in the previous section. For each candidate, the sample period begins with the opening of the nomination contract on the IEM (see Table 1) and ends with the formal announcement of withdrawal by the candidate. For the eventual winner, we end the sample on the date of withdrawal of the last competitor listed on the IEM so as to avoid including the dead period between the practical end of the primary and the formal nomination at the convention.

The foremost concern with estimating Equation (1) is possible measurement error in the dating of contributions. Ideally, we would regress each contribution on the political conditions prevailing at the time the contributor made the decision to contribute. But there are several sources of lag between the date at which the contributor decided to contribute and the date reported by the campaign to the FEC for that contribution. The first is the delay between when the contributor makes the decision to contribute and when the decision is implemented by writing and mailing the check. This may

Table 1. Iowa electronic markets winner-take-all contracts.

Market	Start date	Last drop-out	Contracts
RNC '96	Jan 5, 1994	Mar 26, 1996	Alexander, Buchanan, B. Dole, Forbes, and Gramm
DNC '00	Jun 14, 1999	Mar 10, 2000	Bradley and Gore
RNC '00	Jun 14, 1999	Mar 10, 2000	Bush, E. Dole, Forbes, McCain, and Quayle
DNC '04	Feb 20, 2003	Mar 4, 2004	Clark, Dean, Edwards, Gephardt, Kerry, and Lieberman
DNC '08	Mar 2, 2007	Jun 5, 2008	H. Clinton, Edwards, and Obama
RNC '08	Mar 2, 2007	Mar 6, 2008	Giuliani, Huckabee, McCain, Romney, and F. Thompson

include delays in the contributor's own information set (i.e., contributors lag the IEM traders in keeping up with the news). The second is due to delivery via post office, in person, or electronic. The third is the delay between receipt and logging by the campaign. Having articulated the sources of delay, it is clear that the delay is going to be highly heterogeneous across observations. As a result, some of the contributions recorded for date t are the result of date t campaign conditions while some are the result of yesterday's conditions and some are the result of last week's conditions. In a manner of speaking, the dependent variable mixes several contribution vintages all of which must be regressed on the same political conditions. This could possibly lead to misspecification as one cannot separate the vintages and separately regress them each on the proper lag of campaign conditions. One potential solution is to simply include several lags of the political conditions and allow each lag to pick up one of the vintages. However, because political conditions, as measured by IEM prices, are a random walk and thus highly persistent, this leads to severe multicollinearity. Luckily, however, we are rescued by this very persistence! Because the IEM price is a random walk, the difference in IEM price between any two dates is white noise error. Thus matching a particular vintage of contributions to political conditions that are too recent

simply induces white noise error in the independent variable. To avoid the resulting attenuation bias, we include lagged differences in the IEM.

More formally, suppose the true model includes heterogeneous delay such that a day's recorded contributions are the result of K lags of political conditions where ψ_k indicates how strongly contributions of delay k respond to political conditions.

$$C_t = \sum_{k=1}^{K} \psi_k P_{t-k} + \varepsilon_t$$

$$P_t = P_{t-1} + \eta_t$$

Substituting recursively allows us to rewrite contributions:

$$C_t = \left(\sum_{k=1}^{K} \psi_k \right) P_{t-1} + \left[\varepsilon_t - \sum_{k=1}^{K} \psi_k \left(\sum_{l=1}^{k-1} \eta_{t-l} \right) \right] \tag{2}$$

Since the error terms, η and ε are both mean zero normal, the term in brackets is also mean zero normal but it is now correlated with the dependent variable, P_{t-1} through previous shocks to the IEM, η. Thus we must include K lags of η, the change in the IEM price, in the regression.[19] Then, regressing contributions on a single lag of IEM price plus the K lagged changes in IEM price

$$C_t = \beta P_{t-1} + \sum_{k=1}^{K} \alpha_k \eta_{t-k} + \varepsilon_t$$

$$\Rightarrow \hat{\beta} = \sum_{k=1}^{K} \psi_k$$

yields an unbiased coefficient estimate equal to the sum of the partial effects at all lags. In sum, we can safely lump all vintages together and regress on a single lag of IEM price because that IEM price is a good proxy for the political conditions prevailing when the decision to contribute was made, whenever that was.

The identification of the model rests on an assumption about the timing of contributions. There are many steps that must take place before an unexpected increase in contributions can affect the candidate's perceived chance

---

[19] We are indebted to an anonymous reviewer for this suggestion.

of victory. First, the check must be recorded and vetted before the funds
are transferred to the campaign. Next the campaign manager must update
budget decisions in response to the extra money. Once the money has been
allocated to a particular expenditure, a contractor must be found and the
money spent on additional mailings or advertising. And finally, these activ-
ities must have their effect on the audience and this effect must be noted
by the IEM participants. Our identification rests on the notion that this
transmission process takes longer than the longest lag, K; thus innovations
in campaign contributions do not cause changes in IEM price within the
same week.[20] Using the implied exclusion restriction, the ARIMA model of
Equation (1) is valid and the estimated relationships may be interpreted as
causal. This identification strategy is one major advantage of using high-
frequency longitudinal data.

The results from the pooled regressions are presented in Table 2. We can-
not control for the general election prospects for the democratic nomina-
tion of 2004 because the relevant IEM market was not initiated until rela-
tively late in the invisible primary. Thus, in columns (1) and (2), we present
results both with and without this control. First, the estimated elasticity of
fundraising with respect to IEM price, 0.36, is moderately large and highly
significant. Thus a doubling of a candidate's IEM price would lead to a 36%
increase in fund-raising. It is worth noting that a positive coefficient can be
generated either by a candidate on the way up enjoying increases in both
perceived chance of victory and fundraising, or by a candidate on the way
down, seeing his or her prospects diminish resulting in withered fundraising.
Indeed, some candidates, such as Howard Dean in 2004, traverse the path in
both directions. Second, the estimated autoregressive coefficient, 0.22, is also
highly significant and moderately large. Thus the total cumulative impact
on contributions from a single innovation to probability of victory, given by
$\beta_1/(1-\varphi_1)$, is roughly 128% of the initial impact.

---

[20] One might wonder why campaigns do not simply release the information immediately, hoping
to generate hype. In fact, this does happen, but only very rarely for unusually large single
day totals. On November 5, 2007, Republican candidate Ron Paul released a press statement
claiming to have raised more than $2.7 million over the past 24 hours via online donations,
setting the single day record. As it turns out, it was not until the next day that the campaign
completed and reported its final tally which turned out to be over 50% larger than originally
estimated. This example shows that even a moment specifically designed as a media coup, with
donations collected online to facilitate counting, required overnight counting and a 50% revision
of the initial estimate. This suggests that keeping a real-time running total of expenditures is
probably not an efficient use of scarce staffer time.

Table 2. The elasticity of fundraising with respect to perceived viability.

	(1)	(2)	(3)
Lag of log(contributions), $[\phi_1]$	0.220	0.203	0.191
	(0.020)	(0.025)	(0.025)
Lag of Log(IEM price), $[\beta_1]$	0.358	0.380	0.023
	(0.063)	(0.069)	(0.162)
Lag of Log(IEM price) squared			0.087
			(0.031)
Lag of Log(General Election IEM price), $[\beta_2]$		0.953	1.740
		(0.901)	(0.954)
Days until the convention, $[\beta_3]$	−0.002	−0.002	−0.003
	(0.0007)	(0.0007)	(0.0007)
Obs.	6449	5140	4678
Candidates	26	20	18
Within-candidate R-squared	0.446	0.465	0.453

All specifications include fixed-effects for each candidate, day of the week, and week of the quarter. Specification (3) does not include the candidates classified as wire-to-wire front-runners (Gore00, Bush00)

Figures 2 and 3 present the results from the candidate-by-candidate regressions.[21] For Figure 2, the y-axis plots the estimated elasticity of fund-raising with respect to IEM price; the x-axis plots the midpoint of the candidate's range of IEM scores during the competitive part of the primary. For example, in 2000 George Bush's IEM score ranged from a low of 65 to a high

---

[21] Estimating independent equations for each candidate may seem to rule out competition between candidates for funds. First, the fundraising literature emphasizes that campaigns do not compete heavily for the same pool of donors, but rather establish their own base and try to milk it. Second, the evidence shows that the largest campaign donors — who might be identified and sought by multiple campaigns due to past support of the party — very often support multiple candidates. Thus we believe such competition is of second order to mobilization of one's own list. Moreover, because the probability of victory must sum to one over all candidates in an efficient prediction market, any improvement of a rival's prospects will be taken into account via the consequent fall in a candidate's own probability of victory. Thus, what fundraising competition does exist is accounted for indirectly in specification (1) despite running the candidates separately.
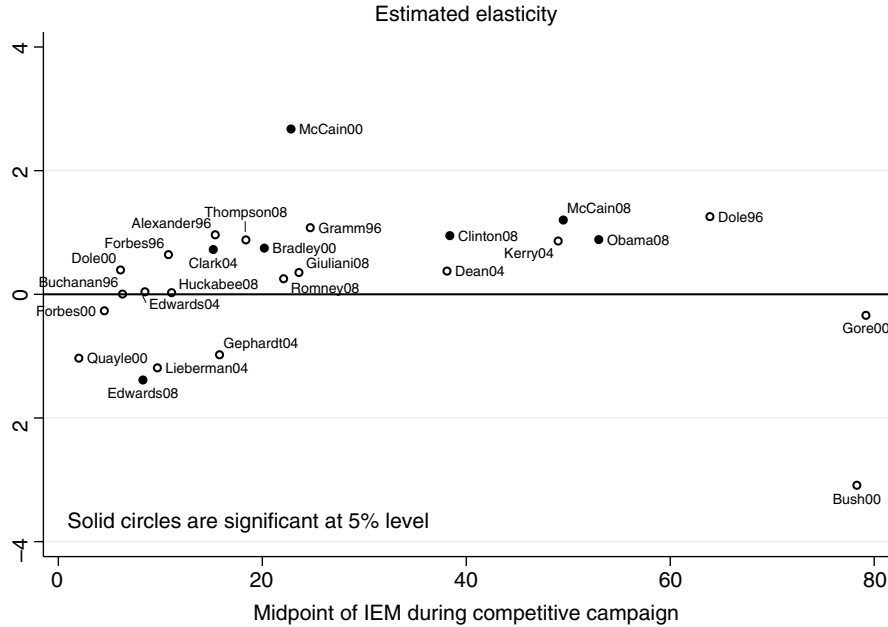
Figure 2. Elasticity of fund-raising with respect to IEM price.

of 91.5 yielding a midpoint of 78.25. The purpose is to demonstrate heterogeneity in the marginal effect of viability. While Bush00, and Gore00 are outliers, the remainder of the sample exhibits a strong pattern: the elasticity increases as the candidate's IEM midpoint increases. Bush00 and Gore00 are the two campaigns in our sample who were wire-to-wire front-runners in the IEM. They are thus the two candidates whose viability was never in doubt. But for candidates whose viability is in doubt, the pattern suggests that the elasticity of fundraising is an increasing function of viability. Thus we have rerun the pooled regression with a quadratic term restricting the sample by dropping the two outliers (Table 2, column 3). The quadratic term is highly significant, confirming that the candidate-by-candidate results of Figure 2 are replicated in the pooled sample. Finally, we can see with the corrected specification that a candidate's fundraising responds strongly to changes in their party's prospects for the general election. While the estimated elasticity, at 1.74, is quite large, it is important to remember that changes in the probability of the general election are generally modest in scope.
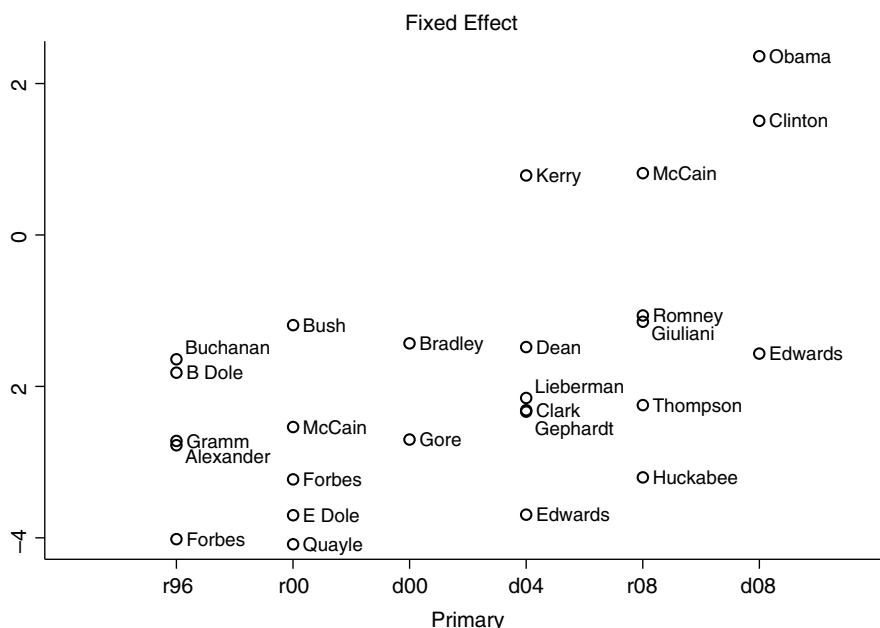
Figure 3. Candidate fundraising abilities.

These are the candidate fixed-effects from Table 2, Specification 1. These are best interpreted as the relative fundraising ability of the candidates after controlling for perceived viability.

Figure 3 plots the fixed-effect from the candidate regressions on the y-axis. These fixed-effects can be roughly interpreted as the candidates' comparative ability to raise money keeping perceived viability and time-to-convention fixed. The x-axis groups the regressions by primary to enable comparisons across candidates within the same contest. As can be seen, more recent primaries draw more money, thus all candidates enjoy larger fixed-effects. Notice that winners tend to be strong fundraisers, even after controlling for perceived viability. Al Gore is the only primary winner that did not have the highest fixed-effect (or very nearly so for Bob Dole) of the competitors in the primary.

We have established that for challengers, fundraising is strongly responsive to perceived viability and that this elasticity is increasing in viability. What causes this nonlinear relationship? Brown *et al.* (1995) note that "[c]ontributors and solicitors who are not strongly committed to a candidate

may disappear if the candidacy falters and the prospects for election diminish.'' In general, the literature on contributors (and the solicitors who deliver them) suggests that a campaign possesses an island of strongly committed backers that will ride through thick and thin amidst a sea of strategic money that is attracted by the prospect of electoral success. Our results fit with this characterization. The viability of the front-runners has already been demonstrated; hence the variations in IEM price are generally swamped by other factors in the contributor's calculus. As a result, front-runners' contributions are largely invariant to fluctuations in IEM price and, to the extent there is some response, it may even be negative as money flows faster when the campaign loses ground to a potential challenger and needs assistance.[22] Not so for lesser challengers, who must demonstrate their viability to potential supporters. Why then does the elasticity increase with the IEM price? The longest of long-shots cannot generate sufficient prospects to begin to attract the tide of strategic money and thus, fluctuations in their slim perceived chance of victory mean little for their fundraising yields. However, as candidates demonstrate increasing viability, increases may plausibly be sold to potential contributors as evidence of a run to prominence.

5   Candidate Appearances

As a second analysis of fundraising, we study the effects of candidate appearances on statewide fundraising. We ask whether perceived chance of victory increases the fund-raising productivity of candidate appearances. Looking at a cross-section of state-level data constitutes a new cut of the data which corroborates our longitudinal results.

In order to raise money, ''candidates must assemble a set of benefits that will attract enough contributors to fund the campaign ... [and] build an organization to distribute these benefits and attract members.'' (Brown

---

[22] In a related analysis, we look at the effect of announcements by two prominent potential candidates waiting in the wings during the primary season: General Colin Powell in 1996 and Hillary Clinton in 2004. To the extent that these constitute large shocks to the perceived chances of the current field of candidates which are not already captured by fluctuations in the IEM, we would expect to find some effect on fundraising. Using interrupted time-series techniques, we find that the elimination of rivals who have already been shown to be lesser (Clinton was trailing in the polls in 2004) makes little difference to the fund-raising process of front-runners, but a legitimate challenge to their status as front-runners (Powell in 1996) can make a very large difference. See Feigenbaum and Shelton (2009).

et al. 1995) One of the most important, and most limited, benefits to be distributed is access to the candidate himself or herself. We have argued in the preceding sections that there exists a positive effect of viability on fund-raising and we have shown that, for many candidates, aggregate contributions increase with perceived chance of victory. If candidate appearances serve as a *quid pro quo*, providing immediate social returns in exchange for contributions, then it seems likely that the more popular the candidate, the greater the demand for his or her presence and the greater the contributions such an appearance would solicit. This kind of exchange is a local one: the contributors involved are physically present at the candidate's event or connected via local news and personal networks. As a result, were we able to track a candidate's appearances, we would expect to see increased contributions in the vicinity.

With this test in mind, we return to the FEC dataset and generate the total contributions in a given week for a given candidate in a given state. We then use the Washington Post dataset on candidate appearances in the 2008 primaries, described in the section on candidate appearances, to create a dummy variable indicating whether a given candidate has made an appearance in a given state in a given week. Thus we have a panel dataset, with weekly data by candidate–state pair, describing total funds raised and whether a candidate appearance was made. To this we add the IEM market data measuring the candidate's perceived chance of victory during the week in question.

We perform a simple panel regression looking for the contemporaneous effect on state-wide fundraising of a candidate appearance within the same state. Our specification is

$$C_{c,s,w} = \varphi_1 \sum_{j=1}^{13} C_{c,s,w-j} + \beta_1 V_{c,w} + \beta_2 A_{c,s,w} + \beta_3 (V_{c,w} \times A_{c,s,w})$$

$$+ \beta_4 P_{c,w} + \beta_5 D_{c,w} + \beta_6 (V_{c,w} - V_{c,w-1}) + F_c + \varepsilon_{c,s,w} \qquad (3)$$

where $C_{c,s,w}$ is total contributions from individuals to candidate c in state s in week w, $V_{c,w}$ is the probability of victory, $P_{c,w}$ is the measure of the popularity of the candidate's party, D_w is the number of days until the candidate's convention, and F_c are candidate fixed-effects. We include a full quarter's worth of weekly lags of the dependent variable to control for the fact that candidates might choose the location of their appearances in response to

previous fundraising successes and failures.[23] And we include the change in the IEM to address the measurement lag in contributions discussed in the previous section. Total contributions for a candidate in a state are quite often zero, especially for lesser candidates, smaller states, and earlier in the campaign. This is analogous to left-censoring of the observed supply of contributions, thus we estimate the model via panel Tobit.[24] The coefficient of particular interest here is β_3, which indicates whether the candidate's current political fortunes ($V_{c,w}$) affect the fundraising productivity of candidate appearances ($A_{c,s,w}$). But we will also look at β_1, β_2, β_4, and β_5 to corroborate results from "The battle for the bucks" section.

This approach contains at least three important simplifications. First, we have chosen to aggregate contributions and events to the state level rather than county, zip code, or some other geographic partition. Making such a choice requires taking a stance on the geographic scope of the fund-raising benefits of an appearance. Both attendance — leading to priming and direct solicitation — and local media coverage — leading to priming for other forms of solicitation — likely reach a wider audience than the immediate zip code. One also suspects that there are unannounced fund-raisers in the evenings after the events in the database. These need not be in the same zip code but are likely in the same state. Of course, while picking up a larger fraction of the signal, aggregating at the state level rather than the zip code is also likely to pick up more noise in the form of unrelated fluctuations in contributions. We believe the state is the proper level of aggregation to maximize the signal to noise ratio.[25] We have also chosen to look only for same-week effects, rather than allowing events to affect local fundraising for

---

[23] Adding additional lags all the way through 16 weeks improves the Akaike information criterion suggesting improved fit of the model. However, a close examination of the coefficients suggests that lags beyond one quarter are contaminated by seasonal patterns. As the gains to the AIC are marginal beyond the 13th lag, we choose to keep only 13.

[24] This also means we cannot use the log transformation so coefficients are no longer elasticities.

[25] We have also tried aggregating by three-digit zip code. Zip codes follow a simple pattern. The first digit represents a group of states (for example, a leading four signals the state is either Michigan, Indiana, Ohio, or Kentucky). The next two digits are the region within that state group, usually centered on a major city (for example, 432xx is a zip code centered on the postal hub of Columbus, OH). These three-digit zip codes represent US Postal Service sectional center facilities. (The final two digits identify cities and towns individually.) Hence the three-digit zip code represents a sizable, contiguous, geographic area including several towns which is nonetheless significantly smaller than the state. However, densely populated metropolitan areas such as New York City often have several three-digit zip codes within close proximity. It is quite likely that an event listed in one zip3 would draw contributions from neighboring zip3s. Indeed, the empirical results do not display a strong pattern.

several weeks in the future.[26] In light of a complete lack of theoretical priors for what such a time-path should look like, we felt such an exercise would constitute little more than data mining. The current approach is thus likely an underestimate of the total local effect of candidate appearances. Iowa and New Hampshire, as the sites of the first Caucus and Primary, receive a disproportionate number of candidate appearances. Because visits are likely subject to diminishing returns and because candidates visiting these states likely conduct their business with a different set of goals (free press rather than fundraising), we drop these two states from the regression. Finally, with the results from "The battle for the bucks" section in mind, we have also run the sample allowing IEM price to have a quadratic effect on contributions.

The results for both specifications are reported in Table 3. The estimates reiterate the results from "The battle for the bucks" section: a candidate's fund-raising responds strongly to his/her perceived chance of victory. To this we can now add that a candidate appearance raises more contributions when the candidate's perceived chance of victory is high. This holds for both the front-runner and the rest of the pack. These results suggest that electoral success increases the productivity of the scarcest campaign resource: candidate time. Most importantly, the results confirm that bandwagoning by contributors eager to associate with a winning campaign is a plausible driver of the link between viability and fundraising.

6   Productivity of Campaign Expenditures

6.1   The Direct Effect

"The battle for the bucks" and "Candidate appearances" sections have documented the effects of electoral success on the ability of candidates to raise money. We have both confirmed the initial hypothesis that perceived viability helps raise money and established that this relationship is increasingly powerful as the candidate increases in status. It is time to turn to the other half of the positive feedback loop: the effects of campaign expenditures on electoral success, both perceived and actual. During the campaign, a candidate spends money to pay for campaigning trips — speeches and appearances that generate support both directly and indirectly via free

---

[26] Unfortunately, at our preferred daily frequency, events are sufficiently rare within the vast {candidate} × {day} × {state} space that several of our independent variables are collinear with the fixed-effects. Thus we must aggregate to weekly data.

Table 3. Candidate appearances and fundraising.

	Linear	Quadratic
	(1)	(2)
Probability of victory, β_1	518.130	429.072
	(58.669)	(141.492)
Probability of victory squared		1.335
		(2.033)
Dummy(appearance), β_2	332.877	291.295
	(4141.604)	(4139.412)
Prob. of victory * dummy (appearance), β_3	952.485	958.320
	(111.114)	(111.082)
Own party prob. of national victory, β_4	18937.990	9581.846
	(22171.040)	(22418.290)
Days to convention, β_5	−177.732	−170.190
	(8.435)	(9.034)
Obs.	8389	8389
Obs., uncensored	6736	6736
χ^2 statistic	7043.799	7058.659
prob $(> \chi^2)$	0	0

Dependent variable is contributions to the candidate from a particular state in a particular week. Estimated using panel tobit. Specification includes one financial quarter's worth of lags of the dependent variable and candidate fixed-effects.

media — and to pay for advertising in a variety of media outlets such as TV, internet, radio, and direct mail. In order for the feedback loop to present a true chicken-and-egg problem, it must be the case that this spending can raise a candidate's stature *during the campaign itself, sufficiently swiftly for this increased stature to then empower future fundraising*, as per the results of previous sections. Without a sufficiently swift reaction, the positive feedback would have insufficient time to develop and would not deliver as strong a barrier to the initial long-shots.

Consider a model in which the probability of victory for candidate c at time t, $V_{c,t}$, depends on the spending in the previous period by the candidate, $E_{c,t-1}$, spending by his or her opponents, $\hat{E}_{c,t-1}$, the quality of the candidate,

Q_{c}, the quality of his or her opponents, $\hat{Q}_{\mathrm{c}}$, and a public preference for candidate c, a_{c}, which is a function of the set of candidates but is imperfectly observed, such as preference based on policy position.

$$V_{\mathrm{c},t} = \beta_1 E_{\mathrm{c},t-1} + \beta_2 \hat{E}_{\mathrm{c},t-1} + \gamma_1 E^2_{\mathrm{c},t-1} + \gamma_2 \hat{E}^2_{\mathrm{c},t-1}$$
$$+ \delta_1 Q_{\mathrm{c}} + \delta_1 \hat{Q}_{\mathrm{c}} + a_{\mathrm{c}} + u_{\mathrm{c},t}$$

With panel data, one can simply roll the unobserved candidate-specific terms into candidate fixed-effects. To the extent that candidate quality is fixed, then estimates of the effect of campaign spending on vote share will be unbiased.[27]

$$V_{\mathrm{c},t} = \beta_1 E_{\mathrm{c},t-1} + \beta_2 \hat{E}_{\mathrm{c},t-1} + \gamma_1 E^2_{\mathrm{c},t-1} + \gamma_2 \hat{E}^2_{\mathrm{c},t-1} + \nu_{\mathrm{c}} + u_{\mathrm{c},t} \qquad (4)$$

We estimate Equation (4) using quarterly data for expenditures and the beginning-of-quarter IEM price to calculate $E_{\mathrm{c},t-1}$ and $V_{\mathrm{c},t}$.[28] Average expenditures per candidate by quarter increase over the course of the campaign and then fall off in the final quarter because many campaigns end during the second quarter of the year of the general election. We also suspect that during the primary season itself (the first two quarters of the year of the general election) the relationship between expenditures and IEM price is affected by voting results and thus likely to be different than the relationship of the preceding year. To avoid erroneously estimating one relationship for two distinct periods, we limit our sample to the year prior to the election.[29]

Much of the effort in the invisible primary is directed at influencing activists and journalists, recruiting skilled campaign workers, setting up local campaigning offices, and eliciting endorsements. While many of these activities are unlikely to show up in the polls until much later, there is

---

[27] We consider candidate quality to encompass the candidate's prior experience in public office, ability as a public speaker, and relative ideological position, among other qualities. While prior record can be spun it cannot be altered. Candidates can and do adjust their issue positions but rarely change relative positions. And while candidates learn, it is clear that idiosyncratic weaknesses are difficult to erase, often resurfacing repeatedly. In sum, we believe these fixed-effects are relatively fixed and that we can successfully demean the probability of victory model given above.

[28] Hence expenditures in the fourth quarter of 1999 are matched to IEM price on Jan 1, 2000.

[29] As it turns out, adding the primary season itself does not change the sign and significance of the coefficients. Nonetheless, given the complexities of the actual primary and the commensurate likelihood of a change in specification, we feel this is the proper approach.

strong evidence that IEM traders do pay attention to endorsements and early pieces of journalism including those in specialty outlets. For example, Howard Dean's price jumped 9 cents in a single day in December 2003 on early news reports that he was to receive Al Gore's endorsement *the following day*. The end of day price following the actual announcement was only 1 cent higher, suggesting that 90 percent of the IEM response occurred before the endorsement was formally announced. In short, campaign efforts during the invisible primary lead to results which move the IEM. While we are unable to disentangle exactly how expenditures lead to increased viability, we can measure the net effects.

The results, presented in column 1 of Table 4 show a strong and significant effect of campaign spending on market estimates of the probability of victory. Spending an additional $1 million (real 2000 dollars) increases the IEM probability of victory by as much as 1.75 percentage points. However, an additional $1 million in expenditures by one's opponents reduces one's probability of nomination by as much as 1 percentage point. As expected, spending by any candidate exhibits decreasing returns to scale. On the one hand, this confirms the other half of the feedback loop. On the other hand, it is worth noting that candidate fixed-effects are estimated to explain 86% of the variation in the probability of victory measure (see ρ). In other words, recent campaign spending is an important factor in determining a candidate's perceived viability, but other factors such as policy positions, campaigning ability, and endorsements are likely even more important.

Because the IEM is a forward looking asset market, we would expect traders to take into account not only current spending, but also expected future spending as measured by cash-on-hand. Columns 2 and 3 of Table 4 include cash-on-hand in linear and then quadratic form. While the standard errors are quite large, the signs are as expected. The magnitude of the coefficients on own expenditure and own cash-on-hand sum to 1.82 (column 2), which is very similar to the original coefficient on own total expenditure. This implies that the original specification was picking up the effects of both current and future expenditures. The effect of current expenditures is closer to 1.15 IEM points per million dollars.

6.2   *Voting with Money: Signaling via Fundraising News*

There is an alternate view of the role of money which deserves mention. In accord with Prat (2002), many believe campaign contributions are signals

Table 4. Quarterly expenditures and IEM price.

	IEM price (V)		
	(1)	(2)	(3)
Own total exp, E	1.752	1.147	1.091
	(0.746)	(0.689)	(0.647)
Own total exp^2, E^2	−0.024	−0.010	−0.008
	(0.014)	(0.018)	(0.017)
Opponents' total exp, $\hat{E}$	−1.030	−0.680	−0.857
	(0.307)	(0.314)	(0.276)
Opponents' total exp^2, $\hat{E}^2$	0.011	0.007	0.009
	(0.005)	(0.005)	(0.004)
Own cash-on-hand, C		0.675	0.749
		(0.588)	(0.825)
Own cash-on-hand^2, C^2			−0.002
			(0.016)
Opponents' total cash-on-hand, $\hat{C}$		−0.318	−0.846
		(0.291)	(0.438)
Opponents' total cash-on-hand^2, $\hat{C}^2$			0.008
			(0.004)
N	73	73	73
Candidates	23	23	23
ρ	0.863	0.781	0.778
R^2 (within)	0.255	0.311	0.362
R^2 (overall)	0.378	0.673	0.678
R^2 (between)	0.41	0.696	0.686

Expenditures data are in millions of real 2000 dollars. IEM price data are in percentage points.

of the candidate's quality. Essentially, each voter possesses noisy private information about candidate quality and gives money to the candidate his/her private information suggests is the best. Thus there is a positive relationship between the true quality of the candidate and the amount of contributions he/she is able to rake in, allowing a voter to improve his/her private signal of a candidate's quality simply by noting how much money

he/she has raised, thereby internalizing the private information of others. In this view, campaign expenditures may or may not also directly influence voters via paid advertising and candidate appearances. Fundraising is thus a sort of continuous straw poll in which monetary votes are publicly counted and may influence the views of other voters going forward.

Given the level of press coverage devoted to quarterly FEC fundraising totals, and the success of signaling models and the informational properties of voting in other contexts, this is an intuitively plausible and appealing model that deserves attention. To test it, we have run an interrupted event study using the FEC reports in which candidates' quarterly or monthly fundraising totals are released. We begin by building an ARIMA model for the IEM markets for each candidate. Then we use intervention analysis to estimate the magnitude of the initial impact and the rate of exponential decay of the news from FEC reports. To limit to the period of most intense media scrutiny, we use the releases for the third and fourth quarter of the year before and the first monthly release for the year of the general election.[30]

The overwhelming pattern in the data is the insignificance of fundraising news releases on the IEM probability of nomination for all candidates in the sample. Of the 45 candidate–release pairs in our sample, only five are significant at the 10% level. This is no different from the results of a random sample. Moreover, the pattern of signs among these significant coefficients does not seem to match the tenor of the press coverage following the release. For example, in December of 2003, Dean reported $16 million in fourth quarter contributions bringing his total to $40.9 million. While both of these marks led the field, the estimated impact of this FEC report was a five point decline in his/her probability of victory.[31] We submit that the results are simply random noise with no evidence of a systematically significant effect.

These results are surprising given that Table 3 clearly showed that cash-on-hand, a measure of expected future spending, was related to current IEM price. Since fundraising is also a measure of expected future spending, we would have expected a connection between fundraising news and IEM price. We suspect this discrepancy has more to do with the dating of the

---

[30] Recall that FEC reports are filed quarterly the year before and monthly the year of the general election.

[31] This result is not driven by Dean' s later failure in the Iowa caucus.

information than its interpretation by the market. Quarterly reports are due exactly 10 days after the end of the quarter and the information is released exactly 5 days after that. Nonetheless, it is quite plausible that the official FEC release date is not, in fact, the actual date at which the information is released to the public or the IEM participants. Many campaigns release their numbers (or hint at them) to the media before the FEC announcements. In an attempt to address early information leaks, we have done media searches to identify the date of first mention and have used this instead of the official release date. The results remain insignificant. Admittedly, we have no guarantees that we have successfully identified the actual date the information first became public. It is possible that insiders leak the knowledge before mention in the press. Nonetheless, while not completely disproving the money-as-signal theory, our evidence suggests that at the very least, the diffusion of that information is very gradual.

7 Simulations

In the preceding sections, we have argued that there is a robust significant positive feedback loop between contributions and perceived chance of victory. Ultimately, we are interested in whether this feedback loop is strong enough to significantly alter the dynamics of a campaign. In particular, we ask two questions. First, we ask how important it is to be anointed the initial front-runner and whether this anointing can, because of the positive feedback loop, be self-sustaining. Second, we ask whether a wealthy candidate can, via profligate self-financing, emerge from the pack to challenge an established front-runner. To answer these questions, we have conducted a pair of calibrated simulations.

We use the coefficients presented in Tables 2 and 4 to simulate the paths of contributions, spending, and perceived chance of victory for a set of candidates in response to a pre-determined shock.[32] The setting is stochastic — in addition to the specified shock of interest, there are random weekly shocks to perceived chance of victory — thus we run the simulation 5000 times,

---

[32] There are two important respects in which the estimates from "The battle for the bucks" and "Productivity of campaign expenditures" sections differ. First, the former are elasticities while the latter are in levels. This requires no special assumptions, merely a transformation of units. Second, the former are daily while the latter are quarterly. Thus we assume that IEM price responds to the quarterly equivalent of current daily spending.

generating a distribution of paths. We then report the mean path plus upper and lower bounds at $+/-$ two standard errors. In addition to the behavior of contributions and the effectiveness of spending, we have calibrated several other important parameters — initial levels of spending, initial levels of perceived chance of victory, and the standard deviation of the shocks to perceived chance of victory — using the data from an actual primary which mimics the scenario in question.

In the first case, we postulate two identical candidates and calibrate their fundraising abilities to the Gore–Bradley race of 2000.[33] We then arbitrarily designate one of the two identical candidates the front-runner, give him a 67–33 advantage in the IEM markets, and simulate the path of contributions and IEM price in response to this symmetry-breaking. The resulting paths are displayed in Figure 4. We have chosen to show only the path of the front-runner because the path of the challenger is precisely a mirror image for IEM price and very nearly so for contributions.

We find that the arbitrarily assigned front-runner advantage is not self-sustaining. The advantage in stature does lead to a sizable advantage in fundraising for the front-runner, which, due to the autoregressive nature of contributions, takes a few days to build to its zenith. Nonetheless, because the effects of additional spending are, while robustly positive, relatively weak, the resulting spending gap is not sufficient to sustain the gap in IEM prices which produced it. As a result, the unearned and unwarranted front-runner advantage gradually bleeds away. Seven months later — the period of time between the opening of the IEM in Jun 1999 and the first primaries in Jan 2000 — the advantage is a mere 52–48.

This is an important result because it suggests that the vicious cycle is not strong enough by itself to enforce and make permanent an advantage gained by (possibly spurious) initial impressions. In a sense, a candidate must also earn the front-runner status in other ways — such as by being the better candidate and thus receiving greater support from a given amount of spending — in order to retain it.

Our second exercise simulates the advantages of an exogenous increase in campaign funding as a result of self-financing by a wealthy candidate. Here

---

[33] Daily contributions for each candidate are set to $47,000 when the IEM is at 50–50 (an average of the two candidates' actual weekly fundraising during the money primary). The standard deviation of shocks to the IEM price is calibrated to match the Gore–Bradley money primary as well.
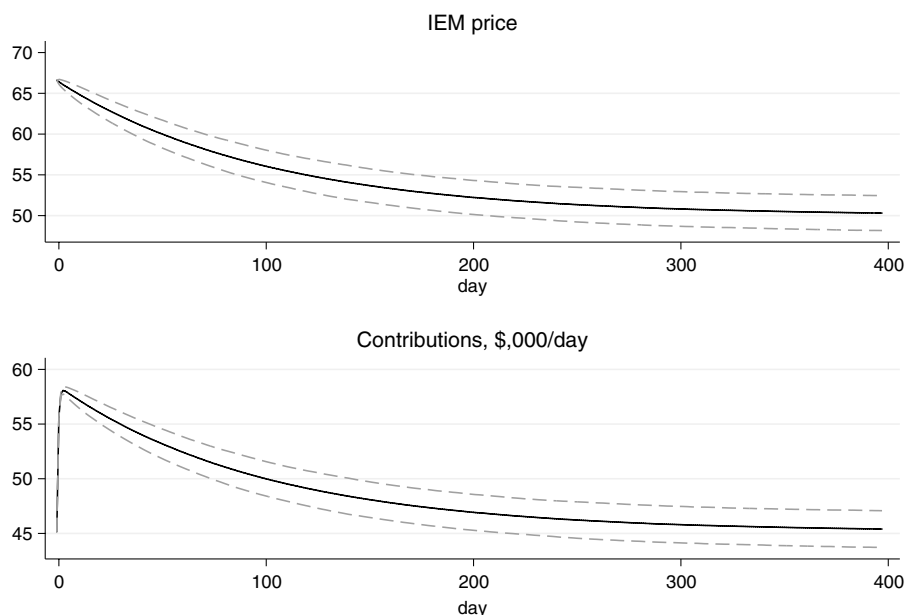
Figure 4. How durable is front-runner advantage?

One of two identical candidates is gifted an initial advantage of 67–33 on the IEM. In the
upper graph, the solid line displays the simulated evolution of the IEM price of the front-
runner over the subsequent year. The dotted lines demark a confidence interval of two
standard deviations on either side. The lower graph shows the evolution of contributions
for the front-runner. The initial advantage in stature conveys a significant advantage in
fundraising but because the productivity of spending is relatively low, this advantage in
fundraising is insufficient to maintain the advantage in IEM price. Thus, the vicious cycle
cannot, on its own, sustain a front-runner: there must be some difference between the
candidates.

we calibrate the scenario to the Republican primary of 1996. Steve Forbes'
formally entered the race on September 22, 1995, 143 days before the Iowa
caucus. During his campaign he spent $37.9 million of his personal fortune,
more than 13 times the private contributions he raised. Given Forbes' date
of entry, we calibrate to 1995q4, when the race had essentially settled into a
front-runner (Dole) and three challengers (Gramm, Alexander, Buchanan)
plus the self-financed Forbes.[34] We model campaign contributions and IEM

---

[34] We take our starting values for the IEM as the normalized IEM prices of the candidates dur-
ing this period, rounded to nice numbers. We calibrate initial candidate contributions as the
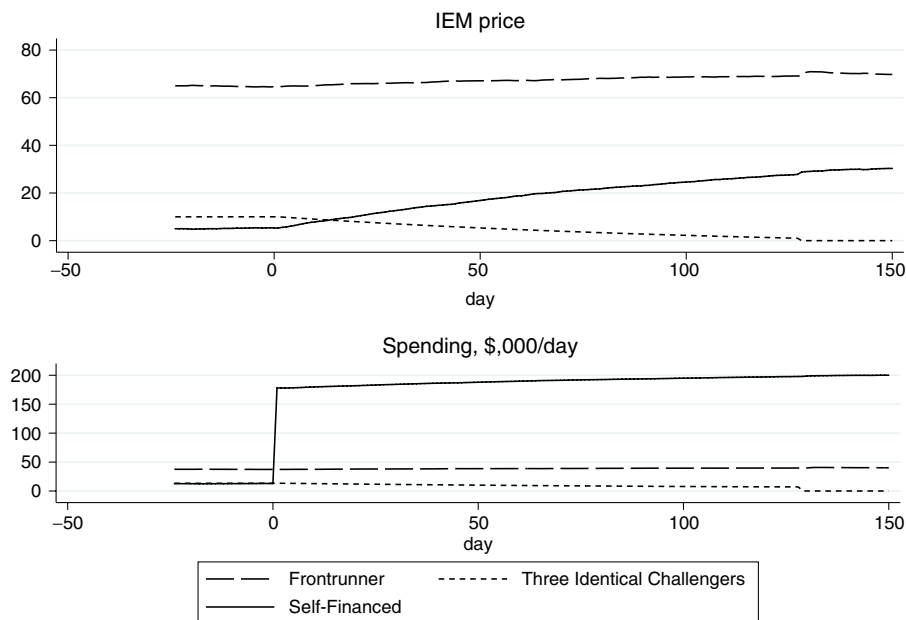average value of each candidate's private fourth quarter contributions data. We deliberately

IEM price

Spending, $,000/day

Figure 5. Can a self-financed candidate emerge from the pack?

A candidate self-finances to the tune of 12 times their external contributions in an attempt to emerge from the pack and challenge the established front-runner. The slight hitch at period 128 is due to the challengers dropping out of the race as their IEM price drops below 1 cent.

price as before, but now allow the self-financed candidate to spend in excess of elicited contributions. The results are displayed in Figure 5.[35]

Our simulation produces dynamics that are similar to the actual invisible primary of 1996. During the invisible primary, Forbes' spending did enable him to emerge from the pack. By February 2, 1996, 133 days after entering the race, Forbes' IEM contract was trading at 21.5 cents, overshadowing Gramm (11.9), Alexander (5.4) and Buchanan (5.1). On the eve of the caucuses, this was Forbes' high-water mark. His contract would decline following

---

simulate three identical challengers so as to focus on the dynamics of the self-funded candidate. Thus we use averages from the three actual challengers — Gramm, Alexander, and Buchanan — to calibrate the generic challenger. The self-financed candidate's extra expenditure is also calibrated to the average daily amount Forbes spent in 1995q4.

[35] Standard errors have been suppressed for legibility. The existence of a local minimum causes estimated contributions to escalate rapidly as IEM price approaches zero. Thus to avoid this unrealistic response, we assume candidates drop out once their IEM price drops below 1%.

the Louisiana (Feb 6) and Iowa (Feb 12) caucuses as it became clear that voter support remained tepid despite his profligacy.

Our simulation, drawing on coefficients estimated from a pooled sample, suggests such dynamics are to be expected more generally. Specifically, 4 months of exceptionally high spending by a marginal candidate can enable that candidate to emerge from the pack as the sole challenger to the established front-runner. However, in our simulations, the self-financed candidate is unable to catch the front-runner (Figure 5 shows the mean result; in *none* of the 500 repetitions did the self-financed candidate catch the front-runner). Forbes entered the race quite late. But our simulation shows that even had he entered the race at the beginning, spending alone would not have overcome whatever flaws he had as a candidate. We find that, even after an entire year of such exceptionally high spending, the self-financed candidate's simulated IEM price is 34 cents and stable. Thus, here too we find that while money is a significant aspect of the invisible primary, it does not dominate candidate selection.

8   Summary and Discussion

Using longitudinal and panel methods on a consistent set of US presidential primaries, we have shown that both sides of the vicious cycle are statistically significant. A candidate's fundraising responds strongly and significantly to the candidate's perceived chance of winning the nomination ("The battle for the bucks" section). Moreover candidate appearances are more productive in fundraising when the candidate is popular ("Candidate appearances" section). This gives direct evidence in favor of the specific mechanism at work — that increases in perceived electoral viability mean increased associative benefits stimulating increased contributions — and serve to confirm the results of the dynamic analysis with a cross-sectional approach. Finally, we take the first look at the dynamic feedback from expenditures to viability *during the campaign* and find strong and significant evidence that money increases the perceived chance of victory of those that spend it, to the detriment of rivals ("Productivity of campaign expenditures" section).

Nonetheless, despite positive and significant feedback in both directions, the "Simulations" section shows that the vicious cycle is not sufficiently strong to explain, *by itself*, a durable front-runner advantage. The

fundraising advantage conferred on a candidate anointed the *ex-ante* front-runner is real, but the increased spending enabled is insufficiently productive to sustain the front-runner status by itself. To sustain a lead, the front-runner must possess some other advantage over his/her rival beyond the initial anointing. The fact that we observe front-runner advantage to be durable in our sample suggests that either the process by which the initial front-runner is identified correctly processes information about the quality of the candidates, or there are other elements to the feedback loop that reinforce front-runner status. For similar reasons, exorbitant spending by self-financed candidates may enable them to emerge from the pack but will not, by itself, deliver the nomination. Thus Aldrich's vicious cycle exists but is too weak to determine the nomination by itself.

Cohen *et al.* (2008) suggest looking first at whether party insiders can co-ordinate on a candidate that is acceptable to all factions and has a good chance of victory, as evidenced by formal endorsements from party elites and interest groups. If they can, money and voters will follow. But in their quantitative work, they find that "fundraising is neither clearly caused by other variables in the invisible primary nor a clear cause of other variables." (Cohen *et al.* p. 264) Our high-frequency analysis finds quite the opposite: money is strongly connected with our aggregate measure of perceived viability with statistically significant causality running in both directions. However, we do concur with their verbal argument in as much as money is more a symptom than a cause of success. Nonetheless, money does matter during the invisible primary and nontrivially so. We find that 22% of variation in the IEM is explained by variation in spending and cash-on-hand. It simply is not solely decisive. At present, we do not know which factors — free media, insider endorsements, policy positions, skilled campaign staff, debate performance, candidate charisma — are most important in accounting for the remaining fluctuations in perceived viability. The Iowa Electronic Markets price remains an aggregate indicator in need of decomposition. Thus we are presently unable to comment further on the central hypothesis in Cohen *et al.*: that party insiders control the nomination and money and voters follow. Further work is needed.

Hence the need for high-frequency data on a number of other dimensions during the invisible primary such as free and paid media, personal and interest group endorsements, and the recruitment of skilled campaign staff. The Supreme Court's ruling in the case of Citizen's United vs. FEC and the

resulting tidal wave of poorly tracked money directed by quasi-independent super PACs has made this job both more complex and of greater interest. Extending high-frequency methods to down-ticket races may be hampered by the thinness of the prediction markets covering these races but is also worth exploring.

We believe this paper shows the usefulness of high-frequency data analysis to untangle the feedback between various indicators of campaign success. The past two decades have seen many innovations facilitating the collection of high-frequency electoral data, among them online electronic access to FEC data, the development and proliferation of political prediction markets, the increasing compilation of repeated public opinion polls, the availability of candidates' calendars, and the recording and analysis of campaign advertising. We anticipate the gathering of systematic, high-frequency electoral data will continue to expand, enabling broader application of these methods.

References

Abramowitz, A. I. 2009. "Viability, Electability, and Candidate Choice in a Presidential Primary Election: A Test of Competing Models." *The Journal of Politics* 51(4): 977–992.

Adkins, R. E. and A. J. Dowdle. 2000. "Break Out the Mint Juleps?: Is New Hampshire the "Primary" Culprit Limiting Presidential Nomination Forecasts?" *American Politics Research* 28(2): 251–269.

Adkins, R. E. and A. J. Dowdle. 2002. "The Money Primary: What Influences the Outcome of Pre-Primary Presidential Nomination Fundraising?" *Presidential Studies Quarterly* 32(2): 256–275.

Adkins, R. E. and A. J. Dowdle. 2005. "Do Early Birds Get the Worm? Improving Timeliness of Presidential Nomination Forecasts." *Presidential Studies Quarterly* 35(4): 646–660.

Aldrich, J. H. 1980. *Before the Convention: Strategies and Choices in Presidential Nomination Campaigns.* Chicago, IL: The University of Chicago Press.

Ali, S. N. and N. Kartik. 2008. "Social Learning in Elections." University of California, San Diego. Working Paper.

Ansolabehere, S., A. S. Gerber, and J. M. Snyder, Jr. 2001. "Corruption and the Growth of Campaign Spending." In *A User's Guide to Campaign Finance Reform.* ed. G. C. Lubenow. New York: Rowman and Littlefield.

Ansolabehere, S., J. M. de Figueiredo and J. M. Snyder. 2003. "Why is There So Little Money in U.S. Politics?" *Journal of Economic Perspectives* 17(1): 105–130.

Aparicio-Castillo, F. J. 2006. "Campaign Finance Law, Electoral Competition, and Economic Policy." Ph.D. diss. George Mason University.

Bartels, L. M. 1988. *Presidential Primaries and the Dynamics of Public Choice.* Princeton, NJ: Princeton University Press.

Berg, J., R. Forsythe, F. Nelson and T. Rietz. 2000. "Results from a Dozen Years of Election Futures Markets Research." College of Business Administration, University of Iowa. Working Paper.

Bronars, S. G. and J. R. Lott Jr. 1997. "Do Campaign Donations Alter How a Politician Votes? Or, Do Donors Support Candidates Who Value the Same Things That They Do?" *Journal of Law and Economics* 40(October): 317–350.

Brown, C. W. Jr., L. W. Powell, and C. Wilcox. 1995. *Serious Money: Fundraising and Contributing in Presidential Nomination Campaigns*. Cambridge: Cambridge University Press.

Callander, S. 2007. "Bandwagons and Momentum in Sequential Voting." *Review of Economic Studies* 74(July): 653–684.

Cohen, M., D. Karol, H. Noel, and J. Zaller. 2008. *The Party Decides*. Chicago and London: University of Chicago Press.

Corrado, A. 2005. "Money and Politics: A History of Federal Campaign Finance Law." In *New Campaign Finance Sourcebook*. Washington: Brookings Institution, pp. 7–47.

Damore, D. F. 1997. "A Dynamic Model of Candidate Fundraising: The Case of Presidential Nomination Campaigns." *Political Research Quarterly* 50(2): 343–364.

Dekel, E. and M. Piccione. 2000. "Sequential Voting Procedures in Symmetric Binary Elections." *Journal of Political Economy* 108(February): 34–55.

Erikson, R. S. and T. R. Palfrey. 1998. "Campaign Spending and Incumbency: An Alternative Simultaneous Equations Approach." *Journal of Politics* 60(2): 355–373.

Erikson, R. S. and T. R. Palfrey. 2000. "Equilibria in Campaign Spending Games: Theory and Data." *American Political Science Review* 94(3): 595-609.

Erikson, R. S. and C. Wlezien. 2008. "Are Political Markets Really Superior to Polls as Election Predictors?" *Political Opinion Quarterly* 72(2): 190–215.

Feigenbaum, J. J. and C. A. Shelton. 2009. "The Vicious Cycle: Fundraising and Perceived Viability in US Presidential Primaries." Robert Day School of Economics and Finance Research Paper No. 2009–08.

Forsythe, R., T. A. Rietz, and T. W. Ross. 1999. "Wishes, Expectations, and Actions: A Survey on Price Formation in Election Stock Markets." *Journal of Economic Behavior & Organization* 39(1): 83–110.

Francia P. L., R. E. Goldberg, J. C. Green, P. S. Herrnson, and C. Wilcox. 1999. "Individual Donors in the 1996 Federal Elections." In *Financing the 1996 Election*, ed. J. C. Green. Armonk, NY: M.E. Sharpe, Inc., pp. 127–154.

Gerber, A. S. 1998. "Estimating the Effect of Campaign Spending on Senate Election Outcomes Using Instrumental Variables." *The American Political Science Review* 92(2): 401–411.

Gerber, A. S. 2004. "Does Campaign Spending Work?: Field Experiments Provide Evidence and Suggest New Theory." *American Behavioral Scientist* 47(5): 541–574.

Gimpel, J. G., F. E. Lee and J. Kaminski. 2006. "The Political Geography of Campaign Contributions in American Politics." *The Journal of Politics* 68(3): 626–639.

Goff, M. J. 2004. *The Money Primary*. New York: Rowman and Littlefield.

Green, D. P. and J. S. Krasno. 1988. "Salvation for the Spendthrift Incumbent: Reestimating the Effects of Campaign Spending in House Elections." *American Journal of Political Science* 32(4): 884–907.

Gurian, P.-H. and A. A. Haynes. 2003. "Presidential Nomination Campaigns: Toward 2004." *PS: Political Science and Politics* 36(2): 175–180.

Hagen M. G. and W. G. Mayer. 2000. "The Modern Politics of Presidential Selection: How Changing the Rules Really Did Change the Game." In *In Pursuit of the White House 2000*, ed. W. G. Mayer, New York, NY: Chatham House Publishers, pp. 1–56.

Hinckley, K. A. and J. C. Green. 1996. "Fund-Raising in Presidential Nomination Campaigns: The Primary Lessons of 1988." *Political Research Quarterly* 49(4): 693–718.

Jacobson, G. C. 1978. "The Effects of Campaign Spending in Congressional Elections." *American Political Science Review* 72(2): 469–491.

Jacobson, G. C. 1985. "Money and Votes reconsidered: Congressional Elections, 1972–1982." *Public Choice* 47(1): 7–62.

Jacobson, G. C. 1990. "The Effects of Campaign Spending in House Elections: new Evidence for Old Arguments." *American Journal of Political Science* 34(2): 334–362.

Jacobson, G. C. 2006. "Campaign Spending Effects in U.S. Senate Elections: Evidence from the National Annenberg Election Survey." *Electoral Studies* 25(2): 195–226.

Klumpp, T., and M. Polborn. 2006. "Primaries and the New Hampshire Effect." *Journal of Public Economics* 90(August): 1073–1114.

Knight, B. G. and N. Schiff. 2010. "Momentum and Social Learning in Presidential Primaries." *Journal of Political Economy* 118(6): 1110–1150.

Levitt, S. D. 1994. "Using Repeat Challengers to Estimate the Effect of Campaign Spending on Election Outcomes in the U.S. House." *Journal of Political Economy* 102(4): 777–798.

Mayer, W. G. 1996. "Forecasting Nominations." In *Pursuit of the White House: How We Choose our Presidential Nominees*, ed. Mayer, William G. Chatham, NJ: Chatham House.

Mayer, W. G. 2003. "Basic Dynamics of the Nomination Process: An Expanded View." In *The Making of the Presidential Candidates*, ed. Mayer, William G. Lanham, MD: Rowman and Littlefield.

Mayer, W. G. and A. E. Busch. 2004. *The Front-Loading Problem in Presidential Nominations.* Washington: Brookings Institution Press.

McDowall, D., R. McCleary, E. Meidinger, and R. A. Hay Jr. 1980. *Interrupted Time Series Analysis.* Beverly Hills, CA: Sage Publications.

Mutz, D. C. 1995a. "Effects of Horse-Race Coverage on Campaign Coffers: Strategic Contributing in Presidential Primaries." *The Journal of Politics* 57(4): 1015–1042.

Mutz, D. C. 1995b. "Media, Momentum, and Money: Horse Race Spin in the 1988 Republican Primaries." In *Presidential Polls and the News Media.* Boulder, CO: Westview Press, pp. 229–256.

Norrander, B. 1996. "Field Essay: Presidential Nomination Politics in the Post-Reform Era." *Political Research Quarterly* 49(4): 875–915.

Norrander, B. 2000 "The End Game in Post-Reform Presidential Nominations" *Journal of Politics* 62(4): 999–1013.

Norrander, B. 2006 "The Attrition Game: Initial Resources, Initial Contests and the Exit of Candidates During the US Presidential Primary Season." *British Journal of Political Science* 36(3): 487–507.

Oliven, K. and T. A. Rietz. 2004. "Suckers are Born but Markets are Made: Individual Rationality, Arbitrage, and Market Efficiency on an Electronic Futures Market." *Management Science* 50(3): 336–351.

Prat, A. 2002. "Campaign Advertising and Voter Welfare." *The Review of Economic Studies* 69(4): 999–1017.

Rhode, P. W. and K. S. Strumpf. 2007. "Manipulating Political Stock Markets: A Field Experiment and a Century of Observational Data." NBER. Working Paper.

Rossana, R. J. and J. J. Seater. 1995. "Temporal Aggregation and Economic Time Series." *Journal of Business and Economic Statistics* 13(4): 441–451.

Snowberg, E. C., J. Wolfers, and E. Zitzewitz. 2005. "Information (In)efficiency in Prediction Markets." In *Information Efficiency in Betting Markets.* Cambridge, England: Cambridge University Press.

Steger, W. P. 2000. "Do Primary Voters Draw From a Stacked Deck? Presidential Nominations in an Era of Candidate-Centered Campaigns" *Presidential Studies Quarterly* 30(4): 727–753.

Steger, W. P. 2007. "Who Wins Nominations and Why?: An Updated Forecast of the Presidential Primary Vote." *Political Research Quarterly* 60(1): 91–99.

Steger, W. P., A. J. Dowdle, and R. E. Adkins. 2004. "The New Hampshire Effect in Presidential Nominations." *Political Research Quarterly* 57(3): 375–390.

Stratmann, T. 1991. "What Do Campaign Contributions Buy? Deciphering Causal Effects of Money and Votes." *Southern Economic Journal* 57(3): 606–620.

Stratmann, T. 1998. "The Market for Congressional Votes: Is Timing of Contributions Everything?" *Journal of Law and Economics* 41(1): 85–113.

Stratmann, T. 2002. "Can Special Interests buy Congressional Votes? Evidence from Financial Services Legislation." *Journal of Law and Economics* 45(2): 345–374.

Stratmann, T. 2005. "Some talk: Money in Politics. A (partial) Review of the Literature." *Public Choice* 124(1, 2): 135–156.

Stratmann, T. 2007. "How Prices Matter in Politics: The Returns to Campaign Advertising." George Mason University. Working Paper.

Verba, S., K. Lehman Schlozman and H. E. Brady. 1995. *Voice and Equality: Civic Volunteerism and American Politics.* Cambridge, MA: Harvard University Press.

Wei, W. W. 2006. *Time Series Analysis: Univariate and Multivariate Methods.* Boston, MA: Pearson Addison Wesley.

Wolfers, J. and E. Zitzewitz. 2004. "Prediction Markets." *Journal of Economic Perspectives* 18(2): 107–126.

Wolfers, J. and E. Zitzewitz. 2007. "Interpreting Prediction Market Prices as Probabilities." NBER. Working Paper.