

# Campaign Fund-raising and Spending for Deterrence and Savings

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April 2009

## Abstract

I present a model of fund-raising in repeated elections where funds are raised to deter the entry of strong challengers, and to increase the probability of winning through campaign spending. The equilibrium relationship between war chests and incumbent strength is non-monotonic because incumbents of moderate strength have an incentive to raise enough money to deter strong challengers and to save a large fraction of those funds for use in subsequent election, while stronger incumbents have less incentive to save. Thus, the savings behavior can mask the entry deterrence effect.

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\*I would like to thank David Austen-Smith, Jeff Banks, Randy Calvert, Dhammika Dharmapala, Kevin Grier, Val Lambson, Skip Lupia, Carlos Maravall Rodriguez, Gilles Serra, Walt Stone, the editors, and an especially helpful referee. A much earlier version of the paper was presented at the 1998 Public Choice Society Meetings; a subsequent version was presented at the Tuesday Group and  $R^2$  seminars at Brigham Young University; this version was presented at the University of Michigan and at the 2006 Midwest Political Science Meetings. This paper was extensively revised while the author was a visitor at Washington University in St. Louis. The author gratefully acknowledges support from the College of Family, Home, and Social Sciences of Brigham Young University. All mistakes remain the author's.

After beating a Democratic incumbent by less than 1500 votes in 1994, Representative John Ensign (R-NV) appeared ripe for a challenge in 1996. National forces also seemed to favor a challenge to Ensign: The Gingrich-led House pushed an aggressive conservative agenda, and shut down the government twice; President Clinton led Republican candidate Bob Dole 15-20 points through much of the election season. But Ensign raised over \$2 million for his reelection campaign, and the Democrats failed to “entice a first-tier challenger to the Republican freshman” (Salant 1996, 2363). Commenting on his extensive fund-raising, Ensign stated, “It’s one of the reasons we did it and did it early. You want to scare as many opponents as you can out of the race” (quoted in Salant 1996, 2363).<sup>1</sup>

Previous systematic empirical work on war chests has concentrated mainly on the deterrence motivation, and has differing results. Goidel and Gross (1994), Hersch and McDougall (1994), and Box-Steffensmeier (1996) find that war chests deter high quality challengers from entering against U.S. House incumbents. Hogan (2001) finds that war chests deter challengers in state legislative elections, particularly in states with less professional legislatures. In contrast, Squire (1989, 1991), Milyo (1998), Ansolabehere and Snyder (2000) and Goodliffe (2001, 2007) argue that war chests do not deter high (or low) quality challengers from entering.<sup>2</sup>

Incumbents may create war chests for other reasons as well. Sorauf states that “incumbents raise large sums as a form of catastrophe insurance against the sudden emergence of a strong and well-financed challenger...” (1988, 160). Sorauf continues, “The incumbent may also simply be saving for a future campaign for the present office” (1988, 161).<sup>3</sup> Squire (1991) finds that U.S. senators raise more funds when they may face stronger challengers. Ansolabehere

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<sup>1</sup>Ensign won the general election 50 percent to 44 percent.

<sup>2</sup>These conflicting results are similar to the results found in the campaign spending literature, where campaign spending is found to have moderate effect on votes (e.g. Gerber 1998) or no effect (e.g. Levitt 1994). Milyo and Groseclose (1999) find that incumbent wealth does not deter challengers.

<sup>3</sup>Sorauf also notes that war chests can be used to build a nest egg for retirement (possible for those elected to the U.S. House before 1980 who retired before 1992), to run for higher office, or for unfavorable circumstances after reapportionment.

and Snyder (2000) find that incumbents save money as an “accident,” or because they had helpful unexpected events (such as running against a weaker-than-expected challenger).<sup>4</sup> Milyo presents data that suggest “that incumbents build up a stock of savings in order to smooth their fund-raising efforts over time” (2001, 122). And Goodliffe (2004) presents and tests a model where war chests are created as precautionary savings.

The primary goal of this paper is to explore the interaction of deterrence and savings. Intuition holds that incumbents use war chests to deter entry of strong challengers, but recent empirical work seems to refute this claim. A formal model of repeated elections that allows for both savings and deterrence, however, shows that the intuitive deterrence result can hold at the same time that savings behavior leads to the empirical patterns that have been taken to refute the intuitive result. Thus, existing empirical tests are uninformative.

## **Related Models**

Previous theoretical models of war chests have also examined how and when war chests deter challengers. Dharmapala (2002) constructs a model of candidates, interest groups, and voters and finds that if fund-raising effectiveness is correlated with legislative effectiveness, then large early fund-raising deters challengers. Epstein and Zensky (1995) develop a formal model of campaign fund-raising, and show that although fund-raising can deter strong challengers in some situations, it is difficult to observe this empirically because their model has both pooling and separating equilibria under the same conditions. Their model has two levels of incumbent strength. However, the patterns I derive of a non-monotonic relationship between war chests and incumbent strength would be impossible with only two levels of incumbent strength.

Empirically, the difficulty in testing either model is determining when fund-raising ends

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<sup>4</sup>Ansola-behere and Snyder also find that war chests are used for retirement (or consumption) and ambition (run for a higher office).

and spending begins. By examining more than one election cycle in the model, I am able to use the war chest—defined as money saved from one election for the next election—as a variable for comparison. In the model I present, war chests are an endogenous result that occurs under specifically delineated circumstances. This is possible because the model covers more than one election, and thus, uncovers intra- and inter-election dynamics.

This model also has similar characteristics to the product quality game of Milgrom and Roberts (1986). In their game, a firm uses both price and advertising to signal to consumers the quality of their product. With multiple signals about a single dimension, consumers are able to distinguish high quality products from low quality products. In my model, there are times where the incumbent can take two costly actions (deciding how much to spend and how much to raise) before the challenger chooses whether to enter. Both these actions (possibly) convey information about a single quality: incumbent strength. Similar to product quality, these multiple signals allow potential challengers to distinguish between all types of incumbents.

## **The Model**

The model takes place in a single district. Different versions examine strategies over one and two election cycles, with the latter in the presence of certainty and uncertainty.

### **Agents and Preferences**

The two agents in the model are an incumbent and a high quality challenger. The range of types of incumbents have a known distribution:  $I \sim G(\cdot)$  with support  $[\underline{I}, \bar{I}]$ , where  $\underline{I}$  is the weakest incumbent and  $\bar{I}$  is the strongest incumbent, and where  $g(\cdot)$  represents the probability density

function.<sup>5</sup>

In the model, the strength of the incumbent is (initially) unknown. I motivate this by observing that incumbents exert great efforts to appear strong to potential challengers, and potential challengers (and the press) constantly attempt to gauge the vulnerability (strength) of incumbents (Mayhew 1974; Fenno 1978, 1992; Herrnson 2007; Jacobson 2009). In addition, in the model, the quality of the challenger is known. I justify this by noting that incumbents are generally aware who their potential challengers are, and their relative strength (Fowler and McClure 1989, Kazee 1994). Even if challenger quality is unknown, or the incumbent does not know who the potential challengers are, the incumbent knows that he wants to deter the highest quality challengers (he would prefer to deter *all* challengers). Furthermore, I am concerned with challenger entry—incumbents are (generally) already in the race. Decisions to challenge the incumbent usually hinge on challengers’ perceptions of incumbent strength.

Let the incumbent’s utility function (for one election) be given by:

$$U_{incumbent} = \begin{cases} 1 - C(\text{money raised}) & \text{if incumbent wins} \\ -C(\text{money raised}) & \text{else} \end{cases}$$

where 1 is the benefit of winning the election and  $C(\cdot)$  is the cost of raising money. If the incumbent loses the first election, he receives 0 in the next election (i.e., does not run for office), and the game ends. Since the incumbent decides how much to raise and spend before the election, he maximizes his expected utility:

$$EU_{incumbent} = \text{Pr}\{\text{winning}\} - C(\text{money raised}).$$

The probability of winning is given by the function  $W(s, I)$ , where  $s$  is the amount of money spent in the election, and  $I$  is the incumbent type. I assume that  $W(s, I) \in [0, 1]$  and  $W(s, I)$

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<sup>5</sup>A compactly supported distribution of incumbents is not required, but makes explication of the equilibria easier.

is twice continuously differentiable for  $s \geq 0$ . I assume that  $W_1(s, I) > 0$  and  $W_{11}(s, I) < 0$ . In other words, spending more money increases the incumbent's probability of winning (cf. Aldrich 1980), but that there are diminishing returns to such spending. Further, I also assume an Inada-type condition to obtain an interior solution:  $W_1(s, I) \rightarrow 0$  as  $s \rightarrow \infty$ . Incumbent strength also affects the probability of winning:  $W_2(s, I) > 0$  and  $W_{12}(s, I) > 0$ . In other words, stronger incumbents have a better chance of winning than weaker incumbents; stronger incumbents also get better returns on their spending than weaker incumbents. Thus, the win function is supermodular (Topkis 1998), and satisfies the single-crossing property (Milgrom and Shannon 1994). Therefore, for the purposes of this model, incumbent strength is operationalized as the ability to win votes and spend money effectively. In addition, the quality of challenger affects the probability of winning. Let  $W^L(\cdot, \cdot)$  be the probability of winning an election when facing a low quality challenger, and  $W^H(\cdot, \cdot)$  be defined similarly for a high quality challenger. I assume that  $W^L(s, I) > W^H(s, I)$  for all  $s$  and  $I$ , and  $W_1^L(s, I) > W_1^H(s, I)$  for all  $s$  and  $I$ . In addition,  $W_2^L(s, I) > W_2^H(s, I)$  for all  $s$  and  $I$ . In other words, for any given spending, the probability of winning an election when facing a low quality challenger is greater than the probability of winning an election when facing a high quality challenger. Further, an incumbent facing a low quality challenger receives higher returns to spending than an incumbent facing a high quality challenger.

Let  $C(r)$  be the cost of raising money, where  $r$  is the amount of money raised. I assume that  $C(r)$  is a twice continuously differentiable function, and that  $C_1(r) > 0$  and  $C_{11}(r) > 0$ . In other words, I assume that raising more money increases costs to the incumbent, and that the marginal cost of raising money increases as the amount of money raised increases. As in the win probability function, I assume Inada-type conditions:  $C_1(r) \rightarrow 0$  as  $r \rightarrow 0$ . From the other assumptions,  $C_{11}(r) \rightarrow \infty$  as  $r \rightarrow \infty$ . Finally, I assume that the curvature of the cost function is sufficiently high to develop some comparative statics that follow. The sufficient

condition is that  $C_{11}(r) > [C_1(r)]^2$ . Given the other assumptions in this model, the condition is met by most convex functions (e.g.  $C(r) = r^2$ ). I also assume that there exists some  $\tilde{r}$  such that  $W^j(\tilde{r}, I) > C(\tilde{r})$ , for all  $I$ , for  $j = L, H$ . In other words, an incumbent always runs for reelection, even against the highest quality challenger.

Holding constant incumbent strength and assuming complete information, the  $r^H$  that solves  $W_1^H(r^H, I) = C_1(r^H)$  is less than the  $r^L$  that solves  $W_1^L(r^L, I) = C_1(r^L)$ , for all  $I$ . This follows from the assumption that  $W_1^L(s, I) > W_1^H(s, I)$  for all  $s$  and  $I$ . That is, the money raised (and spent) against a high quality challenger is lower than the money raised (and spent) against a low quality challenger. This somewhat counter-intuitive result does not take into account that most strong incumbents run against weaker challengers, and have higher returns to spending. Note that the cost function does not depend on the strength of the incumbent or the quality of challenger running. However, if increasing incumbent strength were operationalized by lowering the cost of raising funds (fixed and/or marginal), the results of the model would be qualitatively the same.<sup>6</sup>

The incumbent may not borrow money, and is limited to spending the money on hand (either raised during this election cycle, or carried over from the previous election).<sup>7</sup>

To focus attention on the incumbent's decision, the high quality challenger merely decides whether to enter the race or not. Like the incumbent's utility function, the high quality challenger receives a benefit from winning and a cost of running. The probability of winning is the complement of the incumbent's probability of winning:  $1 - W^H(r, I)$ . Following Jacobson and Kernell (1983), higher quality challengers have more to lose when running (often, they cur-

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<sup>6</sup>Increasing the marginal benefit or decreasing the marginal cost have the same effect in the model. In other words, from a modeling perspective, assuming  $C_2(r, I)$  and/or  $C_{12}(r, I) < 0$  is roughly the same as assuming  $W_2(s, I) > 0$  and/or  $W_{12}(s, I) > 0$ . Using both sets of assumptions complicates the model without changing the results.

<sup>7</sup>In reality, incumbents may go into debt, or more importantly, have both cash-on-hand and debt, although the vast majority do not. However, allowing incumbent borrowing does not affect the logic of the following propositions.

rently hold office, which they would lose by running).<sup>8</sup> Thus, the utility function for the high quality challenger is:

$$EU_{HQ\ challenger} = [1 - W^H(r, I)] \cdot 1 - c^H,$$

where 1 is the benefit of office, and  $c^H$  is the high quality challenger's cost of running for office.<sup>9</sup> From the assumptions above, the high quality challenger prefers to run against weaker incumbents. Among high quality challengers, those with higher quality have greater  $c^H$ . This parameter is important in characterizing the equilibria. The high quality challenger can also choose not to enter the race, in which case she receives a payoff of 0.

In the model, a low quality challenger runs against the incumbent if the high quality challenger chooses to stay out.<sup>10</sup> The utility function for such a challenger is:

$$EU_{LQ\ challenger} = [1 - W^L(r, I)] \cdot 1,$$

where the cost of running is zero so that the low quality challenger always enters if the high quality challenger does not.

## Equilibrium

Since the challenger has incomplete information about the preferences of the incumbent, an appropriate equilibrium concept for this game is *perfect Bayesian equilibrium* (PBE). Loosely,

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<sup>8</sup>There is a sizable literature assessing challenger quality. See Squire (1995) for a survey. For this paper, I do not worry what constitutes a high quality challenger; I merely assume that there is a difference between high and low quality challengers.

<sup>9</sup>To concentrate on the incumbent's fund-raising, spending and saving decisions, the challenger does not raise or spend money. The win and cost functions can be thought of as reduced-form expressions of a game where both candidates raise and spend money.

<sup>10</sup>The decision by low quality challengers to stay out of the race when a high quality challenger runs can be thought of a reduced form of the primary election, which high quality challengers usually win (Canon 1990).



incumbents and challengers maximize their expected payoffs at every point in time, where the expectation is with respect to the challenger's beliefs, updated by Bayes' rule when possible. In addition, I look for PBE that satisfy the *universal divinity* criterion for out-of-equilibrium beliefs (Banks and Sobel 1987). Loosely, universal divinity specifies that when a player takes an out-of-equilibrium action, the player type that can benefit the most from that action is assigned the out-of-equilibrium belief.

## One Election Cycle

I present a model where the probability of challenger entry is determined endogenously by the challenger. In addition, for simplicity, the challenger may only enter at a certain time in the election cycle. Incumbents may be able to deter challenger entry. Since there is only one election, there is no reason for the incumbent to save money for future elections.

## Decision Sequence and Information

The incumbent's probability of reelection is determined by how much he spends and whom he runs against. The incumbent has an opportunity to raise money, and then an opportunity to spend that money (or less) in the election cycle. The time-line is as follows: The incumbent decides how much money to raise for the election. Next, a high quality challenger (hereafter, the "challenger") decides whether to enter the race against the incumbent. The incumbent then decides how much of the raised money he spends in the election. The election winner is probabilistically determined by incumbent spending, incumbent strength, and challenger quality. Then the game ends. The decision sequence is common knowledge. Similarly, the challenger's and incumbent's preferences are common knowledge up to the value of  $I$ . The challenger has a common knowledge prior belief ( $g(I)$ ) over the incumbent's type; the incumbent knows his

type. Although incumbent strength might be roughly known, there is always some uncertainty about incumbent electoral strength—How much of last election’s win came from presidential coattails, or a brilliant ad campaign, or a challenger’s scandalous behavior? How much has re-districting affected the incumbent’s strength? The idea of the model is that potential challengers may be able to learn about the incumbent’s strength over time, but would still be somewhat uncertain.<sup>11</sup>

Denoting challenger quality with  $j$ , the incumbent’s expected utility function is:

$$-C(r) + W^j(s, I).$$

If the high quality challenger decides not to enter the race, a low quality challenger runs against the incumbent. To summarize preferences:

$$EU_{HQ\ challenger} = \begin{cases} [1 - W^H(s, I)] - c^H & \text{enter against incumbent} \\ 0 & \text{not enter} \end{cases}$$

$$EU_{incumbent} = \begin{cases} -C(r) + W^H(s, I) & \text{enter} \\ -C(r) + W^L(s, I) & \text{not enter} \end{cases}$$

## Strategies

Without loss of generality, I restrict attention throughout to pure strategies.

The incumbent’s *fund-raising* strategy is a map:

$$\rho : I \rightarrow \mathbb{R}_+.$$

Thus, for any incumbent  $I$ ,  $\rho(I) = r$  is the amount of money raised.

After observing the incumbent’s fund-raising, the challenger forms a belief about the value(s)

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<sup>11</sup>Another way of justifying the incomplete information is that each incumbent receives a shock to his strength after each election, following Rogoff (1990).

of  $I$  that may have generated  $r$ . Let  $\mu(I|r)$  be the probability that the challenger assigns to the event that the incumbent's strength is  $I$  when the incumbent raises  $r$ .

The challenger's *entrance* strategy is a map:

$$\alpha : \mathbb{R}_+ \rightarrow \{\text{enter, not enter}\}.$$

Thus, for the challenger,  $\alpha(r)$  denotes whether she enters the race, having observed the incumbent's fund-raising.

After the challenger has decided whether to enter, the incumbent decides how much to spend in the last election. The incumbent's *spending* strategy is a map:

$$\sigma : \{\text{enter, not enter}\} \times I \rightarrow \mathbb{R}_+$$

where  $\sigma(\{\text{action}\}, I) = s$  is the amount spent in the election given the *action* of the challenger in the second election, and the incumbent's strength. The incumbent's spending strategy is trivially derived: Because the incumbent increases his probability of winning by increasing spending ( $W_1(s, I) > 0$ ), and the costs of raising the money is already sunk, the incumbent spends all that he has in the election ( $s = r$ ). Thus, I only concentrate on the strategy pair  $(\rho^*, \alpha^*)$ .

## Equilibrium

Since the marginal benefit of spending money increases as incumbent strength increases, *if incumbents could not affect challenger quality*, stronger incumbents would raise and spend more money.<sup>12</sup> This means that strong incumbents may be able to distinguish themselves from

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<sup>12</sup>This result is immediate from the Inada conditions and the Edlin-Shannon monotonicity theorem (Edlin and Shannon 1998). With an additional sufficient (but not necessary) assumption ( $W_2(s, I) \gg W_{12}(s, I)$ ), one can

weak incumbents through their money raising and spending (and saving) behavior.

The high quality challenger runs against an incumbent if

$$c^H < E [1 - W^H(r, I)|r].$$

If it is not too costly, the incumbent's task is to make the high quality challenger prefer not to enter or indifferent between entering the race or not, in which case the challenger does not enter. The equilibrium of this game depends on how strong the challenger is, that is, the value of  $c^H$ , relative to the range of incumbent strength.

**Proposition 1** *(One Election) [Semi-pooling] A universally divine PBE exists in which sufficiently strong incumbents ( $I \geq \hat{I}$ ) pool at a level of fund-raising ( $\bar{r}$ ) that suffices to deter entry, and weaker incumbents choose the optimal level of fund-raising given that they will face a high quality challenger. The high quality challenger enters only if fund-raising is less than the stronger incumbent pooling level ( $\bar{r}$ ).*

PROOF:<sup>13</sup> Let  $\hat{I} \in [\iota, \bar{I}]$  be the break point of an equilibrium, where  $\iota$  is defined to solve  $c^H = E [1 - W^H(\bar{r}, I)|\bar{r}] = 1 - \int_{\iota}^{\bar{I}} g(I)W^H(\bar{r}, I)dI$  and where  $\bar{r}$  is the amount raised such that incumbent  $I = \hat{I}$  is indifferent between imitating other strong incumbents (and deterring a high quality challenger) and revealing his type (thus drawing a high quality challenger). This  $\iota$  is the lowest possible break point.  $(\rho^*, \alpha^*)$  is a strategy pair such that:

$$\begin{aligned} \rho^*(I) &= \bar{r} & \forall I \geq \hat{I} \\ \rho^*(I) &= \check{r}(I) & \forall I < \hat{I} \\ \alpha^*(r) &= \{\text{not enter}\} & \text{if } r \geq \bar{r} \\ \alpha^*(r) &= \{\text{enter}\} & \text{if } r < \bar{r} \end{aligned}$$

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also show that war chests in the two-election models increase as incumbent strength increases if incumbents could not affect challenger quality. The proof is available on request from the author, or at <http://goodliffe.byu.edu/papers>.

<sup>13</sup>A more technical proof, which rules out other equilibria, is available at <http://goodliffe.byu.edu/papers>.

where  $\check{r}(I)$  is the amount raised by incumbent  $I < \hat{I}$  knowing that the high quality challenger will enter. I show that  $(\rho^*, \alpha^*)$  are best responses.

For the challenger, any incumbents who raise less than  $\bar{r}$  reveal their strength. Given their strength and the funds raised, the challenger wishes to enter the race ( $c^H < 1 - W^H(\check{r}(I), I)$ ) for  $I < \hat{I}$ ). Incumbents who raise  $\bar{r}$  pool so that the challenger cannot distinguish between them. The challenger updates her beliefs on the pooling incumbents; her expected payoff if she enters the race is  $c^H - E \left[ 1 - W^H(\bar{r}, I) | I \geq \hat{I} \right] = c^H - \left[ 1 - \int_{\hat{I}}^{\bar{I}} g(I) W^H(\bar{r}, I) dI \right] \leq 0$ . Thus, she (weakly) prefers to stay out of the race.

The break-point incumbent,  $I = \hat{I}$ , is indifferent between separating (and inducing challenger entry) and pooling (and keeping the challenger out). Incumbents below  $\hat{I}$  find it too costly to pool, and thus separate, and raise funds expecting challenger entry. Incumbents above  $\hat{I}$  strictly prefer pooling. For these strong incumbents, raising more than  $\bar{r}$  does not change the challenger's decision, but costs more. Raising less than  $\bar{r}$  leads the challenger to enter, decreasing utility.  $\square$

A graphical illustration of the one-election imperfect-information equilibrium is in Figure 1. This equilibrium is constructed with incumbents distributed on  $[0, 1] = [\underline{I}, \bar{I}]$ , and with  $\hat{I} \approx 0.3$ . Incumbents weaker than  $\hat{I}$  face the high quality challenger; incumbents stronger than (or equal to)  $\hat{I}$  do not face the high quality challenger. Because there is one period, incumbents spend all that they raise. In the upper region, all incumbents raise and spend the same amount (i.e. they pool). The expected payoff to the high quality challenger of entering against the pooling incumbent is equal to the cost of running; thus the high quality challenger does not enter. For incumbents in the lower region, it is too costly to raise the extra money to pool and keep the high quality challenger from entering, and these weak incumbents (in the lower region) raise and spend money with the expectation that the high quality challenger will enter. The incumbent at the break point ( $I = \hat{I}$ ) is indifferent between pooling or separating.

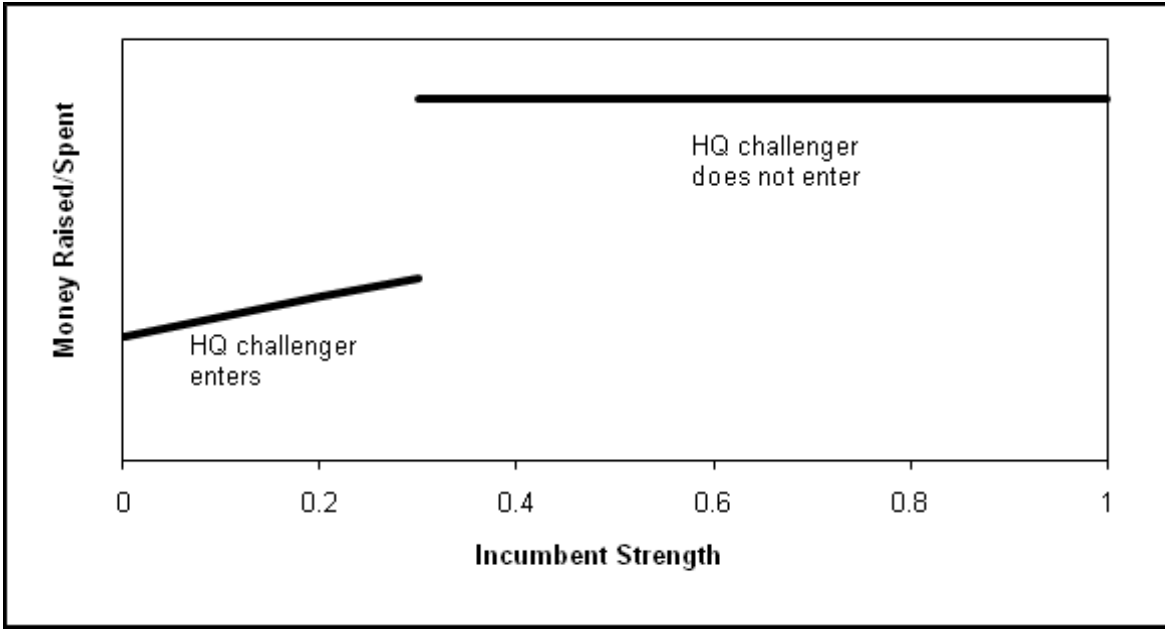


Figure 1: Sample Equilibrium: One Election

A range of (universally divine) equilibria exist for this model. All of them have the same form, with a lower separating region, and an upper pooling region. Where the breakpoint,  $\hat{I}$ , equals  $\iota$ , the high quality challenger is indifferent between entering and not entering against a pooling incumbent (and does not). Where  $\hat{I} > \iota$ , the high quality challenger strictly prefers not to enter against a pooling incumbent. From an *ex ante* perspective, both the incumbent and high quality challenger obtain the highest (expected) utility from the equilibrium where  $\hat{I} = \iota$ , because utility is lost when making the high quality challenger strictly prefer not to enter. It is thus the pareto-optimal equilibrium among universally divine equilibria. Compared to the same model under complete information (Goodliffe 2005), the challenger runs less often, i.e. there are some incumbents the challenger would run against if the challenger knew the incumbent's strength.

The lowest possible break point ( $\iota$ ) between the two regions depends on the cost of running for the high quality challenger ( $c^H$ ). As this cost decreases, the lowest possible break point ( $\iota$ )

increases.

Although this is only a one-election version of the model, there are some interesting features of the equilibrium. Given that the challenger does not initially know the incumbent's strength, it would appear that extra fund-raising keeps out high quality challengers. Thus, a model without savings supports the intuition that pre-emptive fund-raising can be used for deterrence. Once savings is permitted by repeating the election cycle, this no longer holds.

## Two Election Cycles, No Uncertainty

### Decision Sequence and Information

The two-election model with no uncertainty is a repeated version of the one-election model. But because there is a second election, an incumbent can save money from fund-raising of the first election to be spent in the second election, thus creating a war chest. The time-line begins in the same way as the one-election model. If the incumbent wins the first election, he decides how much money to raise for the second election. Then the challenger again decides whether to enter the race, the incumbent decides how much money to spend in this second election cycle, and the election winner is again probabilistically determined by incumbent spending, incumbent strength, and challenger quality. (See Figure 2.)

Denoting the election with subscripts and the quality of first-election challenger the incumbent faced with superscripts, the incumbent's expected utility function over two election cycles is:

$$-C(r_1) + W^j(s_1^j, I) + W^j(s_1^j, I) [-C(r_2^j) + W^k(s_2^j, I)] ,$$

where  $j$  is the challenger quality in the first election and  $k$  is the challenger quality in the second election. The second  $W^j(s_1^j, I)$  denotes the probability of winning the first election, and thus

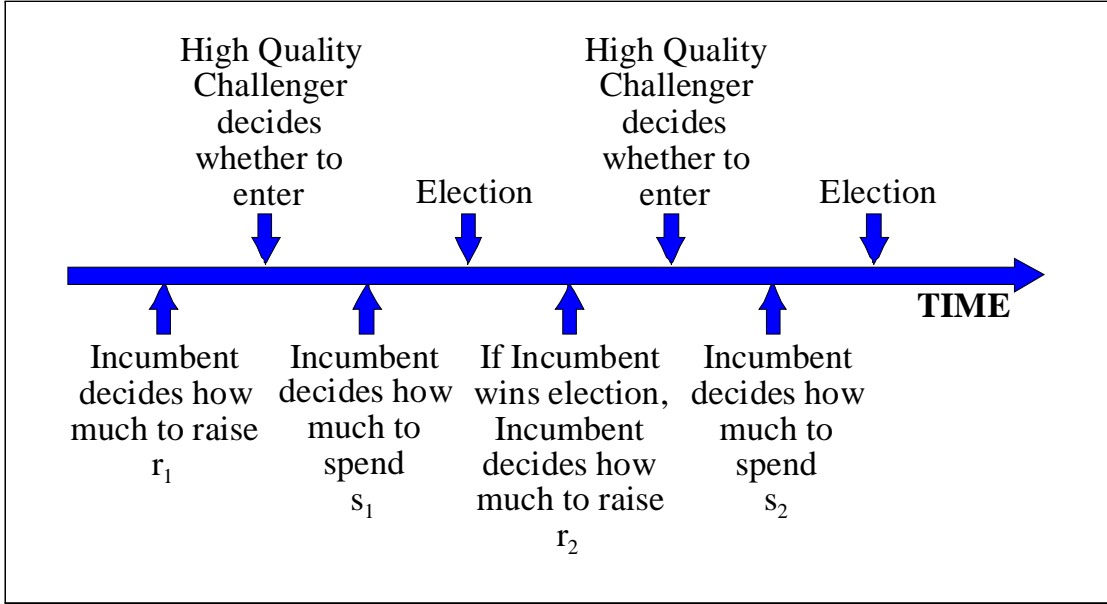


Figure 2: Two Election Decision Sequence

getting to the second election. In each election, if the high quality challenger decides not to enter the race, a low quality challenger runs against the incumbent. To summarize preferences:

$$EU_{HQ\ challenger} = \begin{cases} [1 - W^H(s, I)] - c^H & \text{enter against incumbent} \\ 0 & \text{not enter} \end{cases}$$

$$EU_{incumbent} = \begin{cases} -C(r_1) + W^H(s_1^H, I) [1 - C(r_2^H) + W^H(s_2^H, I)] & \text{HQ enters both} \\ -C(r_1) + W^H(s_1^H, I) [1 - C(r_2^H) + W^L(s_2^H, I)] & \text{HQ enters first} \\ -C(r_1) + W^L(s_1^L, I) [1 - C(r_2^L) + W^H(s_2^L, I)] & \text{HQ enters second} \\ -C(r_1) + W^L(s_1^L, I) [1 - C(r_2^L) + W^L(s_2^L, I)] & \text{HQ enters neither} \end{cases}$$

## Strategies

The incumbent's *first-election fund-raising* strategy and the challenger's *first-election entrance* strategy are the same as the one-election model.

After the challenger has decided whether to enter the first election, the incumbent decides how much to spend in the next election. In addition, he decides how much he will raise if he wins the election. The incumbent's *first-election spending (and second-election saving)* strategy



is a map:

$$\sigma : \{\text{enter, not enter}\} \times \mathbb{R}_+ \times I \rightarrow \mathbb{R}_+^2.$$

Thus,  $\sigma(\{\text{action}\}, r_1, I) = (s_1^j, r_2^j)$  is the following double: the amount spent in the first election and the amount raised in the second election, given the *action* of the challenger in the first election, how much the incumbent raised in the first election, and the incumbent's strength. If the (high quality) challenger enters,  $j = H$ ; if she does not (and the low quality challenger enters),  $j = L$ .

After observing the incumbent's behavior thus far (if the incumbent is reelected), the challenger again forms a belief about the value(s) of  $I$  that may have generated  $(r_1, s_1^j, r_2^j)$ . Let  $\nu(I|r_1, s_1^j, r_2^j; j)$  be the probability that the challenger believes that the incumbent's strength is  $I$  when the incumbent chooses  $(r_1, s_1^j, r_2^j)$ , having run against  $j$  in the first election.

The challenger's *second-election entrance* strategy is a map:

$$\beta : \mathbb{R}_+^3 \times \{H, L\} \rightarrow \{\text{enter, not enter}\}.$$

Thus, for the challenger,  $\beta(r_1, s_1^j, r_2^j; j)$  is the probability that the challenger enters the race, having observed the incumbent's fund-raising and spending in the first election, and fund-raising in the second election, given  $j$  entered in the first election.<sup>14</sup>

As in the one-election model, the incumbent's *second-election spending* strategy is trivially derived: Because  $W_1(s, I) > 0$ , the incumbent spends all that he has in the last election:  $s_2^j = r_1 - s_1^j + r_2^j$ . Thus, I only concentrate on the strategy pairs  $\{(\rho^*, \sigma^*), (\alpha^*, \beta^*)\}$ .

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<sup>14</sup>The high quality challengers in the first and second elections can be thought of as the same challenger in each election (unless she wins the first election, in which case, the game ends), or two different high quality challengers with the same  $c^H$ .

## Equilibrium

The results for the two-election model are dramatically different than the one-election model. Instead of pooling, strong incumbents separate. The primary reason for this is that the incumbent sends multiple (costly) signals before the challenger enters in the second election.

**Proposition 2** *(Two Elections, No Uncertainty) [separating] A universally divine PBE exists in which stronger incumbents ( $I > \hat{I}$ ) choose an optimal higher level of fund-raising and spending to make the high quality challenger in each election indifferent between entering the race or not, and weaker incumbents choose an optimal lower level of fund-raising and spending given that they will face a high quality challenger in both elections. High quality challengers enter if fund-raising is less than the lowest optimal higher level or spending is greater than the highest optimal higher level.*

PROOF:<sup>15</sup>  $\{(\rho^*, \sigma^*), (\alpha^*, \beta^*)\}$  is a strategy pair such that:

$$\begin{aligned}
 \rho^*(I) &= \hat{r}_1(I) & \forall I > \hat{I} \\
 \rho^*(I) &= \check{r}_1(I) & \forall I \leq \hat{I} \\
 \alpha^*(r_1, I) &= \{\text{not enter}\} & r_1 > \hat{r}_1(\hat{I}) \\
 \alpha^*(r_1, I) &= \{\text{enter}\} & r_1 \leq \hat{r}_1(\hat{I}) \\
 \sigma^*(\{\text{not enter}\}, r_1, I) &= (\hat{s}_1^L(I), \hat{r}_2^L(I)) & \forall I > \hat{I} \\
 \sigma^*(\{\text{enter}\}, r_1, I) &= (\hat{s}_1^H(I), \hat{r}_2^H(I)) & \forall I > \hat{I} \\
 \sigma^*(\{\text{not enter}\}, r_1, I) &= (\check{s}_1^L(I), \check{r}_2^L(I)) & \forall I \leq \hat{I} \\
 \sigma^*(\{\text{enter}\}, r_1, I) &= (\check{s}_1^H(I), \check{r}_2^H(I)) & \forall I \leq \hat{I} \\
 \beta^*(r_1, s_1^j, r_2^j; j) &= \{\text{not enter}\} & r_1 \geq \hat{r}_1(\hat{I}) \text{ and } s_1^j \leq \hat{s}_1^j(\hat{I}) \\
 & & \text{and } r_2^j \geq \hat{r}_2^j(\bar{I}) \\
 \beta^*(r_1, s_1^j, r_2^j; j) &= \{\text{enter}\} & r_1 < \hat{r}_1(\hat{I}) \text{ or } s_1^j > \hat{s}_1^j(\hat{I}) \\
 & & \text{or } r_2^j < \hat{r}_2^j(\bar{I})
 \end{aligned}$$

where  $(\check{r}_1(I), \check{s}_1^j(I), \check{r}_2^j(I))$  are the amounts raised and spent by incumbent  $I \leq \hat{I}$ , knowing that the high quality challenger enters (in both elections), and  $(\hat{r}_1(I), \hat{s}_1^j(I), \hat{r}_2^j(I))$  are the amounts

<sup>15</sup>Technical details of the proof are available at <http://goodliffe.byu.edu/papers>.

raised and spent by incumbent  $I > \hat{I}$  where the high quality challenger is indifferent between entering the race or not *and* incumbent  $I = \hat{I}$  is indifferent between imitating *and* knowing that the high quality challenger does not enter (in either election). I show that the strategies of the incumbent and challenger are mutual best responses.

**Step 1: First Election Challenger Entry.** Incumbents in the lower region ( $I \leq \hat{I}$ ) raise and spend money expecting the high quality challenger to enter. Since  $c^H \leq 1 - W^H(\tilde{r}_1(I), I)$  (in both elections, but specifically in the first election here), the best response is for the high quality challenger to enter. For incumbents in the upper region ( $I > \hat{I}$ ), the incumbent raises and spends money expecting the high quality challenger not to enter. Since  $c^H = 1 - W^H(\hat{r}_1(I), I)$ , the challenger chooses to stay out.

**Step 2: Second Election Challenger Entry.** Using the same reasoning as the first election, the high quality challenger (weakly) prefers to enter against incumbents in the lower region, is indifferent between entering or not against incumbents in the upper region (and chooses not to enter).

**Step 3: First Election Fund Raising.** Incumbents in the lower region ( $I \leq \hat{I}$ ) have no incentive to raise *less* money than  $\tilde{r}_1(I)$  in the first election—they still run against the high quality challenger, but decrease their utility. If the same incumbents raise *more* money, then one of two things may occur. If the high quality challenger still enters, then they decrease their utility. If they raise enough money to deter the challenger, it is more expensive (utility-wise) than just letting the high quality challenger run.

For incumbents in the upper region ( $I > \hat{I}$ ), raising *more* money just adds to their overall cost without affecting challenger entry. Raising *less* money may encourage the challenger to enter, and even if she does not, the incumbent no longer maximizes utility. Incumbents in this region also do not wish to imitate each other as there are increasing differences in spending and

incumbent strength.<sup>16</sup> Thus, no incumbent has incentive to deviate.

**Step 4: First Election Spending, Second Election Fund Raising.** The reasoning is similar to first election fund raising. Incumbents in the lower region are maximizing their utility, given the high quality challenger does enter the second election. Raising and spending enough money to deter the challenger is too costly; raising and spending less reduces utility. Incumbents in the upper region raise and spend enough money to make the challenger indifferent. Raising more money or spending less money reduces utility, raising less or spending more induces challenger entry. As above, incumbents in this region also do not wish to imitate each other as there are increasing differences in spending and incumbent strength. Thus, they do not deviate.□

Why is there no (semi-)pooling in this model? Two features of this model prevent an upper region of pooling similar to the one-election version. First, the incumbent takes two actions  $(s_1, r_2)$  before the challenger chooses whether to enter in the second election cycle. Two separate actions that convey information on one parameter can induce strategic separation (Milgrom and Roberts 1986). Second, the tendencies of spending go opposite to the tendencies of fund-raising. Suppose that there were a semi-pooling equilibrium, so that all incumbents in some upper region raised and spent the same amount of money and the challenger did not enter against the pooling incumbents. No one would want to raise more money—it would cost more without changing challenger behavior. No one would raise less money—the challenger would believe that the incumbent was weak (by universal divinity), and would enter against him. This is the same reasoning found in the one-election model. But it is a different matter for spending money. Having all raised the same amount of money, the strongest incumbents would want to spend more of the money as it would increase their utility. By universal divinity, the challenger would believe that such an incumbent was strong, and still not enter the election. This breaks

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<sup>16</sup>More technically, the utility function is supermodular in incumbent spending and incumbent strength. A common feature of signalling games is that it is incentive compatible to separate when the utility function is supermodular. See Milgrom and Shannon (1994) for a discussion of supermodularity and references to other applications.

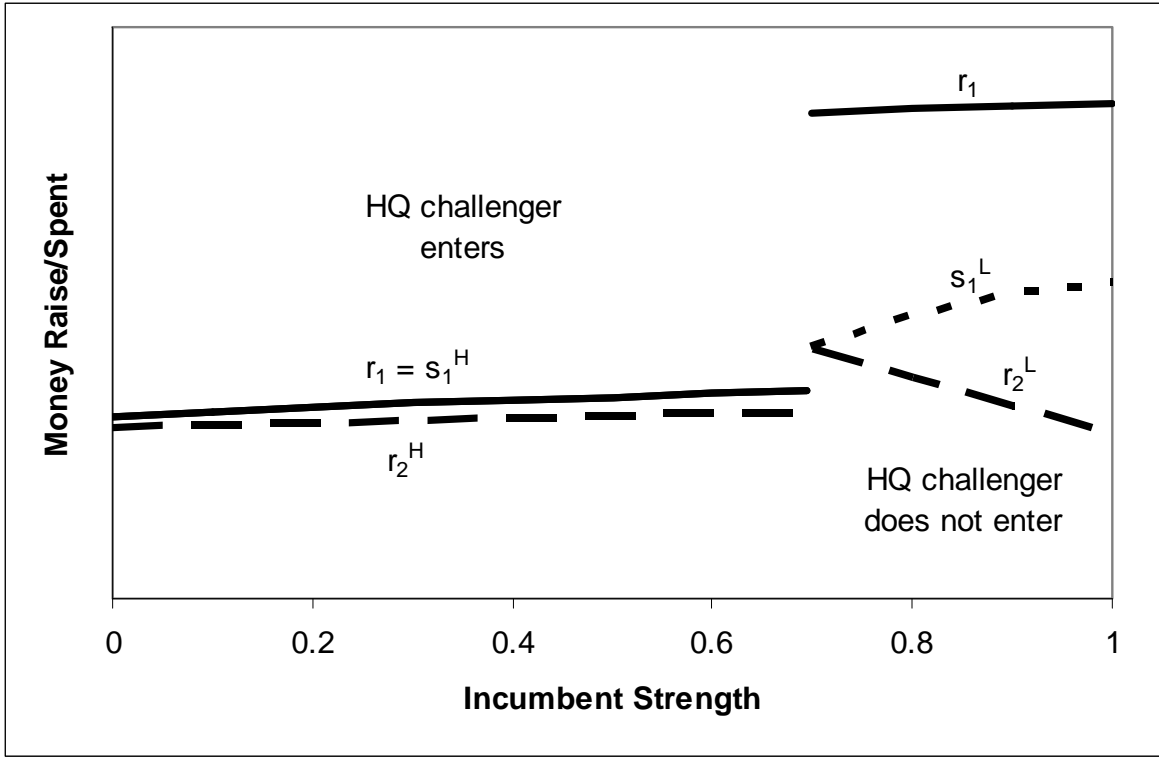


Figure 3: Sample Equilibrium: Two Elections, No Uncertainty

the pooling equilibrium.

A graphical illustration of the two-election perfect-information equilibrium is in Figure 3. This equilibrium is constructed with incumbents distributed on  $[0, 1] = [\underline{I}, \bar{I}]$ , and with  $\hat{I} \approx 0.7$ . In both elections, incumbents weaker than  $\hat{I}$  face the high quality challenger; incumbents stronger than (or equal to)  $\hat{I}$  do not face the high quality challenger. Looking at fund-raising behavior in the first election (the solid line), stronger incumbents raise enough funds to deter the high quality challenger from entering and discourage other incumbents from imitating them, knowing that the high quality challenger does not enter in either election. Within this upper region, stronger incumbents raise more money. It is too expensive for weaker incumbents to raise enough funds to deter, so they behave anticipating high quality challenger entry. Within

this lower region, stronger incumbents raise more money.

Looking at spending behavior in the first election (the dotted line), incumbents in the upper region run against the low quality challenger, and are able to save some money for the next election, thereby creating a war chest (which is equal to  $r_1 - s_1^L$ ). Although stronger incumbents spend more money, they save *less* money. Thus, in the upper region, the war chest is decreasing in incumbent strength, and non-monotonic for all regions. Interestingly, the weaker incumbents in this upper region would prefer to spend more and save less, but they need the money (whose cost is now sunk) to deter the challenger in the next election. Incumbents in the lower region, spend all of the money that they raised—creating no war chest—as they knew they would be running against the high quality challenger. Within this region stronger incumbents spend more.

Looking at behavior in the second election, weaker incumbents (in the lower region) again raise funds knowing they will face a high quality challenger. Because there are no future elections, the amount raised is lower than the amount raised in the first election. Within this lower region, stronger incumbents raise and spend more. In the upper region, incumbents raise enough money to deter the strong challenger from entering the second election. Because they do not need as much money, stronger incumbents raise less funds than weaker incumbents in this region.

As before, the break point ( $\hat{I}$ ) between the two regions depends on the cost of the high quality challenger ( $c^H$ ). As this cost decreases, the break point increases to the point where it would eliminate the upper region. As the cost increases, the break point decreases to where it would eliminate the lower region.

The model has some interesting features. It appears that extra fund-raising keeps out high quality challengers. In addition, because this extra fund-raising is correlated with a war chest, it would also appear that a war chest keeps out high quality challengers, though it is actually the war chest and fund-raising jointly that deters. Fund-raising in the first election is increasing in

incumbent strength, but fund-raising in the second election and the war chest is not monotonic, which would make empirical testing complex.

## Two Election Cycles with Uncertainty

In this section, I alter the two-election model so that the challenger in the first election is chosen randomly. This enables me to examine the interaction between deterrence and savings reasons for war chests.

### Decision Sequence and Information

The time-line and information are the same as the previous model except that the challenger entry in the first election is determined randomly rather than strategically.<sup>17</sup>

I denote the probability that a high [low] quality challenger runs against the incumbent as  $\eta$  [ $1-\eta$ ], where  $0 \leq \eta \leq 1$ . Denoting the election with subscripts and the quality of challenger the incumbent faced in the first election with superscripts, the incumbent's expected utility function over two election cycles is:

$$-C(r_1) + \eta \{W^H(s_1^H, I) [1 - C(r_2^H) + W^k(s_2^H, I)]\} + (1 - \eta) \{W^L(s_1^L, I) [1 - C(r_2^L) + W^k(s_2^L, I)]\},$$

where  $k$  is the quality of challenger in the second election. In the second election, if the high quality challenger decides not to enter the race, a low quality challenger runs against the incum-

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<sup>17</sup>If the challenger is chosen randomly in the second election (and not the first), the results are qualitatively similar to the one-election model.

bent. To summarize preferences with uncertainty:

$$EU_{HQ\ challenger} = \begin{cases} [(1 - W^H(s, I)] - c^H & \text{enter against incumbent} \\ 0 & \text{not enter} \end{cases}$$

$$EU_{incumbent} = \begin{cases} -C(r_1) + \eta \{W^H(s_1^H, I) [1 - C(r_2^H) + W^H(s_2^H, I)]\} & \text{HQ enters} \\ -C(r_1) + (1 - \eta) \{W^L(s_1^L, I) [1 - C(r_2^L) + W^H(s_2^L, I)]\} & \text{HQ does} \\ -C(r_1) + \eta \{W^H(s_1^H, I) [1 - C(r_2^H) + W^L(s_2^H, I)]\} & \text{not enter} \\ -C(r_1) + (1 - \eta) \{W^L(s_1^L, I) [1 - C(r_2^L) + W^L(s_2^L, I)]\} & \end{cases}$$

## Strategies

Because the challenger that enters the first election is determined randomly, the incumbent makes three decisions before the high quality challenger chooses whether to enter in the second election cycle: how much to raise and spend in the first election, and how much to raise in the second election. The incumbent's *fund-raising* strategy is a map:

$$\rho : I \rightarrow \mathbb{R}_+^5.$$

Thus, for any incumbent of strength  $I$ ,  $\rho(I) = (r_1, s_1^L, r_2^L, s_1^H, r_2^H)$ , where  $r_1$  equals the amount of money raised in the first election,  $s_1^L$  equals the amount of money spent in the first election if the incumbent faces a low quality challenger,  $r_2^L$  equals the amount of money raised in the second election if the incumbent faces a low quality challenger in the first election (given the incumbent wins the first election),  $s_1^H$  equals the amount of money spent in the first election if the incumbent faces a high quality challenger, and  $r_2^H$  equals the amount of money raised in the second election if the incumbent faces a high quality challenger in the first election (given the incumbent wins the first election). Let  $\mu(I|r_1, s_1^j, r_2^j)$  be the probability that the challenger assigns to the event that the incumbent's strength is  $I$  when the incumbent raises  $r_1$ , runs against challenger  $j$ , spends  $s_1^j$  and raises  $r_2^j$ .



The challenger's *entrance* strategy is a map:

$$\alpha : \mathbb{R}_+^3 \times \{H, L\} \rightarrow \{\text{enter, not enter}\}$$

Thus, for the challenger,  $\alpha(r_1, s_1^j, r_2^j; j)$  is the probability that the challenger enters the race, having observed the incumbent's fund-raising and spending in the first election, and fund-raising in the second election, given challenger  $j$  entered in the first election.

As in the previous models, the incumbent's *spending* strategy is trivially derived: Because the incumbent increases his probability of winning by increasing spending ( $W_1(s, I) > 0$ ), and the costs of raising the money is already sunk, the incumbent spends all that he has in the last election  $s_2^j = r_1 - s_1^j + r_2^j$ . Thus, I only concentrate on the strategy pair  $(\rho^*, \alpha^*)$ .

## Equilibria

The results for the two-election model with uncertainty are similar to the two-election model without uncertainty.

**Proposition 3** *(Two Elections with Uncertainty) [Separating] When the quality of challenger in the first election is determined randomly, a universally divine PBE exists in which stronger incumbents ( $I > \hat{I}$ ) choose an optimal higher level of fund-raising and spending to make the high quality challenger in the second election indifferent between entering the race or not, and weaker incumbents choose an optimal lower level of fund-raising and spending given that they will face a high quality challenger in second election. The high quality challenger in the second election enters if fund-raising is less than the lowest optimal higher level or spending is greater than the highest optimal higher level, given the challenger that ran in the first election.*

PROOF:  $(\rho^*, \alpha^*)$  is a strategy pair such that:

$$\begin{aligned}
\rho^*(I) &= (\hat{r}_1(I), \hat{s}_1^L(I), \hat{r}_2^L(I), \hat{s}_1^H(I), \hat{r}_2^H(I)) & \forall I > \hat{I} \\
\rho^*(I) &= (\check{r}_1(I), \check{s}_1^L(I), \check{r}_2^L(I), \check{s}_1^H(I), \check{r}_2^H(I)) & \forall I \leq \hat{I} \\
\alpha^*(r_1, s_1^j, r_2^j; j) &= \{\text{not enter}\} & r_1 \geq \hat{r}_1(\hat{I}) \text{ and } s_1^j \leq \hat{s}_1^j(\hat{I}) \\
& & \text{and } r_2^j \geq \hat{r}_2^j(\bar{I}) \\
\alpha^*(r_1, s_1^j, r_2^j; j) &= \{\text{enter}\} & r_1 < \hat{r}_1(\hat{I}) \text{ or } s_1^j > \hat{s}_1^j(\hat{I}) \\
& & \text{or } r_2^j < \hat{r}_2^j(\bar{I})
\end{aligned}$$

where  $(\hat{r}_1(I), \hat{s}_1^L(I), \hat{r}_2^L(I), \hat{s}_1^H(I), \hat{r}_2^H(I))$  are the amounts chosen by  $I > \hat{I}$  that maximize utility and make the challenger indifferent to entering and  $I = \hat{I}$  indifferent to imitating, knowing  $\eta$  (which is determined by Nature) and foreseeing that the high quality challenger will not enter.  $(\check{r}_1(I), \check{s}_1^L(I), \check{r}_2^L(I), \check{s}_1^H(I), \check{r}_2^H(I))$  are the amounts that are chosen by incumbents  $I < \hat{I}$  knowing  $\eta$  (which is determined by Nature) and foreseeing that the high quality challenger will enter. The proof is similar to the two-election model with no uncertainty.

A graphical illustration of the two-election imperfect-information equilibrium is in Figure 4. This equilibrium is constructed with incumbents distributed on  $[0, 1] = [\underline{L}, \bar{I}]$ , and with  $\hat{I} \approx 0.6$  and  $\eta_1 = 0.5$ . The illustration shows the results if Nature chooses a low quality challenger in the first election, but a similar illustration is found if Nature chooses a high quality challenger. The equilibrium is qualitatively similar to the equilibrium of the two-election model with no uncertainty, and thus the same problems remain for empirical testing. The break point where the challenger enters changes because the incumbent can do nothing to deter the incumbent in the first election and does not take as costly an action raising funds.

As in the previous models, the break point ( $\hat{I}$ ) between the two regions depends on the cost of the high quality challenger ( $c^H$ ). As this cost decreases, the break point increases to the point where it would eliminate the upper region. As the cost increases, the break point decreases to where it would eliminate the lower region. As in the previous two-election model, the universal divinity refinement eliminates any (semi-)pooling equilibria.

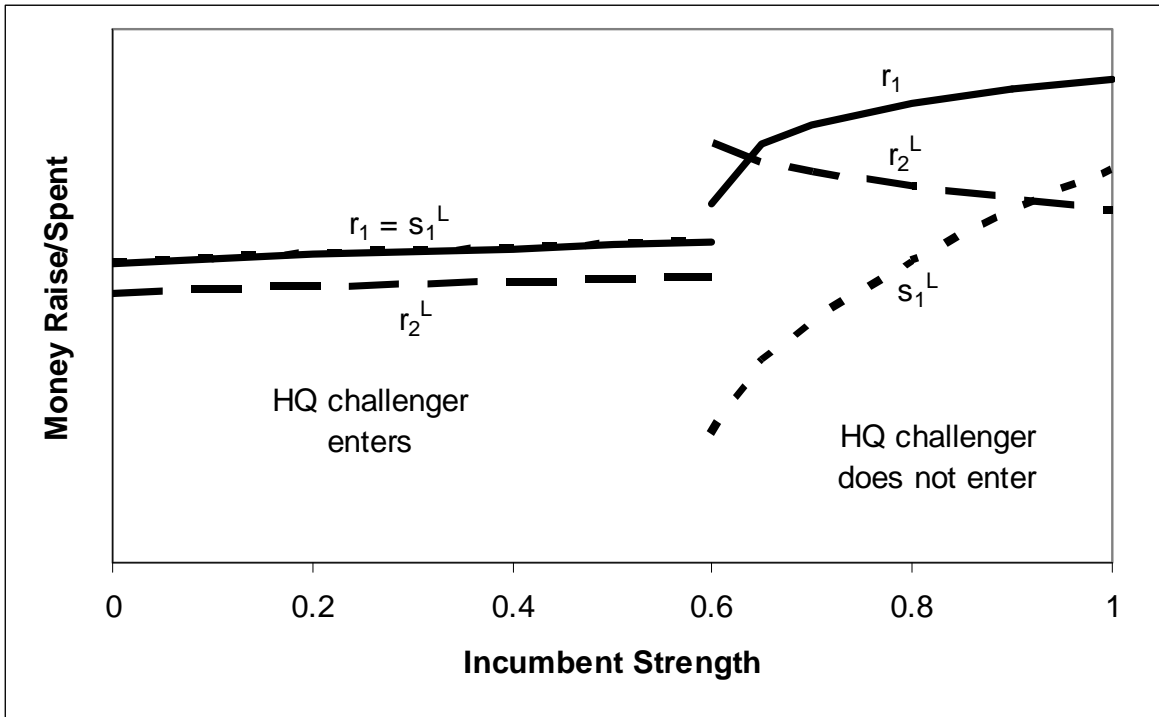


Figure 4: Sample Equilibrium: Two Elections with Uncertainty

## Discussion and Empirical Predictions

In both of the two-election models (with and without uncertainty), the stronger incumbents want to communicate to the challenger that it is in their mutual best interest if she does not enter the race. The strong incumbent thus takes a costly action—raising an excessive amount of money—to demonstrate his strength to the challenger. The weaker incumbents cannot imitate. Thus, initial fund-raising allows stronger incumbents to convey information about their strength to the challenger. In a companion paper (Goodliffe 2005), I examine the same model under complete information. Compared to a complete information model, the incumbent runs against the high quality challenger about as often (i.e. runs against the same strength of incumbents), but incumbents must raise much more money than in the complete information model. This

extra fund-raising is a deadweight loss.<sup>18</sup>

When there is no uncertainty, the high quality challenger stays out of the (first) election if the incumbent has raised a lot of money. Since that incumbent then runs against a low quality challenger, he does not need to spend all of the money he has raised, and a war chest is left over for the next election. Thus, a large war chest is created as a joint result of the excessive amount of money raised to deter the high quality challenger in this election *and* that the high quality challenger did not run against the incumbent in the first election.

In contrast, when there is uncertainty (incorporated here by randomizing the first-election challenger), the first-election challenger affects the size of the war chest. In the (random) event that a high quality challenger enters the first election race, even the strongest incumbent spends more of his money (compared to running against a low quality challenger) to fend off this challenge. Thus, even though the money was initially raised to deter a high quality challenger from entering (in the second election), the money can be used in case a high quality challenger enters in the first election (i.e., it becomes a savings account that the incumbent can draw on).

In both of the two-election models, the stronger incumbents continue to distinguish themselves by the money they spend against the challenger in the first election (and the money they save for the next election). Among these strong incumbents, the stronger the incumbent, the smaller the war chest. An interesting feature of the model with uncertainty is that incumbents take three different actions before the challenger makes her decision. Thus, stronger incumbents must wait for a long time before reaping the benefit. Since they face the possibility of a high quality challenger in the first election, and the possibility of defeat no matter who is the challenger, strong incumbents exert a significant amount of effort to deter a high quality challenger from entering the second election, even though they are unsure that they will even make it to the second election.

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<sup>18</sup>In addition, in the complete information model, both fund-raising and the war chest are non-monotonic in incumbent strength.

In the second election (in either model), stronger incumbents have war chests to draw on to defeat their low quality challengers. Thus, they do not need to raise as much money to deter the high quality challenger for the second election.

With or without uncertainty, weak incumbents find it too costly to imitate strong incumbents, and thus reveal their strength when they raise funds in the first election. In the model without uncertainty, weak incumbents compound their weakness by drawing high quality challengers in the first election, and must spend all of the money they raised to fend them off. They act knowing that they will face a high quality challenger in the first election, and in the second election as well. Because they know that they face a high quality challenger in each election, they have no incentive to save any money, for savings or deterrence—every day is a rainy day. Relative to other weak incumbents that reveal their strength, the weakest incumbents raise (and spend) less than others. Weak incumbents act similarly in the model with uncertainty. The only difference is that they are not certain to run against the high quality challenger in the first election. If weak incumbents have somehow defeated the (high quality) challengers in the first election (having spent all of their money), they are again made weaker by drawing a high quality challenger in the second election. Anticipating the entry of high quality challengers, they raise their optimal amount, and spend it all.

The first empirical prediction of the model is that large war chests appear to deter high quality challengers from entering. This prediction has already been tested by several studies, and the results are mixed. The deterrence studies differ across years examined and control variables included (and differences in how a war chest is defined). However, according to this model, the empirical evidence adduced against deterrence fails because the savings behavior of incumbents can mask the deterrence effect. When the deterrence and savings components are both included, among those incumbents that create war chests, the stronger the incumbent, the *smaller* the war chest he creates. The non-monotonic nature of the relationship confounds

studies that have assumed a monotonic relationship.

Another possible explanation for the contradictory results is the extent to which a crucial unobserved variable in this model is incorporated (or correlated with included variables) in the empirical tests: the strength of the potential high quality challenger. A cross-sectional study of U.S. House districts, for example, would need to identify potential high quality challengers in each district. Recent work from the Challenger Emergence Study (Stone and Maisel 2003) would be the first step in a more rigorous test of the hypothesis. Some work by Box-Steffensmeier and Franklin is suggestive. In their study of the 1992 U.S. Senate elections, Box-Steffensmeier and Franklin (1995) argue that a safe incumbent raises and saves money to deter challengers and an unsafe incumbent raises and spends money to respond to a strong challenge. If incumbent strength is correlated with vote share, then their evidence is consistent with the model's prediction.

The second empirical prediction is that one should observe a smaller war chest (or no war chest at all) if an incumbent faced a high quality challenger in the previous election. This is true for both models. An incumbent may not form a war chest, however, even if that incumbent faced a low quality challenger in the previous election. This prediction is confirmed by Ansolabehere and Snyder (2000) and Goodliffe (2004).

The third empirical prediction is that because low quality challengers only enter when high quality challengers choose not to, the two types of challenger entry are negatively correlated. This prediction was tested in Goodliffe (2001), and confirmed.

Thus, this model squares with previous empirical tests, and offers an alternative explanation why war chests appear to deter in some circumstances but not others, and identifies circumstances when it is used for savings as well as deterrence. For stronger incumbents, a war chest is a by-product of their efforts to distinguish themselves from weaker incumbents—an effort designed to deter high quality challengers from entering future races. Thus, a war chest is initially

created for deterrence, and becomes savings for future races.

Compared to a complete-information model (Goodliffe 2005), strong incumbents in these incomplete-information models raise and spend more money. Thus, roughly, the less that is known about an incumbent, the more he would have to spend to distinguish himself.

A final prediction is that incumbent strength is revealed through the electoral process. From a modeling perspective, this is true because incumbents are able to take multiple actions before a challenger chooses whether to enter. Since this is almost always true in an actual campaign, we should not expect the (semi-)pooling equilibria that other models have predicted.

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