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ELECTIONS AND THE THEORY OF CAMPAIGN CONTRIBUTIONS: A SURVEY AND CRITICAL ANALYSIS*

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The formal theory of campaign contributions in elections has expanded in the past decade. The basic assumptions and results of these models are examined and analyzed. The assumptions of the models are often inappropriate for the political actors considered and the results are sometimes not empirically supported. We suggest ways in which these models may be altered to alleviate some of these problems.

1. INTRODUCTION

The role of campaign contributions in elections, long a subject of empirical investigation, has now come under the scrutiny of more theoretically inclined political scientists and economists. Formal models of elections and campaign contributions are proliferating rapidly. In contrast with earlier models of elections, these models consider simultaneously the actions of contributors, voters, and politicians, and allow an explicit role for campaign contributions in electoral competition.[1] Models of this sort are in their infancy but possess great promise. At the same time, however, most existing models have important shortcomings. In some models, voters seem to behave irrationally [see Austen-Smith (1990) for a discussion]; in others, candidates fail to take obvious strategic moves with respect to contributors; and in some, it is difficult to imagine any actual political service that corresponds with that being modeled (we will elaborate in the rest of the paper). We believe that the problems arise because relatively little systematic consideration has been devoted to the basic assumptions. For example: What are reasonable demand primitives for interest groups? How do politicians compete with one another for campaign contributions? What role do information asymmetries create for campaign expenditures?

In this essay we explore some of the central questions about models of elections and campaign contributions. We begin by considering what is known about the

[1] Notable models include those of Bental and Ben-Zion (1975), Ben-Zion and Eytan (1974), Denzau and Munger (1986), Austen-Smith (1987), Baron (1989a, 1989b), Cameron and Enelow (1989), Hinich and Munger (1989), Magee, Brock, and Young (1989), Mueller (1989), Coates (1989), and Snyder (1990).

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empirical phenomena of campaign contributions. We summarize some of the relevant stylized facts about campaign contributions; we focus primarily on those empirical regularities which the theoretical models have attempted to address. Next we present an overview of the assumptions in the existing theoretical models. We examine the assumptions with respect to the three types of actors involved: voters, contributors, and candidates. We suggest there are essentially two types of models: models of position-induced contributions and models of service-induced contributions. Since the latter have received less critical attention than the former, we devote considerably more scrutiny to models of service-induced contributions, which we discuss in detail in Section IV, where we present several new results. The results highlight important difficulties that do not seem to have been widely recognized.

First of all, we explore the nature of the services involved and determine that these services must be without policy content and of a purely private nature in order to satisfy the requirements of the postulates. We find that, in elections in which the candidates are identical, unless candidates face exogenous capacity constraints in their abilities to provide services, service-induced campaign contributions will be negligible. We also discover that if one of the candidates has an *a priori* electoral advantage, such as name recognition for an incumbent or a larger capacity to provide services, in the electoral equilibrium challengers will not receive any service-induced campaign contributions. Therefore, we conclude that at present, the service-induced model cannot adequately explain the level and distribution across candidates of campaign contributions in elections. In the final section, we discuss implications for future research.

II. STYLIZED FACTS ABOUT CAMPAIGN CONTRIBUTIONS

With the advent of legal controls and reporting requirements on the sources and amounts of campaign expenditures, the role and pattern of such monies in elections began to be extensively studied.[2] Probably the most analyzed question has been the effect of gross campaign expenditures on electoral outcomes. The early empirical evidence suggests that campaign expenditures have a positive effect on the probability of winning for non-incumbents, with a surprisingly non-positive impact on the probability of an incumbent winning.[3] It is unclear why incumbents choose to raise so much money that its apparent net marginal product is negative.*

[2] Most of the empirical work has examined the effects of campaign expenditures in Congressional or other national elections. Patterson (1982) is one noteworthy exception.

[3] Abramowitz (1988), Chapman and Palda (1984); Glantz, Abramowitz, and Burkart (1976); Jacobson (1978, 1980, 1985); Johnston (1978); Kau and Rubin (1982); Kau, Keenan, and Rubin (1982); Lott and Warner (1974, 1975); Palda (1973, 1975); Palda and Palda (1985); and Welch (1974, 1976, 1981) all estimate a type of election production function with campaign expenditures as an input.

*Baron (1989a) shows that the probability of winning plotted cross-sectionally against a measure of incumbency advantage may have an inverted U shape, which might explain the inconsistent empirical results.

One reason for the confusion may lie in the simultaneity in the estimations. That is, campaign contributions are likely to be a function of the probability of election and the monies received by an opponent as noted by Jacobson (1985).[4] Recent empirical work suggests that when such simultaneity is accounted for through more sophisticated estimation techniques, the positive effect of campaign expenditures upon electoral outcomes also holds for incumbents [see for example Ansolabehere (1990); Green and Krasno (1988); and Banaian and Luksetich (1991)]. Perhaps reassuringly for those who would like to think of politicians as rational, the massive quantities of monies gathered by candidates do seem to increase the probability of election of the receiving and spending candidate, incumbent or challenger.

Unfortunately, little empirical research has attempted to investigate how money influences voters. Husted, Kenny, and Morton (1991) analyze whether campaign expenditures increase the amount of information voters possess about candidate policy positions. They find that campaign expenditures appear to slightly increase the errors made by voters in evaluating candidate positions, suggesting that candidates are ambiguous about their positions in their advertising and may choose to advertise non-policy characteristics such as "honesty".

The second most investigated empirical concern has been the role of campaign expenditures in altering policy positions or securing specific favors; that is, to what extent does money "buy" political results. Empirical studies that examine voting on issues in which the economic benefits can be easily assigned to particularized interest groups do find that campaign expenditures can affect Congressional voting.[5] However, studies that examine several votes or votes on less particularized benefits find little evidence of overall influence of campaign contributions on political decisions by the Congress.[6] Some investigators find that the influence of campaign contributions is larger the less publicly visible the issue considered.[7] Hall and Wayman (1990) argue that campaign expenditures "buy" activity rather than votes; they demonstrate that legislative involvement in issues can be explained by campaign contributions by interest groups who are concerned with these issues. The conclusion seems to be that campaign contributions do have some impact on legislative products, albeit a subtle and complex one.

There are several noteworthy empirical examinations of the contribution decisions of interest groups; in particular see Grier and Munger (1991); Grier, Munger, and Roberts (1991); Poole and Romer (1985); Sabato (1985), and Wright

[4] Moreover, Snyder (1990) argues that, for campaign contributions given in order to receive private non-policy favors, the equation estimated is essentially an equilibrium condition and therefore identification of any effects of such investor motivated campaign expenditures upon electoral outcomes is impossible.

[5] See Silberman and Durden (1976); Chappell (1981); Feldstein and Melnick (1984); Frendeis and Waterman (1985); Kau, Keenan, and Rubin (1982); Kau and Rubin (1982); and Stratman (1991).

[6] Chappell (1982); Grenzke (1989); Wayman (1985); Welch (1982); and Wright (1985).

[7] See Jones and Kaiser (1987) and Schroedel (1986). However, both suffer from important methodological shortcomings.

(1985). A full review of this work is beyond the scope of this paper. Much of the relevant empirical debate concerns the extent to which contributions are motivated by overall ideological concerns or given in return for special redistributive favors. Welch (1980) and Snyder (1990) argue that contributions by corporations and labor unions are given to receive particularized benefits since these groups generally give most of their contributions to likely winners. Grier and Munger (1991) note that interest groups tend to give larger contributions to legislators on committees with jurisdiction over issues of concern to the groups, supporting the work of Hall and Wayman (1990) on the relationship between campaign contributions and legislative behavior. The positive effect of campaign expenditures on votes on particularized benefits and less publicly visible issues suggests that contributions are motivated for these reasons. On the other hand, Poole and Romer (1985) find support for the ideological basis of campaign contributions. They point out that incumbents in close races receive larger amounts of money and that there is a strong positive correlation between ideological positions of contributors and recipients.

Poole and Romer (1985) also discover that few contributors give to two candidates in the same race. Sabato (1985, pp. 88–90) presents similar data on split giving as do Magee, Brock, and Young (1989).[8] Mueller (1989, p. 213) concludes that the dearth of split giving is evidence of ideologically motivated contributions. However, the analysis in Section IV to follow suggests that such a pattern of giving would exist even if contributions are offered for special redistributive favors.

The general assumption of ideologically motivated campaign contributions is that they are given to elect the candidate with the preferred policy position as discussed in the next section. Yet empirical examination of the size of contribution leads one to conclude as Keim and Zardkoohi (1988) that the likely impact of each group is negligible and that PAC's must work in concert to affect political outcomes leading to numerous free-rider problems. Therefore, the motivations of the contributing interest groups cannot be easily uncovered.

In conclusion, the empirical literature suggests the following as "stylized facts": (1) campaign expenditures do increase the probability of election of the spending candidate, incumbent or challenger; (2) the mechanism through which campaign expenditures influence voters is not well understood; (3) campaign contributions have little discernible impact in the aggregate on roll call votes, but appear to

[8] Sabato (1985, p. 89) notes that the by-laws of many PAC's explicitly prohibit split giving. He states on page 88: "Instances of split giving usually receives a great deal of publicity, partly because the practice tends to confirm the critics' view of PACs as vote buying influence-seekers. . . . Yet it is also true that split giving is rare. For almost all the major PACs I interviewed, there were no more than half a dozen cases of split giving (out of dozens or hundreds of contributions) over several election cycles." Magee, Brock, and Young (1989) report that split contributions comprised only 7% of campaign contributions in the presidential election of 1964, while they were 14% in 1968. As they point out the increase can be explained by ". . . the large number of contributors in 1968 who gave to antiwar candidates of both parties before the conventions." (p. 69) See also Poole, Romer, and Rosenthal (1987).

affect voting on particularized, less publicly visible issues and may influence the allocation of legislative time to issues; (4) contributing interest groups may give for either ideological or redistributive purposes or both, and the circumstances in which one motivation is predominant are not well understood; and (5) interest groups rarely give to two candidates in the same race.

III. BASIC ASSUMPTIONS: A ROAD MAP

The essential characteristic of models of campaign contributions is that they involve a game between candidates, contributors, and voters. However, the nature of this game changes dramatically depending on assumptions about payoff functions, strategy spaces, and especially information. In this section we provide a road map of the literature by reviewing basic assumptions. Those assumptions which we will use in our analysis of service-induced models of campaign contributions in Section IV will be stated formally and numbered.

A. Voters

In the traditional literature in political science, voters are conceived as acting either prospectively [as in Downs (1957)] or retrospectively [as in Key (1966)]; focused either on policy or performance, or on personal services [as in Cain, Ferejohn, and Fiorina (1988)]; and concerned either with individual candidates or with political parties. Some of the models under review do not explicitly consider voting strategies, as discussed below. However, all the models that do explicitly incorporate individual voters treat them as prospectively oriented,[9] focused on policy rather than service, and concerned with individual candidates rather than political parties.[10]

The modeling choice results in the use of some variant of the standard spatial model of elections [Enelow and Hinich (1984), Calvert (1986), Coughlin (1989)], which entails the following. First a voter's evaluation of a candidate is assumed to be a decreasing function of the distance between the expected policy outcome associated with the candidate (that is, the action taken by the candidate if elected) and the voter's ideal or most preferred policy outcome. Second, voters are assumed to vote for the preferred candidate. Therefore, a voter's strategy is a function from candidates evaluations to a vote, with the preferred candidate

[9] Models of retrospective voting have close links with the literature on mechanism design in economics and typically investigate problems of adverse selection [Harrington (1989), Banks (1990a)] or moral hazard [Ferejohn (1986), Austen-Smith and Banks (1989)] in elections, focusing on the informational properties of elections. To the best of our knowledge no model of this kind has yet incorporated interest groups and campaign contributions. Accordingly, we do not review these models here.

[10] Magee, Brock, and Young (1989) blur the distinction between candidates and parties but the general thrust of their model seems clearly competition between two candidates. Party loyalty or bias can easily be built into models utilizing the spatial theory of voting, but the thrust of the models remains candidates rather than parties.

receiving the vote. The critical issue for the voter component of models of campaign contributions is the relationship between the voter's evaluation of candidates and the candidates' policy positions, service promises, and interest group contributions.

With respect to policy positions, an immediate difficulty is the absence of a mechanism in the standard spatial framework by which candidates can commit themselves credibly to policy positions. As a consequence, rational voters should interpret announced positions as at best signals about a candidate's actual intentions (her type) [Banks 1990b)] or at worst view campaign statements as completely uninformative.

The lack of a commitment mechanism is unquestionably a difficult issue. However, we suspect that extending the basic framework to include multiple elections [Austen-Smith and Banks (1988)] or treating candidates as part of overlapping generations within a political party could lead to a plausible solution. Alesina and Spear (1988) consider such an overlapping generations framework in which candidates are members of an on-going political party which faces repeated elections and find that candidates can be constrained to act in the interest of the party.

Candidate service promises, which may be necessary to receive contributions, present different problems. As Denzau and Munger's (1986) simple but illuminating analysis made clear, services to groups may lead voters to sanction politicians. Several models ignore this possibility, however. For example, Hinich and Munger (1989) allow the incumbent to provide services to contributors, but provision of services does not alter voters' perception of the incumbent's policy position nor does it stimulate a direct voter response. Similarly Baron (1989a) models candidates as selling service promises to contributors without fear of direct voter sanctions or even the worry that voters will deduce from campaign expenditures that candidates have "sold out" to the special interests. These assumptions may be valid for some types of services supplied in particular ways, but little attention has been paid to these problems.

A closely related difficulty is the absence of a mechanism in the standard spatial framework for interest group contributions to affect voters' evaluations of candidates. If one takes campaign advertising as the canonical form of campaign expenditure, then apparently advertising must alter voter strategies. However, since the standard spatial model assumes complete information, there is nothing for voters to learn from advertising.

Several models use essentially black box advertising technologies [Austen-Smith (1987), Cameron and Enelow (1989), Hinich and Munger (1989)]. In one approach, voters are assumed to be risk averse and uncertain about each candidate's position, while "knowing" the candidates' expected positions.[11]

[11] This type of assumption about voter information was also used in a spatial voting model by Bernhardt and Ingberman (1985) and Shepsle (1972). Campaign contributions are not explicitly included in their model, however.

Campaign advertising is then assumed to somehow transmit useful information that reduces this uncertainty (although perceptions of the candidates' expected positions do not change). Given risk aversion, voter evaluations of the candidate increases. The second approach is quite similar. Voters are assumed to value some non-policy characteristic of candidates (e.g. honesty), with increased campaign advertising somehow leading to a perception of a higher value of this characteristic.

No truly convincing justification for black box advertising technologies has yet been given. For instance, in the case of the variance reduction technology, the candidate presumably sends a message whose import is, "My position is really, truly x." That is, the candidate tries to trim certain possible types from voter consideration. However, models using a variance reduction technology do not actually analyze campaign messages, and such an analysis is incompatible with an assumption of complete information in any case. Similar problems afflict the non-policy characteristics approach. Clearly, analysis using black box advertising technologies should be regarded as quite tentative until plausible microfoundations emerge.[12]

Austen-Smith (1990) suggests an alternative approach to campaign advertising, treating spending as a readily observed costly signal of a candidate's type. Coates (1989) and Cameron and Jung (1990) provide analyses along these lines; separating (information revealing) equilibria do emerge in these models. However, these models employ quite restrictive assumptions or analyze what can be seen as special cases. It remains to be seen how robust these findings are to more general assumptions. We suspect many political scientists who study campaigns as well as campaign operatives would argue that campaign advertising frequently has informative content.

Finally, most service-induced and some position-induced campaign contributions models try to finesse the difficult issues of voter behavior by substituting an aggregate vote function or probability of election function for an explicit model of voter calculation [Ben-Zion and Eytan (1974); Bental and Ben-Zion (1975); Denzau and Munger (1986); Magee, Brock, and Young (1989); Baron (1989a), (1989b); and Snyder (1990)]. This function is essentially a standard production function whose arguments include either campaign expenditures and positions or just campaign expenditures.

More formally, if we assume (as in almost all of the campaign contribution models), two candidates, indexed by $i = 1,2$, then the relationship between the probability of election for candidate one, P, is given by Assumption A1 below:

Assumption A1: The probability of election for candidate one, P, is dependent upon the campaign contributions of various interest groups as follows:

[12] Harrington (1989) provides several analytical results on cheap talk in campaigns. Chappell (1989) uses computer simulation to examine candidate strategies concerning rhetoric under a number of different assumptions. These papers begin to address the microfoundations of black box technologies. As noted in Section II, Husted, Kenny, and Morton (1991) find slight evidence that campaign expenditures might actually increase the errors made by voters in evaluating candidate positions.

$P = P(X_1, X_2)$, where X_i is the total campaign contributions given to candidate i. The probability of election for candidate two is equal to 1-P and it is assumed that P is continuously differentiable, strictly increasing at a decreasing rate in X_1, strictly decreasing at an increasing rate in X_2, $P(\cdot, 0) = 1$, and $P(0, \cdot) = 0$.

The vote production function will depend on whether one of the candidates is an incumbent, that is, has previously held the same position. Elections in which neither candidate is an incumbent are called open-seat elections and the candidates are generally assumed to be symmetric. The typically used functional form for P in the open-seat case is given in equation (1) below:

$$P = X_1/(X_1 + X_2). \tag{1}$$

Models that use aggregate vote functions sometimes incorporate incumbency advantages by introducing weights. For example, if we assume candidate one is an incumbent, then due to name recognition, her campaign expenditures may have a larger effect on P than expenditures by her opponent. That is, for the case in which candidate one is an incumbent:

$$P = \beta X_1/(\beta X_1 + X_2), \ \beta > 1. \tag{2}$$

Baron (1989a) uses the above functional form as one way to represent incumbency advantages. As in the service-induced model of Hinich and Munger (1989), Baron also considers the alternative assumption that incumbents are capable of providing more services than challengers and have an electoral advantage as a consequence.[13]

Austen-Smith (1990) vigorously attacks the use of such functions. He argues that the results in these models often hinge on assumptions about the vote production function that cannot be justified by rational behavior of individual voters. Accordingly, conclusions in models using a vote production function should be viewed as contingent on the assumed function actually existing, an open question at present. This caveat applies to the model analyzed in Section IV.

B. Contributors

Contributors share some similarities with voters. For example, contributors may act prospectively or retrospectively; focus either on policy or services; and concern themselves either with candidates or parties. Most models reviewed here assume contributors focus on candidates rather than parties and are largely prospective

[13] In Baron (1989a), as demonstrated in Section III, the service constraint on a candidate depends on the disutility of providing services so that candidates with lower disutility will have greater service capacities. Other potential sources of electoral advantages investigated by Baron are the role of campaign resources provided by parties or the candidate himself and the influence of policy positions of the candidates.

in orientation. However, the models differ sharply in their assumptions about the position versus service orientation of contributors.

Differences arise because contributors are not simply voters who "vote" with money. A single contribution, unlike a single vote, may plausibly alter the expected value of the outcome associated with a particular candidate by changing the probability of that candidate's election. In addition, an offer of money naturally suggests the possibility of exchange, i.e. political benefits for cash. Hence, contributing may increase the expected value of the outcome associated with a particular candidate's election by altering the candidate's future actions. Existing models thus divide rather neatly into models of *position-induced contributions* and models of *service-induced contributions.*

1. Position-induced Models. Models of position-induced contributions assume contributors take the outcome associated with each candidate as fixed while attempting to alter the probability of election of the candidates. That is, contributors offer donations in order to help politicians with favorable positions win elections. Contributors choose a contribution level in order to maximize their expected utility received after the election. This formulation requires contributors to have preferences over policy actions in much the same way voters do. Moreover, since candidate behavior is presumably influenced by the actions of all contributors, potential contributors find themselves in a game with each other.

Ingberman (1989) labels this class of models "freedom of speech" models because contributors act without an explicit *quid pro quo* of money for services. Alternatively, these models might be called "stack the deck" models since the ultimate goal of a contributor can be seen as altering the composition of a political institution, such as a legislature, in its favor. In this case, preferences over policy actions are induced by preferences over policy outcomes. In either case, a strategy for a contributor is a pair of contributions, given the announced policy positions of the candidates and the ideal points of the interest groups (their types).

An important issue in position-induced models is the "wedge" problem. It is well known that unless there is an exogenously given difference in candidates, the candidates will be driven to equivalent policy positions [See Austen-Smith (1987)]. If candidates have equivalent policy positions there is no incentive for interest groups to contribute since the policy outcome will be unaffected by the contribution given. In essence, some wedge must drive the candidates apart, if only minutely, so that contributions can enter the model.

Unfortunately, position-induced models face several empirical problems. First and foremost, it is not clear that contributors are capable, given existing limits on campaign spending, of influencing the probability of election of the desired candidate, as noted in Section II. If contributors cannot affect the probability, then the interest group will receive no benefits from contributing and contributing is "irrational". Secondly, position-induced models typically assume that the position is a "public good" and cannot be particularized in terms of special benefits for contributing groups. The empirical evidence that campaign

expenditures have more effects in terms of particularized legislation and less publicly visible issues suggests that more complex motivations are determining contribution decisions. Position-induced models of campaign contributions, then, have not been entirely successful in explaining some basic stylized facts about such contributions.

2. *Service-induced Models.* Service-induced contribution models do not rely upon interest groups attempting to alter the probability of winning of the preferred candidate. Instead these models assume contributors take probabilities of election as fixed while attempting to alter the outcome associated with a candidate if she wins. That is, models of service-induced contributions assume a straightforward *quid pro quo* of money for services: campaign contributions resemble bribes, although provision of services may be perfectly legal. In essence, the contributor buys a contingent contract promising the delivery of valuable services should the candidate actually win the election; the financial donation required to purchase the promised favor is exactly equivalent to a price. Therefore, it is necessarily assumed contributors have some willingness-to-pay schedule for services.

Since the action of the politician may depend on the contributions received from all affected parties, it is possible contributors find themselves in a game with each other. Nonetheless, all of the service-induced models of campaign contributions assume that interest groups are small relative to the total number of groups so that groups ignore any cross-effects of campaign contributions across interest groups. These models also implicitly assume that the service is entirely a private good and requires no significant taxes on any other party, such that groups do not perceive that they are in a game with each other. Obviously, the basic contours of service models depend crucially on the nature of the service under consideration, a point we return to later. In these models, a strategy for a contributor is a pair of contributions, given the service prices of the candidates, the probability of election of the candidates and, conceivably, the valuation by the contributor of the services being sold (the contributor's type).

The postulates about interest group behavior in the service-induced model are most easily represented using a simplified version of the formulation of Baron (1989a)[14] and stated in Assumption A2:

Assumption A2: There is a continuum of interest groups. Each group is identified by $\theta \in [0, \theta^+]$ and there is a given distribution of interest group types, $F(\theta)$. Group θ's private return from service provided by candidate i is given by: $R(s_i, \theta)$, where s_i is the level of service provided to each group that contributes c_i. The return is postulated to be an increasing function of service level with diminishing

[14] In Baron the interest groups are also indexed by candidate since they may be aligned by fixed candidate policy positions. We will address issues concerning the nature of services below. In the case in which services are entirely non-policy or in elections with symmetric candidates, which is the focus of the majority of his analysis, Baron assumes that the distribution of interest groups across candidates is identical as in A2.

marginal returns after some service level s_i^* and an increasing function of θ.[15] Groups will contribute if the expected gain is greater than or equal to zero, where the expected gain for contributing to candidate i is given by $G_i(\theta)$:

$$G_i(\theta) = p_i R(s_i, \theta) - c_i. \tag{3}$$

p_i is the expected probability that candidate i will be elected. As noted above, interest groups act as if this probability is unaffected by their campaign contributions.

Baron (1989a), Snyder (1990), and the analysis of this paper assume that interest groups take the price of service, that is, c_i, as constant and simply choose whether to purchase the service or not.[16] In Hinich and Munger (1989) a finite number of interest groups choose a contribution level given a service/contribution function chosen by the candidate. This difference is innocuous to the analysis of this paper since the two models yield largely equivalent results.

The return from service is also dependent upon the cost of alternative investment opportunities for the interest group. Hinich and Munger explicitly incorporate these considerations through the use of an interest group specific budget constraint for political activity in which a budget surplus is invested in other opportunities or a budget deficit is covered by interest group "borrowing". Snyder also assumes that interest groups will compare the campaign contribution prices with the return from a "similar investment", which might be interpreted as a favor provided from another politician in another race.

The commitment problems facing voters apply with a vengeance to contributors in both types of models. In position models contributors, like voters, must infer likely policy actions from an announced position that is not really binding. Similarly, in service models the winning candidate may renege on her agreement to supply services following the election. Baron (1989b) examines the extent to which candidates may be enforced to meet *a priori* service arrangements through the constraint of facing repeated elections.

C. *Candidates*

Given an objective function for the candidates and a specification of their strategy spaces, their behavior follows fairly straightforwardly from the assumptions made about voters and contributors. Most models assume the candidates are pure probability of winning maximizers. In position models the candidates' choice variable is a policy position in issue space, while in service models the candidate

[15] The interest group index, θ, could be thought of as a measure of the size of the group, with larger groups having a greater demand for the service.

[16] Baron (1989b) allows candidates to discriminate across groups in campaign contribution prices and services levels. In Snyder (1990) different groups may receive different service levels, but the per unit price is constant given his assumption of a perfectly elastic demand for "favors".

chooses a service level and a contribution price given a total level of services available. For service-induced models, this can be formally represented by Assumption A3 below:

Assumption A3: Candidate one's objective is to choose s_1 and c_1 in order to maximize P subject to the constraint that the total service level provided is less than or equal to T_1, while candidate two wishes to choose s_2 and c_2 in order to maximize $[1-P]$ subject to T_2. T_i is an exogenously given total level of "favors" available for candidate i.

An alternative specification is that politicians are utility maximizers. Baron (1989a) and (1989b) assumes, for example, that politicians receive utility from participating in policy decisions and disutility from providing services to contributors. Assumption A4 formally presents the disutility model of candidate behavior.

Assumption A4: Candidate i maximizes her expected value of winning which is equal to the probability of winning times the net value received while in office, $[V_i - b_i S_i]$, where V_i is the value to candidate i of holding elected office, b_i is the constant marginal cost to candidate i of providing services, and S_i is the total level of services actually provided by candidate i. Candidate one's objective is to choose s_1 and c_1 in order to maximize $P[V_1 - b_1 S_1]$, while candidate two wishes to choose s_2 and c_2 in order to maximize $[1-P]\ [V_2 - b_2 S_2]$.

These candidates do not have personal policy references in the sense of Wittman (1900) since they only receive utility from being elected and are indifferent to the service or policy position advocated. Incorporating policy references as in Wittman or in Alesina and Spear (1988) would almost certainly be required in extensions with retrospective voting and incomplete information about candidate types [see Austen-Smith (1989) for a discussion].

Given any assumption in which holding office is desirable, the candidates must compete for votes and almost certainly compete for contributions. Competition for votes via position-taking is the central theme of the spatial theory of elections and we will not recapitulate basic results. More interesting is the competition for contributions and its interaction with the competition for votes.

In position models, candidates compete for contributions by adopting positions. The basic problem for a candidate is to calculate her optimal position, trading off direct losses in votes from favoring contributors with indirect vote gains from acquiring contributions, taking into account the position of the competitor. Position models generally assume politicians move before contributors. Subgame perfection in these models not surprisingly implies that campaign contributions alter candidate positions via anticipated effects on contributors and voters. Interest groups will find it optimal in the equilibria to give campaign contributions only to the most preferred candidate, since any contribution to her opponent will

lower the probability that preferred policies are enacted. As noted above, in position models in which candidates maximize probability of election, unless an exogenous wedge in candidates exists, the candidates will be driven to equivalent policy positions resulting in zero campaign contributions in electoral equilibria.

Competition for contributions among the two candidates in the same election in service models has been little studied. Hinich and Munger (1989, p. 60), for example, forthrightly state: "We do not consider the strategic elements of candidate pledges in competing for contributions from the same prospective investors". However, as those authors go on to note: "Such competitive elements are likely to shape real world allocation strategies and should be accounted for in future work."

In Baron (1989a, 1989b) the demand primitives of contributors are such that candidates need not compete for contributions. In contrast, Snyder assumes that the competition for "favors" is such that the demand curve facing each candidate is perfectly elastic. Essentially he postulates that there are a large number of candidates competing in many elections who can provide the same type of service. He does not recognize that the competition between candidates within the same race for campaign contributions may be different from the competition between candidates in different races. In addition, he assumes positive campaign contributions in equilibrium which may not necessarily occur as we show in Section IV.

A second type of competition which faces providers of services is also sometimes ignored in these models. Except in Snyder, candidates are assumed to be monopoly providers of services once elected. This is an unattractive assumption concerning legislators because usually several elected legislators can potentially provide the services. It is not evident that a candidate can arbitrarily set her campaign contribution price for the service without being affected by potential competition from incumbents. For example, Ramseyer and Rasmusen (1990) present a model in which wealth-maximizing members of a legislature compete to provide a lobbyist with favorable votes on special interest legislation. They find that the legislators may be driven to an equilibrium in which the price of their votes, which are called "bribes" by the authors, are significantly lower than the value of the service provided. This competition among incumbents is an important issue, but we will focus in this paper on the implications of competition of service-induced campaign contributions among candidates for the same position.

IV. SERVICES AND THE COMPETITION FOR CAMPAIGN CONTRIBUTIONS

A. The Nature of Services

Political services may be classified along two dimensions, policy vs. non-policy, and public vs. private. A non-policy service is undifferentiated horizontally (i.e. the service is non-spatial in nature), though different services may be substitutes

or complements. In contrast, a policy service changes the position of government policy and therefore is necessarily differentiated horizontally. For example, a politician may assist a contractor in receiving overdue reimbursement from a government agency. This is a non-policy service. Alternately, the politician could alter a provision of the tax code affecting the contractor so that her marginal tax rate falls. The tax rate can be represented as a point on the unit interval, and the service changes the location of the tax rate. Hence, the service is a policy service.

Political services may be public or private goods depending on the number of actors affected. Since only the contractor is affected by the politician's help in receiving timely reimbursement, this service is a private good. If many firms are affected by the change in the tax code, the service is a public good. All of the service-induced models considered assume that the services are private and therefore excludable.

Clearly, the politics of service provision are likely to vary dramatically depending on the nature of the service. For example, the provision of a public service is likely to involve problems of free-riding among the affected parties. With respect to policy services, a critical fact is that the status quo to be altered must be or have recently been a political equilibrium: the status quo prevails for a reason. Therefore, it must be shown how the new status quo following provision of the service can be a political equilibrium. Moreover, most policy services cannot be supplied by an individual politician at will. Instead the politician intent on supplying a policy service usually must employ governmental structures such as legislative committees or public bureaucracies. Models of policy services that ignore the technology of service provision (i.e. how political institutions are actually organized and operate) cannot be very convincing. As noted above, service-induced models finesse this problem by assuming that candidates have "monopoly" power to provide the relevant service or postulate that the services are non-policy.

Using this classification scheme, the most sensible interpretation of current service-induced models is that they analyze the special case of private, non-policy services. For example, Snyder (1990) explicitly assumes that "investor contributors," who give money in order to receive private services, are not "ideological", do not have horizontally differentiated policy preferences. Therefore, the services modeled must be non-policy services. Hinich and Munger (1989) also postulate that the favors provided by elected officials have insignificant policy content.[17] In contrast, Baron (1989a, 1989b) suggests that the services he models may have policy content. He postulates that each candidate may be associated with different policy positions for the relevant services,

[17] However, Snyder states that the services may include "special tax exemptions" and Hinich and Munger consider possible services as "private tax exemptions". The assumption these authors make is that the change in the tax schedule provided is so insignificant as to not affect the tax schedule in the existing legislative equilibrium. One wonders how the pre-existing tax rate could have been an equilibrium.

although this horizontal differentiation is neither represented formally nor explained. Each candidate is taken to have a bloc of potential contributors aligned with her. Members of the two blocs do not play a game with each other or across blocs, so the services in question must be private.

However, it is not shown why the current status quo for an aligned contributor was an equilibrium, how the service would alter that status quo, nor how the new status quo for each contributor could be an equilibrium. If the model is taken to be about policy services, it is grossly underspecified. On the other hand, if the model analyzes private non-policy services it bears a straightforward and sensible interpretation. But then the assumption of aligned groups must be dropped, and indeed this is done in most of Baron's analysis. In short, current models of service-induced contributions are best understood as analyzing services for contributors that are the equivalent of finding lost social security checks for voters; the models do not really analyze services like altering important legislation or intervening in critical regulatory proceedings.

We will present the basic non-policy service model and demonstrate the unreasonableness of the assumptions concerning candidate behavior. We show that a candidate has an incentive to reward only those contributors who do not also give to her opponent. We demonstrate that under such a reasonable assumption, if an electoral equilibrium exists in which capacity is not exogenously constrained, service-induced campaign contributions will be negligible in open-seat elections with identical candidates. We then examine the asymmetric case in which one of the candidates has an *a priori* electoral advantage. We find that a candidate with an incumbency advantage will also reward only those contributors who do not give to her challenger. We discover that challengers will receive zero service-induced campaign contributions in asymmetric equilibria.

B. The Simple Service-Induced Model

1. The Probability of Winning and the Role of Campaign Contributions. As discussed above and formally stated in Assumption A1, the typical service-induced model of campaign contributions begins with a black box probability of winning function which is solely dependent upon the campaign contributions received by the two candidates. Recall that in Hinich and Munger (1989), following Austen-Smith (1987), this function is derived from a probabilistic voting model in which campaign contributions are used to reduce the variance in voter perceptions of exogenous candidate policy positions. In an open-seat election with identical candidates it is also assumed that P is symmetric such that $\partial P/\partial X_1 = -(X_2/X_1)(\partial P/\partial X_2)$ and if $X_1 = X_2$, $P = 0.5$.

Note that it is implicitly assumed that voters are, as discussed in Denzau and Munger (1986), "rationally ignorant" with respect to services provided to the interest groups, since the probability of election is not decreased with the level of services provided. That is, voters do not perceive that the time the elected

official devotes in service activities will decrease the effectiveness of the elected official in achieving voter policy preferences. Nor are voters concerned that public revenues may be affected by changes in the overall service level provided. Some services can be provided by the politician's staff (particularly non-policy ones) and the politician has the option of hiring more staff through raising public revenues, a fact which voters are unaware in the service-induced campaign contribution model. While we have criticized the use of this function, we use it in this Section in order to examine the implications of competition between candidates for campaign contributions in the typical service-induced model.

2. *Interest Group Behavior.* As explained in Section III, in service-induced models the interest groups give campaign contributions with the expectation that they will receive a level of service in return by the candidate if elected. The interest groups are expected utility maximizers and will make the contribution if the expected return from the anticipated service is greater than the opportunity cost of the contribution. The assumptions about interest groups are summarized in Assumption A2 above.

Note that P is the actual probability of winning for candidate one and p_1 is the rational expectation of groups of P. In the electoral equilibrium, assuming rational expectations, which is the typical assumption, requires that $p_1 = P$. Define θ_i as the solution of $G_i(\theta_i) = 0$, then groups $\theta \geqslant \theta_i$ will contribute to candidate i. The total contributions received by candidate i will equal $X_i = c_i$ [the number of groups who contribute to candidate i] $= c_i[1 - F(\theta_i)]$ and the total level of service provided by candidate i will be given by $S_i = s_i$ [the number of groups who contribute to candidate i] $= s_i[1 - F(\theta_i)]$.

3. *Probability Maximizing Candidates and the Symmetric Equilibrium.* We will initially assume that candidates maximize the probability of election as formally stated in Assumption A3. This is the approach used by Magee, Brock, and Young (1989), Hinich and Munger (1989), Snyder (1990), and in position-induced models of campaign contributions such as Austen-Smith (1987). In the symmetric case, candidates are assumed to face equivalent capacity constraints on the level of services available, that is, $T_1 = T_2 = S$.

The Kuhn Tucker first order conditions for candidate one are:

$$-P_1 c_1 f(\theta_1)(\partial\theta_1/\partial s_1) + \lambda_1 [s_1 f(\theta_1)(\partial\theta_1/\partial s_1) - (1 - F(\theta_1))] = 0 \tag{4}$$

$$P_1 [(1 - F(\theta_1)) - c_1 f(\theta_1)(\partial\theta_1/\partial c_1)] + \lambda_1 s_1 f(\theta_1)(\partial\theta_1/\partial c_1) = 0 \tag{5}$$

$$\lambda_1 [S - s_1(1 - F(\theta_1))] = 0 \tag{6}$$

$$S - s_1(1 - F(\theta_1)) \geqslant 0 \tag{7}$$

$$\lambda_1 \geqslant 0 \tag{8}$$

where $P_i = \partial P/\partial X_i$ and $f(\theta_i) = \partial F(\theta_i)/\partial\theta_i$.

If strict concavity of P with respect to the c_1 and s_1 holds, conditions (4) and (5) are therefore necessary and sufficient for a global maximum which is unique.

If $[1-P]$ is strictly concave with respect to c_2 and s_2 then there is a unique global maximum for candidate two.[18] A Nash equilibrium exists if both candidates are maximizing their respective probabilities of winning. As one would expect, in the symmetric equilibrium in which the candidates are identical, the candidates distribute the maximum amount of services allowed [see Hinich and Munger, Corollary I] and the probability of winning for each candidate is equal to 0.5. The following proposition describes this equilibrium [all propositions are proved in the appendix]:

Proposition 1: *In a symmetric equilibrium in which the probability of winning is a function of campaign contributions and the candidates desire to maximize this probability subject to a capacity constraint on total services: (a) the probability of winning for each candidate will be equal across candidates, (b) the level of service provided by the winner will equal the maximum allowed, and (c) the service levels and contribution prices across candidates will be equal.*

4. The Disutility Model of Candidate Behavior and Equilibrium. In the disutility model, candidate i maximizes her expected value of winning which is equal to the probability of winning times the net value received while in office $[V_i - b_i S_i]$ as assumed in Assumption A4. In the symmetric case candidates have identical values and marginal costs, therefore the subscripts on V and b will be dropped in the remainder of this paper. Candidate one's objective is then to choose s_1 and c_1 in order to maximize $P[V-bS_1]$, while candidate two wishes to choose s_2 and c_2 in order to maximize $[1-P][V-bS_2]$. The first order conditions for the two candidates are:

for candidate one:[19]

$$\begin{aligned}&-P_1c_1f(\theta_1)(\partial\theta_1/\partial s_1)[V-bs_1(1-F(\theta_1))]\\&+Pb[s_1f(\theta_1)(\partial\theta_1/\partial s_1)-(1-F(\theta_1))]=0 \qquad (9)\\&P_1[1-F(\theta_1))-c_1f(\theta_1)(\partial\theta_1/\partial c_1)]\ [V-bs_1(1-F(\theta_1))]\\&+Pbs_1f(\theta_1)(\partial\theta_1/\partial c_1)=0 \qquad (10)\end{aligned}$$

for candidate two:

$$\begin{aligned}&P_2c_2f(\theta_2)(\partial\theta_2/\partial s_2)[V-bs_2(1-F(\theta_2))]\\&+[1-P]b[s_2f(\theta_2)(\partial\theta_2/\partial s_2)-(1-F(\theta_2))]=0 \qquad (11)\\&-P_2[1-F(\theta_2))-c_2f(\theta_2)(\partial\theta_2/\partial c_2)]\ [V-bs_2(1-F(\theta_2))]\\&+[1-P]bs_2f(\theta_2)(\partial\theta_2/\partial c_2)=0. \qquad (12)\end{aligned}$$

While appearing different from the assumption about candidate behavior used in the majority of campaign contribution models, the disutility model becomes

[18] Note that since the candidates are identical and the probability function is symmetric, then if strict concavity holds for candidate one, strict convexity holds for candidate two and vice-versa.

[19] Equations (9) and (10) are Baron's (1989a) first order conditions (7) and (8) correcting typographical errors in those equations.

equivalent when the probability of winning is extremely dependent upon the differences in campaign contributions and the constraint on service level is in the limit equal to V/b. It is also evident that the lower the marginal cost from providing services the more the candidates resemble probability maximizers with the ability to provide unlimited amounts of services. As $b \to 0$, then equations (9) and (10) become (4) and (5). The equivalence of the disutility approach to constrained and unconstrained probability maximization is stated in the proposition below:

Proposition 2: *(i) If when* $X_1 > X_2$, $P = 1$ *and when* $X_2 > X_1$, $P = 0$, *then the conditions of proposition 1 apply and the candidate equilibrium in the disutility model is equivalent to that found when candidates maximize probability subject to the constraint that the total service levels not exceed* $S = V/b$.
(ii) If $b = 0$, *then regardless of the shape of* P, *the conditions of Proposition 1 apply and the candidate equilibrium in the disutility model is equivalent to that found when candidates maximize probability subject to the constraint that the total service level is sufficient to meet the entire demand for services.*

The disutility model becomes equivalent to the straight probability maximizing model the greater the role that campaign contributions play in determining the probability of election. Since candidates receive no value if they are not elected, the larger the importance of campaign contributions in controlling the probability of election, the more likely the candidate is to behave as a probability maximizing candidate. The disutility from service matters only if the probability of election is still positive even when a candidate is expected to lose. This implies that some uncertainty about the benefits of campaign contributions to achieving electoral victory must exist. If there is no uncertainty about the effects of campaign contributions, then one would expect that when $X_1 > X_2$, $P = 1$ and when $X_2 > X_1, P = 0$.

Even with uncertainty as to the effects of campaign contributions upon the probability of winning, the disutility model implicitly assumes that the marginal cost of providing service by the candidates is positive and significant enough to limit the total service level to less than total demand. Candidates with lower marginal costs have significant electoral advantages by assumption in his model. It appears fairly obvious that in any full electoral competition, candidates with low marginal costs will defeat those who find providing services extremely distasteful. In the limit then, the winning candidates are probability maximizers with an unlimited ability to provide services.

C. Net versus Gross Contributors

In both types of service-induced campaign contribution models described above candidates ignore the effects of campaign contributions for their opponents and it is explicitly assumed that interest groups may contribute to both candidates.

These candidates are not behaving reasonably. Since the probability of winning is a function of the level of contributions received by both candidates, then interest groups who contribute equally to both candidates will have no effect upon the probability of either candidate winning and candidates are no doubt aware of this. A candidate then, may desire to condition her service activities for a particular interest group upon the group's net contribution. That is, the candidate may only reward those interest groups who do not contribute also to her opponent. Candidate one, for example, would give service level s_1 to interest groups who give c_1 only if the interest group chooses not to contribute to candidate two and vice-versa. Since the choice of interest groups to contribute to a candidate is by definition all-or-nothing, the requirement that an interest group give more to candidate one than to candidate two is, in a symmetric equilibrium, roughly equivalent to the requirement that the group not give to candidate two at all. This is an extreme version of a type of "retribution effect" described in Magee, Brock, and Young (1989).[20]

If at least one of the candidates just rewards contributors who do not split their support, it is straightforward to show that no interest group will rationally give positive contributions to both candidates. This result is stated formally in the following lemma:

Lemma 1: *If at least one of the candidates requires that contributions of interest groups for her opponent be zero in order for an interest group to receive service-related activities in return for campaign contributions, no interest group will rationally support both candidates.*

In the analysis to follow we will assume that when an interest group is indifferent between the two candidates and at least one of the candidates only accepts net contributions the interest group will randomly choose which candidate to give to such that the probability of each candidate receiving that interest group's contribution is equal to 0.5. Since candidates now must share a common demand for services, if the campaign contribution prices differ and service levels are the same they must ration the market. We will assume that the demand for services is divided in this case by the candidates by parallel rationing, where the most eager interest groups (those with higher demands for the services) buy first from the candidate with the lower price and the candidate with the higher price sells to the remaining interest groups.

Candidates have a choice in objectives, whether to reward all contributors or only those interest groups who are net contributors (do not also give to the candidate's opponent). Each candidate has a significant incentive to only reward net contributors and set c_i less than her opponent if she believes that there is

[20] The credibility of this threat will be considered later in this section. Retribution may also involve threatening to provide "negative" services to interest groups who contribute to one's opponent. For example, encouraging a government agency to withhold payment to a contractor.

a positive probability that her opponent rewards gross contributions. That is, the symmetric equilibrium examined above in Proposition 1 in which both candidates choose to reward gross contributors is not probability maximizing if candidates can choose to accept only "net" contributions and lower their campaign contribution price. This result is stated formally below:[21]

Lemma 2: *In the symmetric equilibrium in which both candidates reward gross contributors and desire to maximize the probability of winning subject to the exogenous service level constraint, neither candidate is probability maximizing if she can accept only net contributions and lower her campaign contribution price.*

The point is that the equilibrium in which both candidates reward gross contributors is not probability maximizing for either candidate, since each candidate has an incentive to reward only net contributors and lower the required contribution level if the candidate believes there is a positive probability that her opponent will also choose to reward only net contributors and lower the required contribution level. As noted in Section II, empirical evidence suggests that interest groups rarely contribute to both candidates in a two candidate race validating the conclusion reached above. While in the service-induced model it may seem rational for interest groups to "hedge" their bets and buy potential favors from both candidates, it is not reasonable for the candidates to accept these contributions.

However, is the threat to punish joint contributors by not granting services credible? That is, if an interest group has already given money to candidate one, it might still plausibly increase candidate two's electoral probability for candidate two to also accept a contribution from that group. Since the interest groups are aware of this, they may not believe candidate two's threat to only reward net contributors. The candidate's optimal strategy to reward only net contributors may not be "time-consistent".

Can candidate two really gain from changing his strategy in this situation? Assume that service levels are constant and equal across candidates. If candidate one maintains her strategy of accepting only net contributions, candidate two can increase his probability only by lowering his campaign contribution price regardless of the source of his contributions. If candidate one accepts gross contributions, it is clearly in candidate two's interest *not* to change his strategy but to lower his campaign contribution price if possible. Moreover, since services are only provided once candidates are actually elected, then candidates will only have an incentive to reward "gross" contributors if this will help their re-election. As we show in Part D of this Section, incumbents will also find it probability

[21] It should be noted that the conclusions reached in this section can be applied to the disutility model. That is, candidates in the disutility model will find that rewarding only "net" contributors maximizes the expected value of winning and that as a consequence candidates will be driven to offering services at zero prices as discussed below.

maximizing to accept only "net" contributions and therefore the threat is clearly credible.

The relevant equilibrium for analysis of service-induced campaign contributions is then the case in which both candidates accept only "net" contributions. In this equilibrium, as in the gross contribution case, the conditions of proposition one will be true. This is stated below:

Proposition 3: *In a symmetric equilibrium in which candidates accept only net contributions and are probability maximizers: (a) the probability of winning for each candidate will equal 0.5, (b) the level of service provided by the winner will equal the maximum allowed, and (c) the proposed service levels and contribution prices across candidates will be equal.*

In the net contribution model candidates engage in direct service price competition, unlike the gross contribution case. The exogenously given capacity constraint is as a consequence crucial in explaining positive levels of campaign contributions. Not surprisingly, when symmetric candidates compete in campaign contribution price and accept only net contributions in the simplistic service model without capacity constraints on service levels, Bertrand like competition will result driving the campaign contribution price for interest groups to zero.[22] This is demonstrated in the proof of the following corollary (see appendix):

Corollary 1: *If candidates maximize probability, if they are unconstrained in service capacity, and if they only reward net contributors an equilibrium with positive service-induced campaign contributions cannot exist.*

Obviously, if capacity is constrained, candidates may not be able to meet the additional demand generated by lowering their campaign contribution prices. Lowering campaign contribution prices can only increase the probability of winning for a candidate if she can provide enough services such that her total campaign contributions exceed her opponents after the change. If a candidate cannot meet the additional demand, then even if her opponents campaign contributions fall somewhat, it is possible that the candidate's campaign contributions will fall by a greater amount.

Candidates have an incentive to attempt to expand services beyond the capacity constraint. In the symmetric equilibrium with positive campaign contribution prices, either candidate can increase her probability of election if she can expand her capacity beyond the constrained level. If the constraint is given by the relative disutility candidates receive from performing services, V/b, as in the disutility model, then candidates with zero marginal costs will be able to drive out those with $b>0$. Alternatively, a candidate may choose to expand her staff to provide services at the taxpayers or contributors to her opponent expense. These forces

[22] See Tirole (1988, pages 209–211) for a discussion of the Bertrand Paradox.

imply that service-induced campaign contributions will approach zero in the limit when full competition over capacity is allowed. Service-induced models of campaign contributions must assume an exogenously given constraint on total service capacity in order to explain positive campaign contributions in the symmetric equilibrium.

D. The Competition for Campaign Contributions in Asymmetric Equilibria

An asymmetric equilibrium may exist when one of the candidates is an incumbent. As noted above, incumbency advantages may be represented by assuming that campaign contributions are more productive for one candidate [as in equation (2)] and/or assuming that incumbents have a greater capacity for granting services. In either case, the incumbent has a distinct electoral advantage and in any equilibrium is likely to win when candidates reward gross contributions. That is, if $\beta > 1$ or if $T_1 > T_2$, then $P > 0.5$. This is demonstrated in Baron (1989a). However, is rewarding gross contributions probability maximizing in an asymmetric equilibrium? Rewarding gross contributions can be probability maximizing only for the challenger. If incumbents choose to reward only "net" contributions, then no interest group will choose to support the challenger and the incumbent will win with a probability of one. This is presented in the following Proposition and its corollary:

Proposition 4: *In an asymmetric equilibrium in which both candidates reward gross contributors, both candidates receive positive levels of contributions, and both desire to maximize the probability of winning subject to exogenous service level constraints, the incumbent is not probability maximizing if she can accept only net contributions.*

Corollary 2: *In an asymmetric equilibrium in which the incumbent rewards only net contributions, the challenger will receive zero contributions and the incumbent will win with a probability of one.*

Incumbents, then have a clear incentive to reward only "net" contributions. Moreover, the credibility of the threat of an incumbent is quite straightforward. That is, suppose the incumbent won previous election in an open-seat race in which she promised to reward only "net" contributions with services. Once elected, she has no incentive to reward "gross" contributors since this will lessen the probability of re-election. She can easily prove prior to the next election that the threat to reward only "net" contributors is credible. It is interesting that the challenger has no such incentive. However, challengers will never win if the incumbent is probability maximizing in this model. Since campaign contributions to challengers are made, the service-induced model does not explain adequately the motivations behind such contributions. Interestingly, the asymmetric case

may explain why campaign contributions are made to incumbents in uncontested elections, since even an incumbent who receives disutility from service will accept some contributions to provide some level of service in order to prevent a possible challenger from winning.

V. IMPLICATIONS FOR FUTURE RESEARCH

The problems in current models discussed in Sections III and IV should be seen as normal for the early stages of modeling a complex phenomenon. In our opinion, all the models reviewed here contribute to a better understanding of fruitful lines of research. In this concluding section, we try to summarize the lessons we take from our review. Others may draw different conclusions.

With respect to the voter component of the models, one critical line of research is finding plausible microfoundations for vote production functions. First, we need a better understanding of the mechanism through which campaign expenditures affects citizens voting decisions. More empirical work could prove extremely helpful here. Second, at a theoretical level campaign advertising needs to be modeled in a more reasonable way, and doing so probably requires moving to models of voters with incomplete information about candidates. Third, we do not find very convincing the assumption that voters ignore sell-outs by incumbents to interest group contributors. Incorporating retrospective voting into the models may address this issue, as well as resolve the commitment problem common to most of the models. This is an obvious avenue for future research.

With respect to contributors an important question is, "Under what circumstances will contributors look like those assumed in position models and under what circumstances will they resemble those assumed in service models?" To the best of our knowledge, this problem has not received any sustained analysis. We are not sanguine about the probable success of empirical tests of the two approaches absent from such an analysis.

If contributions are to be modeled as service-induced, it seems clear that the industrial organization of the market for contributions needs to be thought through quite carefully. For example, the problem of Bertrand competition among politicians needs to be addressed in a plausible way. How to do so is not yet clear, at least to us. More generally, researchers interested in models of service-induced contributions need to specify the nature of the service in question (public or private, non-policy or policy) explicitly. If the service is public, some acknowledgment of collective action problems should be made. If the service is policy related, then much more serious attempts to model political institutions and the policy making process seem in order. We share the conviction of Austen-Smith (1990) that the "new institutionalism" will prove highly relevant here. However, how models of this kind might work remains to be seen.

Lastly, other aspects of candidate competition need to be explored in much greater detail. None of the work examined in this paper considers the role of campaign contributions as an entry deterrent. Nor do these models allow for

multiple candidate races. The institutional roles of primaries and political parties need to be explicitly incorporated. In summation, the existing work has increased our understanding of the behavior of voters, contributors, and candidates. Nevertheless, crucial empirical and theoretical research remains to be done.

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APPENDIX

Proof of Proposition 1: (a) Assume that $P<0.5$. Then $c_1 \neq c_2$, or $s_1 \neq s_2$, or both are true. Clearly since the candidates are identical, then if they provide equal contribution and service levels the same number of interest groups will contribute to both, each candidate will receive the same total level of contributions, each candidate will provide the same level of service, and the probability of winning for each candidate will equal 0.5. Candidate one cannot be probability maximizing since she can immediately increase P to 0.5 by choosing the same service and campaign contribution combination chosen by candidate two. If $P>0.5$, candidate two cannot be maximizing his probability.

(b) This can be demonstrated by solving simultaneously equations (4), (6), (7), and (8). Since the first term of equation (4) is positive, $\lambda_1 \neq 0$ and $S=s_1[1-F(\theta_1)]$. Corresponding results can be demonstrated for candidate two's service level.

(c) From (b) above service levels will be identical if $\theta_1=\theta_2$. The campaign contribution prices will be identical given the symmetry and strict concavity of the probability function. That is, for $P=0.5$ and $S=s_i[1-F(\theta_i)]$ there is a unique campaign contribution price $c^*=c_1=c_2$, if P is strictly concave in c_1, strictly convex in c_2, and symmetric as assumed.

Q.E.D.

Proof of Proposition 2: (i) The three conditions of Proposition 1 are satisfied as follows: (a) Assume that $P<0.5$ and candidate two is maximizing his expected value of winning. In this case $P=0$ and the expected value of winning for candidate one is zero regardless of the service level provided. As above, $c_1 \neq c_2$, or $s_1 \neq s_2$, or both are true. Candidate one is not maximizing her expected value of winning since she can immediately increase P to 0.5 by setting $c_1=c_2$ and $s_1=s_2$. She will then receive contributions from more groups than currently received, but less than candidate two received before candidate one makes her change since the new θ_1 will be greater than the previous θ_2. The expected value of winning for candidate one will be increased to $0.5\ [V-bs_2[1-F(\theta_1)]]>0$. If $P>0.5$ candidate two cannot be maximizing the expected value of winning either.

(b) Assume that $P=0.5$, but the total level of service for both candidates is less than S. Candidate one can increase P to 1 by increasing her total service level. The expected value of winning will increase for candidate one since there exists some value of ΔS_1 such that $0.5[V-b\Delta S_1]>0$. Candidate two can also increase his expected value from winning by increasing his S_2.
(c) As (b) above demonstrates both candidates will be driven to providing service levels equal to the maximum allowed. Candidates will offer equivalent campaign contribution prices and service levels at this maximum level.
(ii) If $b=0$, the disutility model is equivalent to probability maximization without a constraint on the size of S.

Q.E.D.

Proof of Lemma 1: Assume that candidate one offers service level s_1 for net contributions $c_1>0$ [by net contributions we mean that the interest groups must choose zero support for candidate two in order to receive services from candidate one] and candidate two offers service level s_2 for gross contributions $c_2>0$. Assume interest group θ^* is indifferent between the two offers. However if θ^* accepts candidate one's offer, it will be impossible to accept candidate two's and if θ^* accepts candidate two's offer, there is no gain from contributing to candidate one. Therefore, the interest group maximizes expected benefit by giving only to one of the two candidates. If interest group θ^* prefers candidate one's service level then there is clearly no gain from contributing to candidate two and vice-versa.

Q.E.D.

Proof of Lemma 2: This lemma can be proved by contradiction. Assume that a symmetric equilibrium exists in which both candidates reward gross contributors as described in Proposition 1 above: $\theta_1=\theta_2$, $c_1=c_2$, and $s_1=s_2$. Groups $\theta>\theta_1$ give c_1 to both candidates. If candidate one lowers her campaign contribution price, slightly, and announces that she will only accept "net" contributions, while maintaining the same total service level (that is, accepting contributions from the same number of groups leaving some excess demand for candidate two) she can increase her probability of winning by decreasing X_2 more than X_1 falls. All of the contributing groups will now contribute to her and candidate two will receive zero contributions, losing the election. Note that unless candidate two also lowers his campaign contribution price, he will not gain any of the excess demand generated by candidate one's action since the high demand groups will purchase from candidate one. Candidate two can similarly increase his probability of winning. Therefore the strategy of accepting gross contributions cannot be probability maximizing.

Q.E.D.

Proof of Proposition 3: (a) Assume that $P<0.5$. Then $c_1\neq c_2$, or $s_1\neq s_2$, or both are true. Again if the candidates are identical, then if they provide equal

contribution and service levels the same number of interest groups will contribute to both, $0.5[1-F(\theta_i)]$, each candidate will receive the same total level of contributions, and the probability of winning for each candidate will equal 0.5. Candidate one cannot be maximizing probability since she can immediately increase P to 0.5 by choosing the same service and campaign contribution combination chosen by candidate two and reduce his contributions by half while receiving the other half. If $P>0.5$, candidate two cannot be maximizing his probability.

(b) Assume s_i is set such that candidate i does not provide the total level of services possible, that is $S_i<S$. Candidate i can increase her probability of winning by increasing s_i to some s_i', holding the other variables constant such that $S_i<S_i'\leqslant S$, where S_i' is the new level of total services. When the per group service level increases, the number of groups contributing also increases, both of which increase S_i. Given continuity of s_i, if $S_i<S$, there will exist some s_i' such that $S_i'\leqslant S$. Therefore if $S_i<S$ is true, candidate i cannot be probability maximizing and an equilibrium cannot exist.

(c) Strict concavity (convexity for candidate two) and the symmetry of P with respect to c and s, imply that there exist unique values of c and s such that $P=0.5$ and $S_1=S_2=S$. The two probability maximizing candidates will then be driven to this set of s and c.

Q.E.D.

Proof of Corollary 1: This corollary can be proved by contradiction. As proved in Proposition 5, if an equilibrium exists it will be symmetric in which $c_1=c_2$ and $s_1=s_2$. Assume that the two candidates are in a symmetric equilibrium in which $c_1=c_2>0$. Each candidate receives campaign contributions $X_i=0.5c_i[1-F(\theta_i)]$ and service levels are such that $S_i=0.5s_i[1-F(\theta_i)]$. Groups with $\theta>\theta_i$ will with 0.5 probability "buy" from candidate one and with 0.5 probability from candidate two. If candidate one reduces her campaign contribution price to c_1', such that $c_2>c_1'>0$ and maintains the same per group service level all contributing groups will prefer to buy services from her and she will win the election. Candidate two has the same incentive to lower his campaign contribution price. Therefore, positive campaign contribution prices are not possible in the unconstrained symmetric equilibrium.

Q.E.D.

Proof of Proposition 4 and Corollary 2: These can also be proved by contradiction. We will consider both types of incumbency advantage: (a) candidate one has "name recognition" and the probability of winning for him is given by equation (2) with β less than positive infinity and (b) candidate one has a greater capacity to provide services.

(a) Under rational expectations, as Baron (1989a, Proposition 3) shows, in this case $p_1=P>0.5$, and $\theta_1<\theta_2$. More groups will contribute to candidate one. Groups $\theta>\theta_2$ will give to both candidates. Note that $G_1(\theta)>G_2(\theta)$ for all θ since

R increases with θ. Therefore, if the groups are required to choose whether to contribute to candidate one or two at the existing equilibrium, all joint contributors will give to candidate one. If candidate one announces that she will only accept "net" campaign contributions she can increase her probability of winning by decreasing X_2 to 0. P will now equal 1, which is higher than when $X_2 > 0$.
(b) As above, if candidate one has a greater capacity to provide services, then she will receive more campaign contributions in the "gross" equilibrium, as shown in Baron (1989a, Proposition 4). Since all contributing groups receive more benefit from contributing to candidate one, if candidate one only accepts "net" contributions, candidate two will receive zero contributions and candidate one will win with certainty.

Q.E.D.

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