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THREE ESSAYS ON CAMPAIGN CONTRIBUTIONS AND CONGRESS

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Abstract

Chapter 1: Buying Votes: A Congressman's Ideological Ambiguity, Receipts of Campaign Contributions, and Expected Ideology

This present paper explores the relation among a Congressman's expected ideology, ideological ambiguity and the receipts of campaign contributions by using a simple one-period model in which two lobby groups compete for the Congressman's vote. First, to attract more influence-motivated campaign contributions, a Congressman should act more ambiguously when one lobby group has more advantage than the other. Second, a Congressman whose ideology is on extreme left or right will receive less in influence-motivated campaign contributions. It is interesting that a Congressman's ideological ambiguity may attract more campaign contributions although two lobby groups dislike the ambiguity by nature.

Chapter 2: How Ambiguous Is a Congressman?

We provide a measure of a Congressman's ideology and a measure of his ideological ambiguity to be used for empirical studies. Poole and Rosenthal and Heckman and Snyder have provided excellent ways to estimate a Congressman's ideology in a multi-dimensional space via roll call voting records, but it is difficult to extend their framework to provide a measure of a Congressman's ideological ambiguity. Starting with a one-dimensional model, we use a Probit model to estimate a Congressman's ideology as well as the ideological ambiguity. We show that ideological ambiguity is one important

characteristic of Congressmen's voting behavior. We also find that Congressmen who are biased to the right or to the left tend to have more ambiguous ideologies.

Chapter 3: Campaign Contributions and Ideology

Campaign contributions can be *influence-motivated* or *election-motivated*. In theory, influence-motivated campaign contributions should be given to unbiased (centrist) Congressmen, and a Congressman's ideological ambiguity may increase such influence-motivated contributions. On the other hand, election-motivated campaign contributions should be given to those Congressmen whose ideologies are biased to the right or to the left, and ideological ambiguity may deter such election-motivated campaign contributions. This paper conducts an empirical study of the relationship between campaign contributions and Congressmen's ideological positions, as well as the ideological ambiguity shown in roll call voting records. Our results suggest that campaign contributions tend to be given to unbiased Congressmen. That is, influence-motivated campaign contributions are more prominent. However, ideological ambiguity has no significant marginal influence on campaign contributions since Congressmen have chosen their optimal ideological ambiguities.

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Chapter 1

Buying Votes: A Congressman's Ideological Ambiguity, Receipts of Campaign Contributions, and Expected Ideology

1.1 Motivation

Since Downs (11), economists and political scientists have used spatial models to discuss issues about politicians' ideologies. Most discussions focused on the position of ideology only. However, Wang (36) pointed out that ambiguity as well is an important feature of a politician's ideology. Here ideological ambiguity is the degree of variety of ideology when the exact position of ideology is unknown. For example, if lobby groups believe that a Congressman's ideology is drawn from $N(0, \sigma^2)$, the variance, σ^2, can be a measure of the Congressman's ideological ambiguity. If a Congressman's ideology follows uniform distribution, the range of the support can be a measure of the Congressmen's ideological ambiguity. Clearly, ideological ambiguity should be included in any through discussion. Unfortunately, only very few papers, such as Sheple (30), Glazer (14), and Alesina and Cukierman (1), Aragonés and Postlewaite (4), addressed it, and those papers focused on the role of ideological ambiguity in electoral games. In Aragonés and Postlewaite (4), even when voters are risk-averse, being ambiguous can still attract more votes because ambiguity allows some voters to hope that candidates' ideologies are close to theirs. Aragonés and Neeman (3) focused on the balance of voters'

risk-aversion and Congressman's freedom (or ambiguity) on policies, and assumed that freedom (or ambiguity) of policies can monotonically increase the Congressman's utility.

Departing from past literature, we will explore the role of ideological ambiguity in lobbying activities. We find a mechanism similar to that described by Aragonés and Postlewaite (4) working in lobby activities. Generically, to maximize campaign contributions seeking a favorable policy, a politician may choose an optimal level of ideological ambiguity. Such a conclusion contradicts the assumption in Aragonés and Neeman (3) that a politician should enjoy high ambiguity on policies after he wins an election. Too high or low a degree of ambiguity may work against a candidate seeking re-election.

Past literature categorized two major purposes of campaign contributions as influence-motive or election-motive (Austen-Smith (5), Wang (34)). The first one is based on the principle of *quid pro quo*. Lobby groups try to buy politicians' influence directly or indirectly. Influence-motivated campaign contributions will go to the moderates. By contrast, election-motivated campaign contributions should be given to those politicians whose ideologies are the same as donors'. In practice, a Congressman's true ideology is unknown to lobby groups. However, past studies merely discuss the relation between politicians' (expected) ideological positions and campaign contributions, and ignore the role of ideological ambiguities in lobbying activities. Since we mainly study lobbying activities in this paper, we will concentrate on influence-motivated campaign contributions. The main contribution of the present paper is to explore how a politician choose an optimal level of ideological ambiguity to maximize influence-motivated campaign contributions.

A Congressman's ideological ambiguity has two dimensions: inter-temporal variety and variation at a given time. Inter-temporal ideological ambiguity is related to a Congressman's reputation or a long-term commitment. There exists controversy among several empirical papers. McCarty and Rothenberg (25) claimed lack of strong evidence for long-term credible commitment between lobby groups and Congressmen. But Kroszner and Stratmann (20) suggested that Congressmen's reputations help in lowering their uncertainty, and political action committees (PACs) award campaign contributions to those who have reputations. However, we will focus on the variation at a given time which no paper has addressed so far. Therefore, (ideological) ambiguity in this paper refers exclusively to the variation of ideology at a given time in this paper.

The present paper characterizes how a Congressman chooses an optimal level of ideological ambiguity under the competition between two lobby groups with a simple one-period model and explores the relation between the Congressman's ideological ambiguity and campaign contributions received. Our major claims are:

1. There exists an optimal level of ambiguity associated with a Congressman's expected ideology when he tries to maximize his receipts of influence-motivated campaign contributions;

2. The optimal level of ideological ambiguity is positive unless no lobby groups naturally dominate in this lobbying game;

3. A Congressman will act more ambiguously when one lobby group has more advantage than the other [1];

4. Once a Congressman has chosen the optimal level of ideological ambiguity, his expected receipts of influence-motivated campaign contributions are less if his (expected) ideology is more extremely liberal or conservative.

These four claims can lead to two major empirical implications about Congressmen's ideological ambiguities. First, supposing that Congressmen choose ideological ambiguities to maximize influence-campaign contributions, the curve of Congressmen's ideological ambiguities against their ideologies can be approximated by a quadratic function and the curve should be U-shaped. Congressmen whose ideologies are extremely right or left tend to choose a higher level of ideological ambiguity to inspire lobby groups on the opposite side to support them. Second, supposing that campaign contributions on the basis of *quid pro quo* can be separated from total campaign contributions, and that Congressmen have chosen their optimal levels of ideological ambiguity, the curve of influence-motivated campaign contributions received against Congressmen's expected ideologies should be inverted U-shaped. Those Congressmen who are extremely liberal or conservative cannot be the target for those lobby groups who want to buy votes even though they've chosen optimal ideological ambiguities to compensate for the disadvantage brought by their ideologies.

In addition, it is interesting that two lobby groups might pay more to a Congressman who acts ambiguously although no lobby groups like ambiguity by nature. The

[1] 'Advantage' means that one lobby group has more resources in lobbying or the Congressman's ideology is more biased to the lobby group.

rest of this paper is structured as follows: Section 1.2 is describes the model; Section 1.3 provides the solutions of how two lobby groups determine campaign contributions; Section 1.4 explores the relation between expected campaign contributions and the level of ambiguity, and the existence of an optimal level of ambiguity; Section 1.5 explores the relation between Congressmen's ideologies and expected receipts of campaign contributions; Section 1.6 finally, Section 1.7 presents conclusion.

1.2 Model

The model is based on Che and Gale (9) and Baron (7). Here, as in Che and Gale (9), two lobby groups use campaign contributions to influence a Congressman's voting behavior. A menu auction is used to model the interaction among lobby groups and the Congressman, as in Grossman and Helpman (16) and Che and Gale (9). The relation between timing of donation and Congressmen's voting behaviors in the real world is not clear. A few lobby groups or interest groups rate Congressmen's voting records constantly. If lobby groups determine their campaign contributions simply based on past voting records, a menu auction might be a better way to model a lobby game than an all-pay auction.

Our menu auction model is similar to the one used by Che and Gale (9). However, in Che and Gale (9), only campaign contributions decide which side a Congressman votes for, and the Congressman has no preference for two lobby groups. Instead, we assume here that a Congressman has his own preference on each issue, as in Baron (7). Baron (7) assigned different utilities when a Congressman votes differently. Since difference of utilities is all that matter, I simply use the difference as the measure of a

Congressman's ideology or his instinct values on policies. Different from Baron (7), a Congressman's preference is unknown to lobby groups in this model, consequently then ideological ambiguity will affect lobby groups' decisions on campaign contributions.

It is assumed that one Congressman whose true ideology is unknown to two lobby groups chooses ideological ambiguity to maximize his receipt of campaign contributions. Like all spatial models, a Congressman's and two lobby groups' ideologies can be mapped on a line or a segment. In addition, each of two lobby groups takes one end of the ideological spectrum. Hence, two lobby groups will support different results of votes and the Congressman must choose to vote for one or the other lobby group. Two lobby groups use campaign contributions to influence the Congressman's voting. Suppose that the exact position of the Congressman's ideology is α, which is unknown to two lobby groups. After the Congressman chooses a level of ideological ambiguity, the Congressman is informed of his true ideology privately. The probability distribution of the Congressman's ideology is publicly known by two lobby groups. Before the Congressman decides which side to vote for, Group G_a announces that if this Congressman votes for group G_a, he will receive a from Group G_a. Simultaneously, Group G_b announces an amount, b, which they will give to the Congressman if he votes for them. The Congressman's utility is $\alpha + a$ while voting for Group G_a and is b while voting for Group G_b. Then,

> if $\alpha + a \geq b$, this Congressman votes for group G_a. Otherwise,
> this Congressman votes for Group G_b.

Figure 1.1 indicates the time line of this model. First, the Congressman chooses a level of ideological ambiguity to maximize his expected receipts of campaign contributions.

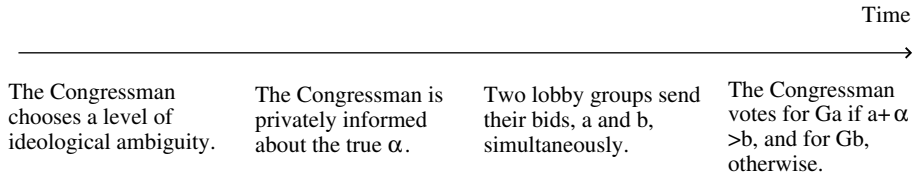


Fig. 1.1. The Time Line of the Model

Then, the Congressman knows his own ideology, α, privately. Two lobby groups send their bids to the Congressman simultaneously, based on the information of the probability distribution of α. Finally, the Congressman votes.

As mentioned above, α is not revealed to two groups although it is known by the Congressman himself. With the setup of our model, the only publicly known information about α is that α is drawn from uniform distribution over $[x+y, x-y]$, where x stands for the expected position of the Congressman's ideology and y stands for the level of the Congressman's ideological ambiguity. y must be non-negative in this model, but x may be. x, the expected α, represents the Congressman's overall preference for two lobby groups. Group G_a's highest willingness-to-pay is A and Group G_b's is B. When the Congressman support Group G_a, Group G_a's pay-off will be $A-a$. Otherwise, Group G_a gets nothing. When the Congressman supports Group G_b, Group G_b gets $B-b$. Otherwise, Group G_b gets zero. Group G_a and Group G_b maximize their expected pay-off based on the knowledge on the distribution of α.

In this model, α is a monetary value showing how this Congressman supports Group G_a naturally. α can be called ideology or anything that can describe a Congressman's idea about a specific issue before lobbying. To prevent unnecessary confusion, α will be called ideology throughout this paper, although the exact meaning of α here might be slightly different from ideology. α could be positive or negative. A positive α means that this Congressman would support Group G_a in the absence of lobbying. Conversely, a negative α means that the Congressman supports Group G_b. An α with a larger absolute value means that this Congressman's ideology is more extreme. This Congressman is maximizing his utility, which depends on his ideology and money received from the lobby group he votes for.

To both lobby groups, α is a random variable in this model. There are two justifications for this assumption. First, ideology pertains to one's thought. Lobby groups cannot know a Congressman well enough to understand everything the Congressman thinks about. Even when a Congressman holds a fixed ideology all the time, lobby groups cannot know the Congressman's exact ideology. Second, a Congressman's ideology might not be fixed all the time in the real world. Congressmen might change their stances on a specific issue to more liberal or conservative positions due to some specific factors, such as strategy, district interest, or log-roll voting. The unfamiliarity to a Congressman and those factors other than campaign contributions which can affect a Congressman's voting are treated as error terms of ideology. Indeed, lobby groups' unfamiliarity to a Congressman and how much those other factors can affect a Congressman's voting should differ with individual Congressmen. Therefore, the degree of variation is also a property of a Congressman's ideology.

In this paper, we assume that a Congressman can choose his own ideological ambiguity. Although many factors can affect ideological ambiguity, a Congressman can always choose whether or not to clarify his ideology. It should be a Congressman's choice rather than an exogenous variable. By contrast, his (expected position of) ideology is assumed to be exogenous. In the U.S, there are only two major parties and Congressmen are elected from single districts. To win elections, Congressmen do not have great freedom in choosing ideologies. Congressmen's ideologies depend on the profile of residents' ideologies in the districts. It is difficult to imagine that an extreme Republican Congressman comes from a Congressional district where most eligible voters are members of unions. Therefore, we assume that the expected positions of ideology are given.

We also assume that a level of ideological ambiguity is chosen to maximize a Congressman's receipts of campaign contributions. However, in electoral games, politicians are assumed to maximize their winning probability. These two assumptions do not contradict each other at all. In practice, the candidate who wins an election usually has the most campaign contributions. To win elections, all candidates try to maximize their receipts of campaign contributions.

Actually, two lobby groups act like bidders in an auction and each bidder has different evaluation. They are assumed to maximize their expected "consumers' surplus" by sending their bids to the seller, the Congressman. The "consumers' surplus" equals the difference between their highest willingness-to-pay and the bid sent to the Congressman if they win this auction, or nothing if they lose the auction. The difference from a usual auction is that the seller could favor a specific bidder in our model. Such a combat can be seen very often in reality. For trade-opening issues, we can see the struggles between

international companies and domestic labor unions. For environmental issues, we can see the fights between energy companies and environmentalists. We believe that this simple model can capture the essentials of reality in many issues.

This model also provides an interesting insight about lobby groups' attitude towards ideological ambiguity. By nature, lobby groups dislike ideological ambiguity. Given x and y, and the opponent's bid, donating one additional dollar in campaign contributions increases the probability if wining by $\frac{1}{2y}$, which is decreasing in the level of ideological ambiguity, y. However, they might pay more to those who are more ambiguous since a high ideological ambiguity can bring hope to lobby groups on the other side .

1.3 The Lobbying Stage

The solution concept is perfect Bayesian equilibrium and we can apply backward induction to solve this game. First, two groups' reaction functions in the lobbying stage can be solved, given the probability distribution of the Congressman's ideology and two lobby groups' willingness-to-pay. There will be seven different types of reaction functions under different ranges of x, y, A, and B. But only six cases would happen generically. Each type of reaction function presents one pattern of contributions from Group G_a and Group G_b due to different combinations of the parameters. Given the pattern of contributions from two lobby groups, the Congressman can choose a level of ideological ambiguity to maximize his expected receipts of campaign contributions.

1.3.1 Two Lobby Groups' Reaction Functions

Given two lobby groups' bids, a and b, if $\alpha \in [x-y, b-a)$, this Congressman will vote for Group G_b. Otherwise, this Congressman will vote for Group G_a. Group G_a is maximizing its expected pay-off. Therefore, Group G_a's problem is

$$\max_a \qquad \frac{(x+y)-(b-a)}{2y} \cdot (A-a).$$

The first derivative with respect to a after rearrangements is

$$\frac{1}{2y} \cdot (A-a) - \frac{(x+y)-(b-a)}{2y} \cdot 1. \tag{1.1}$$

In Equation 1.1, the first term is the product of the increase of winning probability by one more dollar bid and gain from winning the Congressman's vote, which is the marginal benefit from biding one more dollar. The second term is winning probability, which is the marginal cost caused by bidding one more dollar. Group G_a's bid is bounded between 0 and A due to the limit of resource and the constraint of non-negative bid. Those constraints make the first derivative not equal to zero in some cases. Therefore, different parameters will give different types of reaction functions.

In the case when, given b, $b-A \geq (x+y)$, Group G_a will have no way of convincing the Congressman even if they promise to give the highest willingness-to-pay, A. This case happens when the Congressman's ideology is biased to Group G_b too much. Without loss of generality, it is assumed that Group G_a will still announce a bid of A although there is still no chance to convince the Congressman. At the opposite end, facing a

given b, $b - a < (x - y)$ for some a, Group G_a will always win the game of bidding the Congressman by sending a bid of $\max\{0, b - (x - y)\}$. This case happens when the Congressman's ideology is biased to Group G_a too much or when the Congressman's ideology is too ambiguous. Group G_a's five possible types of reaction functions are illustrated in Panel A, B, C, D, and E, Figure 1.2.

Type A:

There are four sections in *Type A* reaction function. In the first section, Group G_a bids nothing but still wins the lobbying game since $0 + (x + y) \geq b$. The second section, which is bound by $a - b = -(x - y)$, means that Group G_a can win the lobby game by sending a bid which can inch out Group G_b when facing Group G_b's bid, b. The third section, which occurs when Equation 1.1 equals zero, represents the possible locations of interior solutions. The last section, which is bound by $a = A$, means that Group G_a cannot win the lobbying game even if they exhaust all possible resources.

Type B:

The three sections of *Type B* reaction function are the last three of *Type A*.

Type C:

As with *Type B*, there are also three sections in *Type C* reaction function. This type of reaction function is a composite of Section One, Section Three and Section Four of *Type A*.

Type D:

The two sections of *Type B* reaction function are the last two of *Type A*.

Type E:

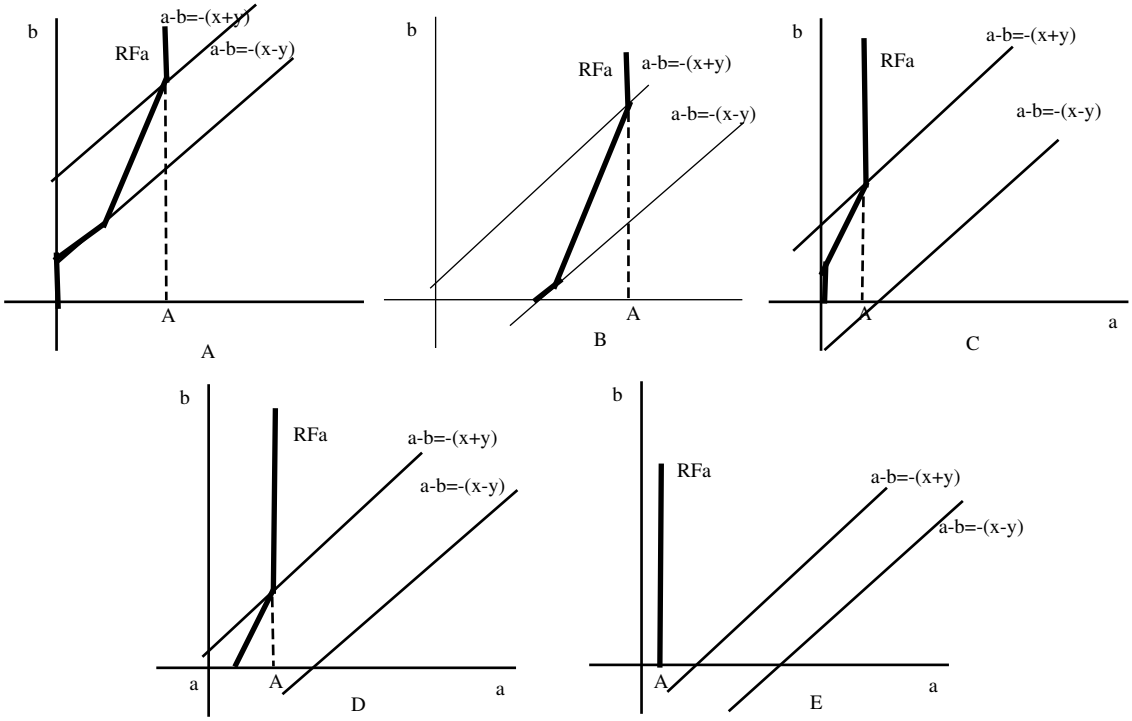


Fig. 1.2. Possible Types of Group G_a's Reaction Functions

In *Type E* reaction function, Group G_a simply bids A although they have no chance to win. This type of reaction function happens when $A \leq -(x + y)$.

Group G_b's reaction function can be dealt by similar way. Two lobby groups have symmetric positions in this lobbying game. The most easy way to get Figure 1.3 is flipping Figure 1.2 along with $a - b = 0$ and replacing 'A' with 'B'.

When we solve the lobbying stage, the whole shape of reaction functions does not mean much. It is only of real interest how two reaction functions cross. Different types of intersections yield different solutions.

1.3.2 Solutions of the Lobbying Stage

Depending on how two groups' reaction functions cross, there are seven possible types of solutions. Of seven, only six could happen in most cases. In addition to the interior solution, corner solutions also might happen when one group's willingness-to-pay is too low, or when the Congressman's ideology tilts to one group too much. Solutions can be classified by patterns of bids from two lobby groups. Each pattern of bids will correspond to different combinations of the parameters in this model, x, y, A, and B. Given x and y, the combinations of A and B for each type of solution can be marked in an $A - B$ plane. The correspondent range of A and B is also provided to simplify later discussion.

The details of calculations for each type of solution can be found in the Appendix. The seven possible types of solutions are:

Case 1: $a < A$ *and* $b < B$

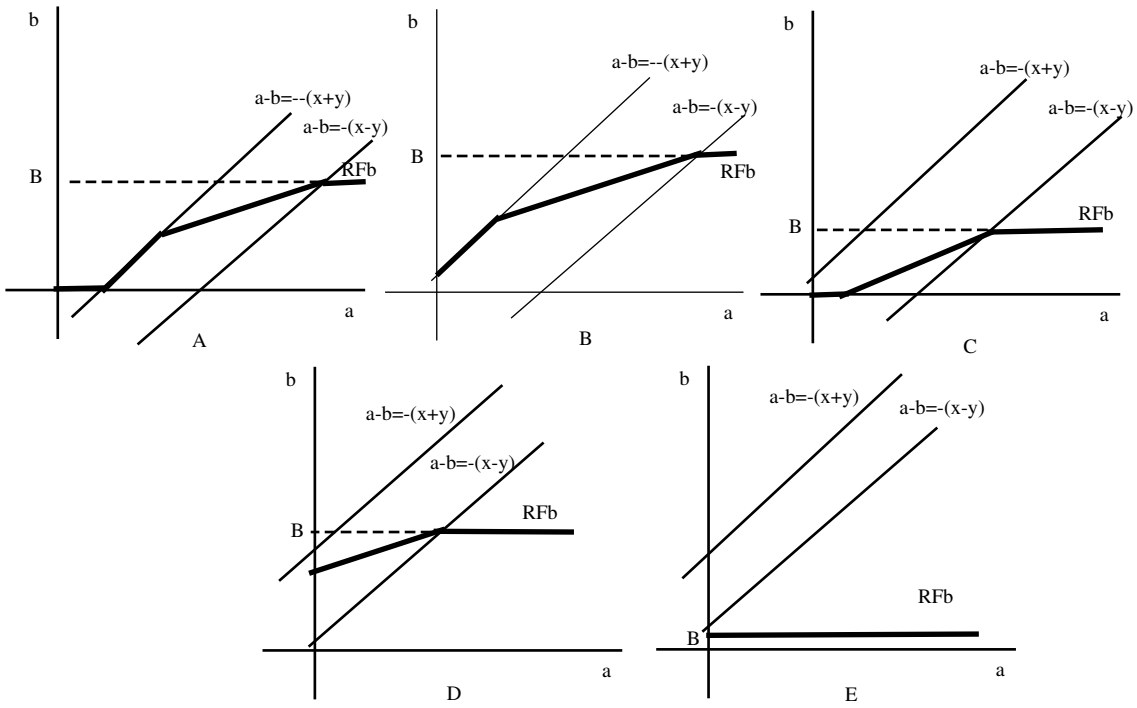


Fig. 1.3. Possible Types of Group G_b's Reaction Functions

In this case, each interest group probably could win the Congressman's vote and the winner can enjoy some surplus. Correspondent region of A and B shows that each lobby group has enough competence to win the lobbying game.

Case 2: $a = A$ *and* $b < B$

Due to the insufficiency of Group G_a's willingness-to-pay, or the Congressman's extremely biased ideology, Group G_b is overwhelming. Even if Group G_a pays all they can afford, there is still no chance to buy the Congressman's vote in this case.

Case 3: $a < A$ *and* $b = B$

Case 3 is just the opposite of *Case 2*. Group G_a and Group G_b simply change their positions. Group G_a enjoys a strong advantage this time.

Case 4: $a = 0$ *and* $b = 0$

Both lobby groups contribute nothing in this case. It is not because they both believe that they would win. Compared to the Congressman's ideological ambiguity, their willingness-to-pay is too low to encourage them to bid more. A high level of ambiguity makes the marginal benefit of campaign contribution lower than its cost.

Case 5: $a = 0$ *and* $b < B$

Only Group G_b makes campaign contributions to the Congressman in this case. Due to low willingness-to-pay, Group G_a will contribute nothing to the Congressman.

Case 6: $a < A$ *and* $b = 0$

Case 6 is just the opposite of *Case 5*. All argument are the same except the reversal of Group G_a's and Group G_b' positions.

Case 7: $a = A$ *and* $b = B$

Case 7 occurs when $x = -A+B$ and $y = 0$, which cannot happen generically. This is a special case in which neither lobby group has an advantage and the Congressman's ideology is perfectly known. This is most unlikely.

Considering symmetry of two groups, we only have four types of solutions: both contribute less than their highest willingness-to-pay; one contributes all and the other contributes less than their highest willingness-to-pay; one contributes nothing and the other contributes less than their highest willingness-to-pay; neither lobby group contributes anything. Lobby groups contribute nothing simply because the Congressman's ideology is so ambiguous that the marginal benefit from campaign contributions is less than the marginal cost. The lobby group that contributes nothing does not necessarily win. In *Case 4* to *Case 6*, both groups have chances to win, as in *Case 1*.

The only cases in which a lobby group definitely wins are that one contributes all and the other contributes less than its highest willingness-to-pay. This type of solution is based on the assumption that a lobby group will bid the highest willingness-to-pay even when it has no chance to win. However, any bid below its willingness-to-pay could be the losing lobby group's dominant strategy since this is not an all-pay auction. Some readers might challenge the possibility of this type of solution in the real world. Actually, this type of solution will not happen often, but it is still possible. First, the Congressman's optimal level of ideological ambiguity will not be chosen in these types of solutions generically[2] (Please refer to the discussion in Section 1.4). Hence, this type of solution cannot often be seen in the real world. Second, the behavior of sending bids to

[2]It could happen in the boundary only. Generically, it won't happen.

a Congressman can be considered contact between lobby groups and the Congressman. Lobby groups might still contact those Congressmen who would never support them[3].

1.3.3 Summary of Solutions

The following are three scenarios classified by the possible range of the Congressman's ideology. In the first scenario, the Congressman's ideology could be biased towards either lobby group. In *Scenario 2*, the Congressman's ideology is completely allied with Group G_b. In *Scenario 3*, the Congressman's ideology is completely allied with Group G_a. The possible range of the Congressman's ideology directly affects the difficulty faced by two groups seeking to convince the Congressman.

- *Scenario 1*: $(x+y) > 0, (x-y) < 0$;
- *Scenario 2*: $(x+y) < 0, (x-y) < 0$;
- *Scenario 3*: $(x+y) > 0, (x-y) > 0$.

Figure 1.4-Figure 1.6 summarize the combinations of A and B and corresponding solutions, given the parameters of a Congressman's ideology x and y. In each figure, each Roman numeral represents one case of solutions. This notation will be used throughout the paper.

These figures completely coincide with the insights we provided. Those cases in which one or both lobby groups contribute nothing only happen when A or B is small

[3]In 'AMA Pains Republicans', Roll Call, Jul 23, 2001, "Because we have to deal with that (the harsh things said about the AMA and about our bill) as we are trying to get this bill passed, it's important for people to know what the opposition is saying." related by Rep. Greg Ganske (R-IO), who sponsored a bill supported by the AMA. The article also mentioned that a member of the AMA contacted Rep. John Cooksey (R-LA), who is strongly against bill supported by the AMA

compared to the Congressman's ideological ambiguity and thus the marginal benefit is too small. Those cases in which one lobby group is willing to contribute all only happen when their willingness-to-pay is much less than the other's. Therefore, one lobby group could never win the Congressman's vote. Interior solutions happen when both lobby groups have competency. In addition, an increase of the Congressman's ideological ambiguity will broaden the area of cases in which both lobby groups could win the Congressman's vote since a high level of ideological ambiguity can elevate the opposite lobby group's hope of winning the Congressman's vote.

Figure 1.7 shows the relation between the boundary of x and solutions. Figure 1.7 also shows that given $x < 0$, increasing y will shift the solution figure from Figure 1.5 to Figure 1.4. Also, given $x > 0$, increasing y will shift the solution figure from Figure 1.6 to Figure 1.4. In general, given y, increasing x will shift the solution figure from Figure 1.5 to Figure 1.4, and to Figure 1.6.

1.4 Optimal Ideological Ambiguity

The Congressman is assumed to maximize the expected receipts of campaign contributions by choosing his level of ideological ambiguity. To explore how he chooses the optimal ideological ambiguity, we need to calculate the expected receipts of campaign contributions in each case. Then we may figure out the optimal level of ideological ambiguity and the relation between the Congressman's expected ideology and his ideological ambiguity.

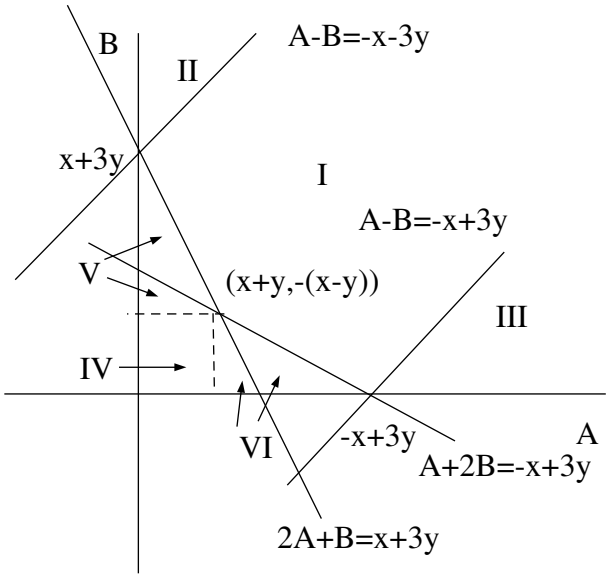


Fig. 1.4. The combinations of A and B and corresponding solutions when $x + y > 0$, $x - y < 0$

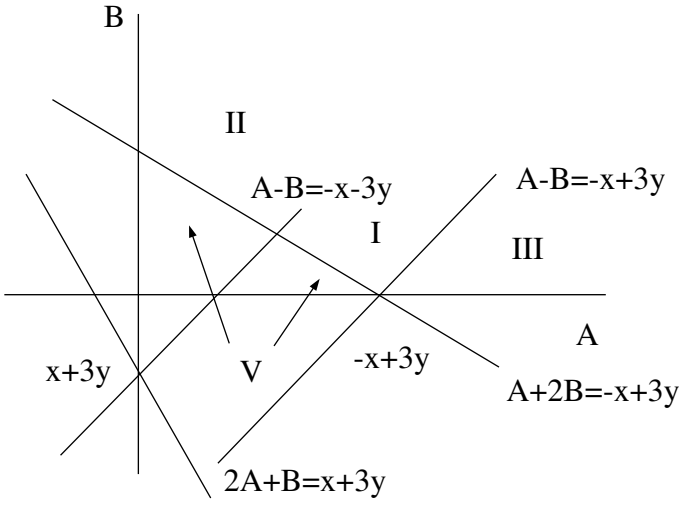


Fig. 1.5. The combinations of A and B and corresponding solutions when $x + y < 0$, $x - y < 0$

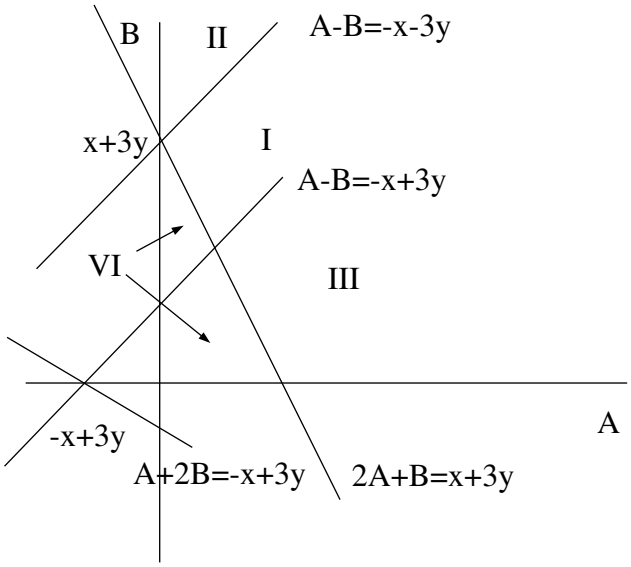


Fig. 1.6. The combinations of A and B and corresponding solutions when $x + y > 0$, $x - y > 0$

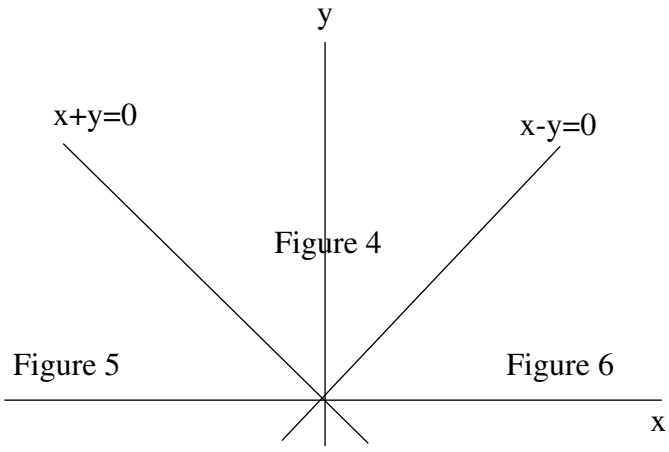


Fig. 1.7. The combinations of x and y and corresponding figures

1.4.1 Expected Receipts from Two Groups in Each Case

Below is a rough guideline for calculating the expected receipts; please refer to the Appendix A for details. There are six possible cases of solutions to this model. One is the interior solution and the other five are corner solutions. The Congressman's ideology is unknown to lobby groups. One set of x and y can characterize a Congressman's ideology. We can calculate the expected payoff for a given set of x and y in each possible case to clarify the relation between campaign contributions and a Congressman's ideology. A Congressman's expected campaign contributions after he chooses a level of ideological ambiguity, y, is

$$ER = W_a \cdot a + W_b \cdot b,$$

where ER is the expected receipts from lobby groups, W_i, $i = a, b$ is lobby group i's winning probability. In most cases,

$$W_a = \frac{(x+y)-(b-a)}{2y}, W_b = \frac{(b-a)-(x-y)}{2y}. \tag{1.2}$$

However, Equation 1.2 could give a negative probability or a probability greater than 1 because two reaction functions could cross outside the area between $a - b + (x + y) = 0$ and $a - b + (x - y) = 0$ due to the limit of willingness-to-pay or lack of incentives to bid on the Congressman. In those cases, the result of the lobbying stage is definitely decided. One lobby group must win and the other must lose. We may set the probability as 0 or 1 directly in those cases.

1.4.2 Ideological Ambiguity and Expected Receipts

Figure 1.8 is a typical solution figure in which the Congressman's ideology is not completely biased to either lobby group. Figure 1.9 shows different solution figures with $y = 0$ and different x. By comparing these figures, some rough ideas about the impact of increasing y can be obtained while x is held constant.

In the process of shift from Figure 1.5 to Figure 1.4, the level of ideological ambiguity, y, is increased given a negative expected ideology, x. Region I (solution area of *Case 1*), IV, V will expand and Region II, III, VI will shrink. Part of Region I becomes Region IV, V, VI, especially Region VI; part of Region II becomes Region I, IV, V, VI, especially Region I and V; part of Region III becomes Region I, IV, V, VI, especially Region I and VI; part of Region V becomes Region IV, VI. In the process of shift from Figure 1.6 to Figure 1.4, the level of ideological ambiguity, y, is increased given a positive expected ideology, x. Regions I, IV, and VI will expand and Regions II, III, and V will shrink. Part of Region I becomes Regions IV, V, and VI, especially Region V; part of Region II becomes Regions I, IV, V, and VI, especially Region I and Region V; part of Region III becomes Regions I, IV, V, and VI, especially Region I and Region VI; part of Region VI becomes Region IV, Region V.

All solutions are symmetric to $A - B + x = 0$. For example, the solution of $A = 1, B = 2, x = 1$ is the same as the case of $A = 2, B = 1, x = -1$ except that Group G_a and Group G_b exchange their positions. To simplify the discussion, we only discuss the case in which $x \geq 0$ in later sections. For given x, A, and B, increasing y from 0

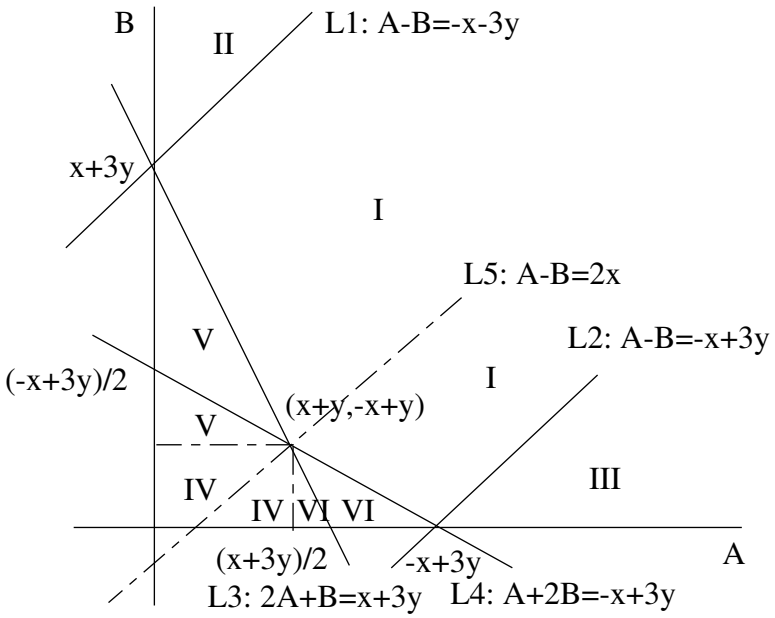
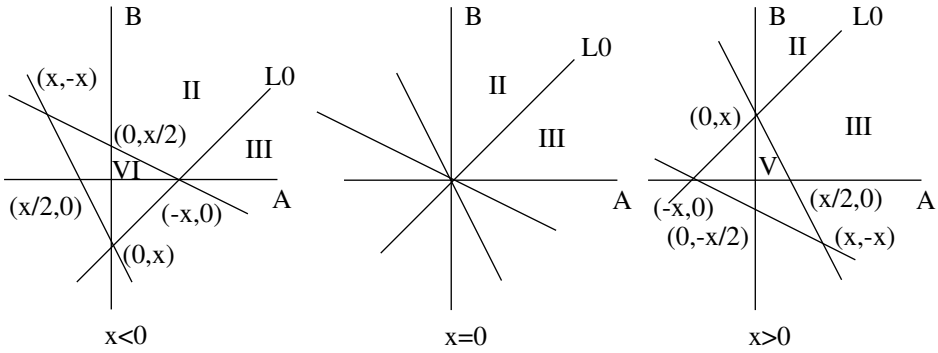


Fig. 1.8. A typical solution map



Note: L0: A-B=-x

Fig. 1.9. Solution figures with $y = 0$ and different x

to infinity will shift solution cases along with the paths illustrated in Figure 1.10 and Table 1.1.

We have five possible solution paths summarized in Table 1.1. For example, if a set of A, B, and x satisfying $A-B \geq -x, A-B < 2x, A+2B \geq 2x$, the solution path is *Path 1*($III \to I \to V \to IV$), which means that as ideological ambiguity increases, solutions of the lobbying stage will be *Case 3*, *Case 1*, *Case 5*, and *Case 4*. More precisely, for $y \in [0, \frac{A-b+x}{3}]$, the solution of the lobbying stage is *Case 3*; for $y \in [\frac{A-b+x}{3}, \frac{2A+B-x}{3}]$, the solution of the lobbying stage is *Case 1*; for $y \in [\frac{2A+B-x}{3}, B+x]$, the solution of the lobbying stage is *Case 5*; $y \geq B+x$, the solution of the lobbying stage is *Case 4*. In this path, $A+x \geq B$, that is, Group G_a has advantage by nature. When the Congressman's ideological ambiguity is small, Group G_b has no chance to win the Congressman's vote even if Group G_b is willing to pay all it has (*Case 3*). If the Congressman chooses a higher ideological ambiguity, both lobby groups have chances to win the Congressman's vote by promising positive campaign contributions (*Case 1*). If the Congressman's ideological ambiguity keeps rising, Group G_a and Group G_b will subsequently cease to promise campaign contributions because the Congressman is too ambiguous (*Case 5, Case 6*).

Path	Region	Critical Points
$III \to I \to V \to IV$	$A-B \geq -x, A-B < 2x, A+2B \geq 2x$	$\frac{A-B+x}{3}, \frac{2A+B-x}{3}, B+x$
$III \to I \to VI \to IV$	$A-B \geq 2x$	$\frac{A-B+x}{3}, \frac{A+2B+x}{3}, A-x$
$II \to I \to V \to IV$	$A-B < -x$	$\frac{-A+B-x}{3}, \frac{2A+B-x}{3}, B+x$
$III \to V \to IV$	$2A+B \geq x, A+2B < x$	$\frac{2A+B-x}{3}, B+x$
$V \to IV$	$2A+B < x$	$B+x$

Table 1.1. Summary of Possible Paths and Critical Points for Given A, B, and x ($x \geq 0$)

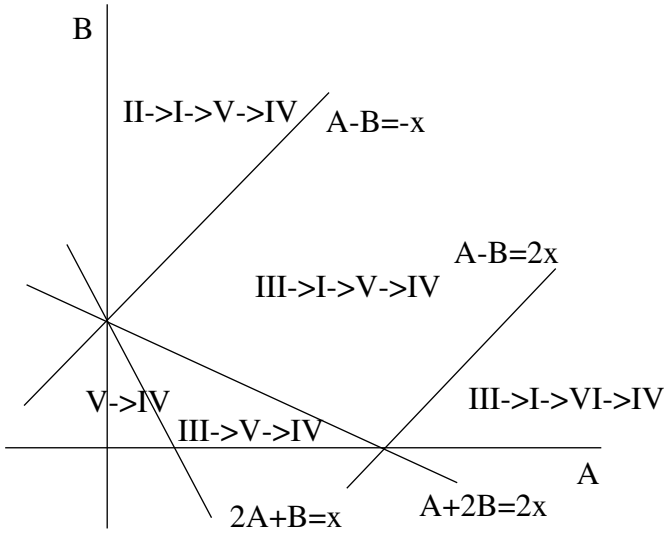


Fig. 1.10. Possible Solution Paths When $x > 0$

Combining the information about the Congressman's expected receipts and the knowledge of how solution shifts along with changes of y, it should be able to show the close form of the relation between the Congressman's ideological ambiguity and his expected receipts of campaign contributions. Unfortunately, the closed form is too complicated to be shown clearly. Instead of illustrating the closed form, Figure 1.11 shows some typical results, simulated by MATLAB, of the Congressman's expected receipts against his ideological ambiguity in each path.

The shape of the curve of expected receipts against ambiguity varies greatly. It could be linear or non-linear; it could be single-peaked or two-peaked. In most cases, however, the curve can be approximated by a quadratic function.

1.4.3 Existence of Optimal Ideological Ambiguity

Observing typical curves of expected receipts against the level of ideological ambiguity gives us a strong hint that there exists an optimal level of ideological ambiguity, given the values of two lobby groups' willingness-to-pay and the Congressman's expected ideology. This level of optimal ambiguity can bring the most expected receipts. With zero ideological ambiguity, the lobbying result is very clear. If $A + x \geq B$, Group G_a will win the vote. Otherwise, Group G_b will. An increase of ideological ambiguity would give hope to the losing side. But if the level of ideological ambiguity is really high, the expected return of campaign contributions would be too low to encourage lobby groups to cast any bid. The first main result about the existence of optimal ideological ambiguity is the following:

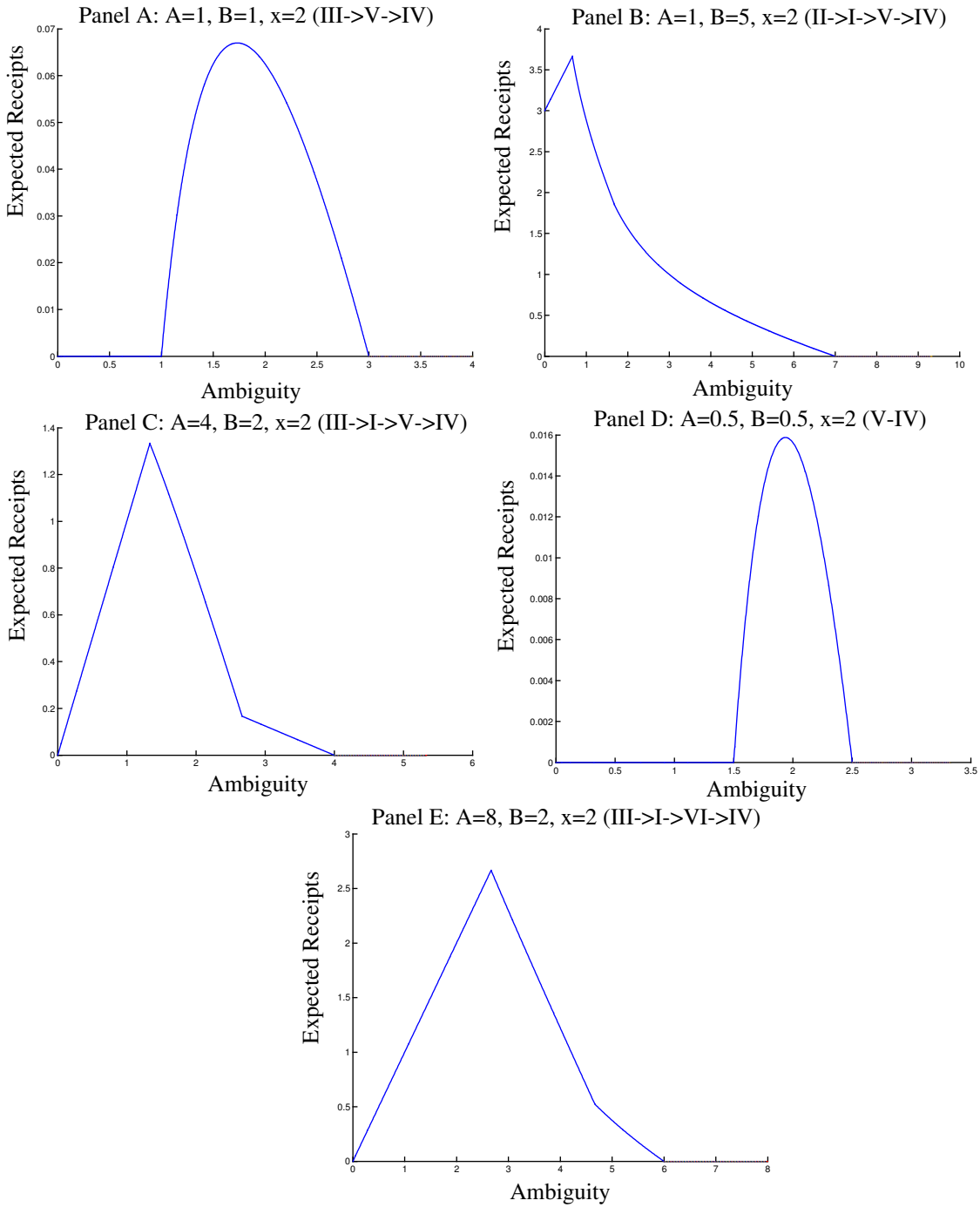


Fig. 1.11. Expected Receipts against Ideological Ambiguity

LEMMA 1.1. *Given two lobby groups' willingness-to-pay, A and B, and a Congressman's expected ideology, x, the Congressman can always choose a bounded positive level of ideological ambiguity to ensure positive receipts of campaign contributions.*

Proof: The first derivatives for two lobby groups's problems are:

$$G_a: \quad [(A - a^*) - ((a^* + x) - b^*)] - y; \tag{1.3}$$

$$G_b: \quad [(B - b^*) - (b^* - (a^* + x))] - y, \tag{1.4}$$

where a^* and b^* are campaign contributions from Group G_a and Group G_b respectively. To make a lobby group give positive contributions, the corresponding first derivative cannot be negative in equilibrium. Therefore, to make at least one lobby group give positive contributions, y must satisfy at least one of the conditions below:

$$G_a: \quad y \leq [(A - a^*) - ((a^* + x) - b^*)]; \tag{1.5}$$

$$G_b: \quad y \leq [(B - b^*) - (b^* - (a^* + x))]. \tag{1.6}$$

Of $(a^* + x) - b^*$ and $b^* - (a^* + x)$, one must be positive and the other must be negative. Otherwise, both are 0. Also, neither $A - a^*$ nor $B - b^*$ can be negative. Therefore, of $(A - a^*) - ((a^* + x) - b^*)$ and $(B - b^*) - (b^* - (a^* + x))$, at least one must be non-negative.

Q.E.D.

LEMMA 1.2. *The Congressman can receive the highest receipt of campaign contributions ($a^* = A$ and $b^* = B$) if and only if $x = B - A$ and $y = 0$.*

Proof: If $a^* = A$ and $b^* = B$, both Equation 1.5 and Equation 1.6 can be rewritten:

$$G_a : \quad y \leq [B - (A + x)];$$

$$G_b : \quad y \leq [(A + x) - B].$$

Both equalities can be satisfied simultaneously only when $x = B - A$ and $y = 0$. If $x = B - A$ and $y = 0$, the two first derivatives, Equation 1.5 and Equation 1.6, becomes

$$G_a : \quad 0 = -2a^* + b^* + 2A - B;$$

$$G_b : \quad 0 = a^* - 2b^* - A + 2B.$$

Both derivatives reach zero at $a^* = A$ and $b^* = B$. That is, both lobby groups will promise all their willingness-to-pay in equilibrium.

Q.E.D.

THEOREM 1.1. *Given two lobby groups' willingness-to-pay, A and B, and the Congressman's expected ideology, x, there exists an optimal level of ideological ambiguity such that the Congressman can maximize the expected receipts. The level of optimal ideological ambiguity is positive unless $x = B - A$.*

Proof: Lemma 1.1 shows that the Congressman must be able to have a positive receipt of campaign contributions by choosing a non-negative level of ideological ambiguity and the optimal level of ideological ambiguity has an upper limit. A level of ideological ambiguity higher than the upper limit will discourage lobby groups from giving campaign contributions due to low marginal improvement of the probability of winning. Lemma 1.2

shows the lower bound of optimal ideological ambiguity can be binding only when $x = B - A$. Combining these two lemmas, it can be concluded that a generic optimal level of ideological ambiguity is positive and bounded.

Q.E.D.

1.4.4 The Optimal Level of Ideological Ambiguity

Given A, B, and x, the shape of the curve of expected receipts against the level of ideological ambiguity is not 'well-behaved' or even fixed. In most situations, the curve has only one peak, but sometimes it has two peaks. Then, it is difficult to tell the exact optimal level of ambiguity by a clean closed form. The following discussion will be divided into two parts. First, the optimal level of ambiguity in each path will be discussed. Second, the transition across paths will be illustrated as x is increased. Then, the following theorem will be proved.

THEOREM 1.2. *For given A and B, the corresponding optimal level of ideological ambiguity to the Congressman's expected ideology is non-decreasing along with $|A + x - B|$ unless the following set of conditions is satisfied*

$$A - B + x > 0 \tag{1.7}$$

$$A - B - 2x < 0 \tag{1.8}$$

$$A + 2B - 2x > 0 \tag{1.9}$$

$$\sqrt{\frac{-1}{18}(A - B + x)(A - B - 2x)} > \frac{2A + B - x}{3} > \sqrt{-B^2 + x^2}. \tag{1.10}$$

Proof:

We will discuss the optimal level of ambiguity path by path. Except in *Path 3*, x is greater than or equal to $B - A$. Therefore, we need to show the optimal level of ambiguity is decreased in x in *Path 3* and increased in x in other paths unless the above conditions are satisfied.

Path 1: $III \to I \to V \to IV$

This is the most complicated path. There exist four candidates for the optimal level of ambiguity: $\frac{A-B+x}{3}$, $\sqrt{-\frac{1}{18}(A-B-2x)(A-B+x)}$, $\frac{2A+B-x}{3}$, and $\sqrt{-B^2+x^2}$[4]. The optimal level of ideological ambiguity depends on A, B and x. Unless the optimal level of ideological ambiguity is $\frac{2A+B-x}{3}$, the optimal level of ambiguity is increased along with x. $\frac{2A+B-x}{3}$ is the optimal level only when Condition 1.7 through Condition 1.10 are satisfied.

Path 2: $III \to I \to VI \to IV$

In *Case 1* and *Case 6*, expected receipts are decreased as the level of ideological ambiguity increases. The optimal level of ambiguity will be the critical point separating *Case 3* and *Case 1*, $\frac{A-B+x}{3}$.

Path 3: $II \to I \to V \to IV$

In *Case 1* and *Case 5*, expected receipt is decreased as the level of ambiguity increases. The optimal level of ambiguity will be the critical point separating *Case 2* and *Case 1*, $\frac{-A+B-x}{3}$.

Path 4 and Path 5: $III \to V \to IV$ and $V \to IV$.

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[4] Although $\sqrt{-\frac{1}{18}(A-B-2x)(A-B+x)}$ is a real number in this path, $\sqrt{-\frac{1}{18}(A-B-2x)(A-B+x)}$ must be between $\frac{A-B+x}{3}$ and $\frac{2A+B-x}{3}$. Then $\sqrt{-\frac{1}{18}(A-B-2x)(A-B+x)}$ is a candidate. Similar constraints also apply to $\sqrt{-B^2+x^2}$.

Only *Case 5* matters in these two paths. The optimal level of ambiguity will be $\sqrt{-B^2+x^2}$.

The transition across paths when x is increasing:

Before discussing transition across paths, transition within *Path 1* should be explored first since there are four possible optimal levels of ambiguity. *Path 1* includes *Case 3*, *Case 1*, *Case 5*, and *Case 4*. The four candidates are $\frac{A-B+x}{3}$, $\sqrt{-\frac{1}{18}(A-B-2x)(A-B+x)}$, $\frac{2A+B-x}{3}$, and $\sqrt{-B^2+x^2}$. $\frac{A-B+x}{3}$ is the boundary point separating *Case 3* and *Case 1*; $\sqrt{-\frac{1}{18}(A-B-2x)(A-B+x)}$ is the inner solution within *Case 1*; $\frac{2A+B-x}{3}$ is the boundary point separating *Case 1* and *Case 5*; and $\sqrt{-B^2+x^2}$ is the inner solution within *Case 5*. Since $\sqrt{-\frac{1}{18}(A-B-2x)(A-B+x)}$ and $\sqrt{-B^2+x^2}$ are both increasing in x [5], therefore, as x is increased, the transition of optimal level of ambiguity within *Path 1* is $\frac{A-B+x}{3}$, $\sqrt{-\frac{1}{18}(A-B-2x)(A-B+x)}$, $\frac{2A+B-x}{3}$, and $\sqrt{-B^2+x^2}$ in that order[6].

As to transition across paths, by Figure 1.10, it is easy to figure out the critical value of x to separate each path.

Table 1.2 shows the critical values of x. Odd rows show the corresponding paths and even rows show the critical values. For example, when $A > B$ and $\frac{A-B}{2} \leq x \geq \frac{A+2B}{2}$, equilibrium path is *Path 4* while y is increased from 0. All conjunctions between equilibrium paths are smooth and there is no jumps between equilibrium paths. For example, when $B > A$, $x = -A + B$ is the critical point separating *Path 3* and *Path*

[5] $\frac{\partial(A-B-2x)(A-B+x)}{\partial x} = -A + B - 4x < 0$.

[6] $\frac{2A+B-x}{3}$ may not be the exact optimal level of ideological ambiguity unless Condition 1.10 is satisfied.

$B > A$	*Path 3*	$\rightarrow$ $-A+B$	*Path 1*	$\rightarrow$ $\frac{A+2B}{2}$	*Path 4*	$\rightarrow$ $2A+B$	*Path 5*
$A > B$	*Path 2*	$\rightarrow$ $\frac{A-B}{2}$	*Path 1*	$\rightarrow$ $\frac{A+2B}{2}$	*Path 4*	$\rightarrow$ $2A+B$	*Path 5*

Table 1.2. Critical Values of x Separating Paths

1. The optimal level of ideological ambiguity in *Path 3*, when $x = -A + B$, is 0. The optimal level of ideological ambiguity in *Path 1* ,when $x = -A + B$, is also 0.

Q.E.D.

The only exceptions in Theorem 1.2 happen at the boundary point separating *Case 1* and *Case 5*. In this special case, Group G_a contributes nothing due to a high level of ideological ambiguity, and Group G_b contributes a non-negative amount. Therefore, in the boundary between *Case 1* and *Case 5*, a candidate might want to lower his level of ambiguity to increase the marginal benefit of Group G_a's contributions and to stimulate contributions from Group G_a. However, if the Congressman's ideology is inclined to Group G_a more and more, lowering his level of ideological ambiguity can only deter the campaign contributions from Group G_b and cannot encourage Group G_a's campaign contributions at all. Therefore, in *Case 5*, the Congressman can only increase his expected receipts by choosing a higher level of ambiguity.

1.5 Expected Receipts versus Expected Ideological Position

When the Congressman's ideology becomes extreme right or left, lobby groups will lose incentives to give campaign contributions to change the candidate's mind. The lobby

groups on the same side of the candidate will not give too much campaign contribution since the candidate is already on the same side. The lobby group on the opposite side will not give too much campaign contributions, either. Conclusions is quite similar to Theory 1.2, but there is no exception case. Here comes Theory 1.3.

THEOREM 1.3. *For given A and B, the Congressman's expected receipts under optimal level of ambiguity is non-decreasing alone with $|A + x - B|$.*

Proof: The last part of the proof of Theorem 1.2 states that all conjunctions across equilibrium paths are smooth. If it can be shown that expected receipts under an optimal level of ambiguity is non-decreasing along with $|A + x - B|$ in each path, the proof is done.

Path 1: $III \to I \to V \to IV$

There are four possible optimal levels of ideological ambiguity in this path. I will show that all derivatives of expected receipts with respect to position of candidates' ideology, x, are negative. Here the optimal level of ambiguity is denoted as y^*, and the corresponding expected receipts as ER.

When $y^* = A - B + x$, $ER = \frac{A+2B-2x}{3}$;

When $y^* = \sqrt{\frac{-1}{18}(A - B + x)(A - B - 2x)}$,

$ER = \frac{A+B}{2} - \frac{\sqrt{18}}{9} \cdot \sqrt{-(A - B + x)(A - B - 2x)}$

Then

$$sign(\frac{\partial ER}{\partial x}) = sign(\frac{\partial (A - B + x)(A - B - 2x)}{\partial x})$$

$$= \quad sign(-A + B - 4x) < 0.$$

When $y^* = \frac{2A+B-x}{3}$, ER is $\frac{6(-A+B+2x)(A+2B-2x)}{(2A+B-x)}$. The derivative with respect to x is

$$\begin{aligned} & \frac{6}{(2A+B-x)^2} \cdot (7A^2 + 7AB + 4B^2 - 16Ax - 8Bx + 4x^2) \\ = \; & (7A^2 + 10AB + B^2 - 7Ax - 5Bx + 4x^2) \\ & -3B(A - B + x) - 9Ax, \end{aligned}$$

where $7A^2 + 10AB + B^2 - 7Ax - 5Bx + 4x^2 < 0$[7], $A - B + x > 0, Ax > 0$.

When $y^* = \sqrt{-B^2 + x^2}$, the ER is $\frac{1}{4}(-\sqrt{-B^2 + x^2} + x)$. The derivative with respect to x is $-(-B^2 + x^2)^{\frac{-1}{2}} \cdot x + 1$. Since $-B^2 < 0$, the derivative is negative.

Path 2: $III \to I \to VI \to IV$

The ER is $\frac{A+2B-x}{3}$, which is decreasing in x.

Path 3: $II \to I \to V \to IV$

The ER is $\frac{2A+B+2x}{3}$, which is increasing in x.

Path 4 and *Path 5*: $III \to V \to IV$ and path $V \to IV$.

The ER is $\frac{1}{4}(-\sqrt{-B^2 + x^2} + x)$. The derivative with respect to x is negative[8].

Q.E.D.

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[7] $y* = \frac{2A+B-x}{3}$ in *Path 1* if and only if $\sqrt{\frac{-1}{18}(A - B + x)(A - B - 2x)} > \frac{2A+B-x}{3} > \sqrt{-B^2 + x^2}$. The first inequality can ensure $7A^2 + 10AB + B^2 - 7Ax - 5Bx + 4x^2 < 0$.

[8] Please refer to *Path 1*.

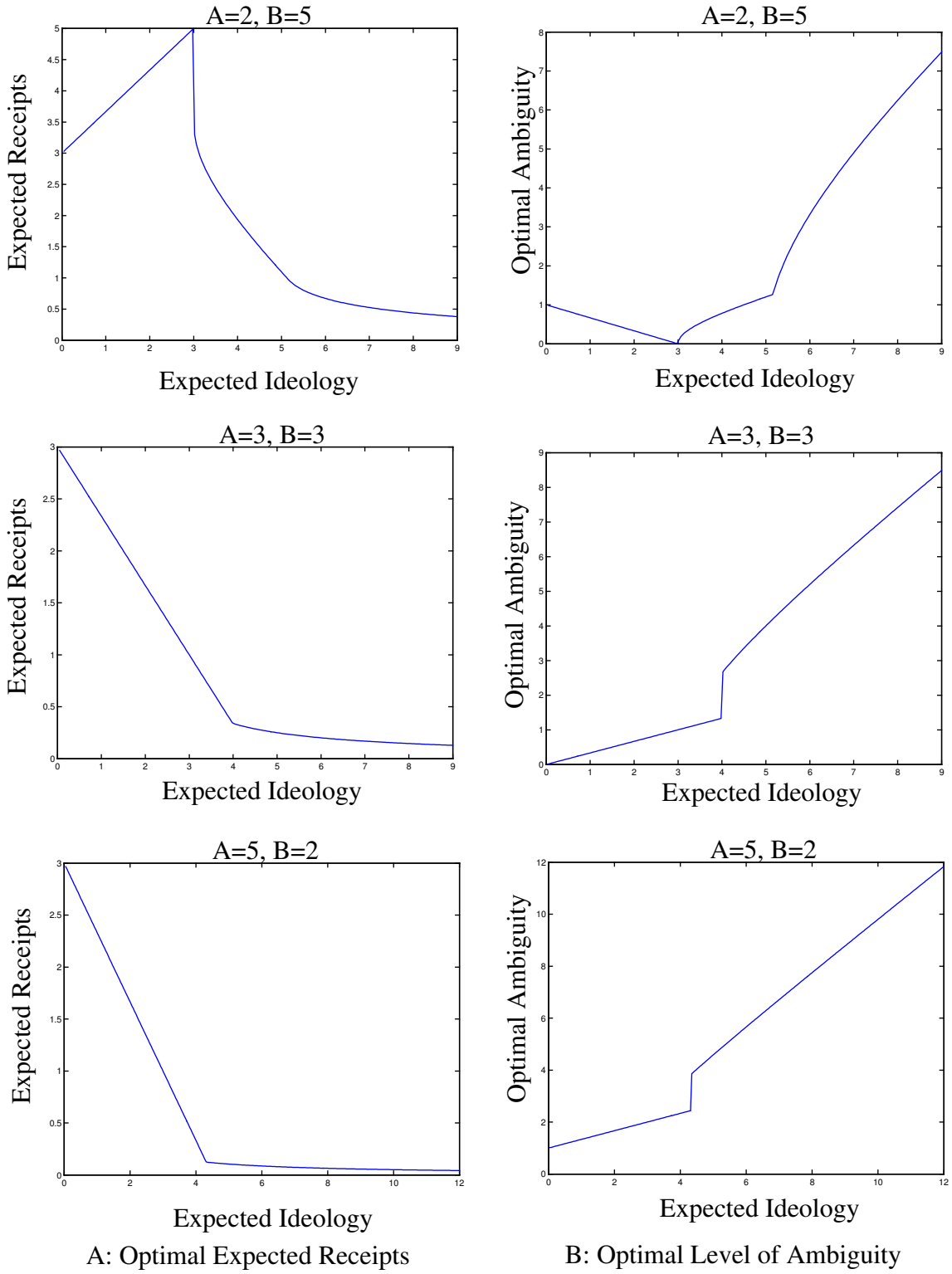
1.6 Simulation Results

Figure 1.12 shows the simulation curve of the Congressman's expected receipts against his expected ideology and the corresponding optimal level of ideological ambiguity. All simulations are done under the assumption $x \geq 0$. However, it is easy to capture the whole features by reflecting diagrams. For case of $A = 2, B = 5$, the expected receipts when $x \geq 0$ is the first diagram in Panel A, Figure 1.12 and the expected receipts when $x \leq 0$ is the mirror image of the third diagram in Panel A, Figure 1.12. Combining two diagrams can give the complete pictures of the curve of expected receipts against candidates' ideology when $A = 2, B = 5$.

Figure 1.12 shows that the Congressman with the expected ideology $B - A$ has the highest expected receipts of campaign contributions and only he will choose zero ideological ambiguity since he doesn't need to use ideological ambiguity to stimulate any campaign contributions. If one lobby group has a greater advantage due to the difference of willingness-to-pay or bias of the Congressman's ideology, the Congressman has to choose a higher ideological ambiguity to encourage lobby groups to promise more. However, ideological ambiguity cannot compensate for the imbalance between two lobby groups. If one lobby group has a greater advantage, the Congressman will receive less.

1.7 Conclusion

Different from most literature about campaign contributions, this paper focuses on the role of a Congressman's ideological ambiguity in a lobbying game. There are two main results which may generate two testable hypotheses. First, this paper shows that a



A: Optimal Expected Receipts

B: Optimal Level of Ambiguity

Fig. 1.12. Optimal Expected Receipts and Optimal Level of Ambiguity

biased Congressman will choose a high ideological ambiguity to attract more campaign contributions even though lobby groups hate Congressmen's ideological ambiguity *per se*. Similar to Aragonés and Postlewaite (4), our present study shows that being ambiguous can convince lobby groups whose preference is different from the Congressman's that they still have a chance to win. Thus, the curve of a Congressman's ideological ambiguity against his expected ideology could be approximated by a quadratic function and it is U-shaped. Second, in this paper it can be shown that a biased Congressman receives less influence-motivated campaign contributions even though he has chosen the optimal level of ideological ambiguity. This leads to the second testable hypothesis: the curve of a Congressman's receipts of campaign contributions against his ideology should be inverted U-shaped.

Since this is a one-period model, I assume that Congressmen vote sincerely. In a multi-period model, Congressmen might engage in strategic voting to attract more campaign contributions by confusing lobby groups. Research about Congressmen's voting behavior across periods can give more ideas about the differences among veterans and freshmen in Congress.

Our model does not consider how lobby groups form a majority in Congress. To pass a bill, lobby groups need a majority, not just one vote. For those Congressmen who are critical in forming a majority, two lobby groups' willingness-to-pay will be higher and those Congressmen's expected receipts of influence-campaign contributions should be also higher. However, the new consideration will not alter our conclusion that the biased Congressmen receive less in campaign contributions. Usually, unbiased Congressmen are those who are critical in forming a majority.

Chapter 2

How Ambiguous Is a Congressman?

2.1 Instruction

There is a long tradition of modeling a politician's ideology in a one-dimensional space since Downs (11). Numerous useful studies followed this strand. A politician's ideology is often described as right-wing (conservative) or left-wing (liberal). The location of ideology can be mapped in the conservative-liberal spectrum. However, in theory and in practice, Congressmen's ideologies may not be completely fixed in all issues. Not only the location of ideology but also the ambiguity of ideology[1] are important in describing a politician's ideology. Some politicians' ideologies are considered ambiguous such as that of former President John F. Kennedy, but no measure of ideological ambiguity was ever proposed. The essential mission of this paper is to construct a measure of the location of ideology and a measure of ideological ambiguity under a unified framework.

Since the result of a democratic political process is determined by voting, it is intuitive to observe a politician's ideology via voting records. Numerous web sites provide Congressmen's voting records and relevant analysis. Most of these web sites are run by interest groups or civil rights groups, such as Public Citizen, Voter Information Services, The League of Conservation Voters, and The American Federation of Labor and

[1] Ideological ambiguity is the possible variation in each issue. For example, if a Congressman's ideology in each issue is drawn from $N(\beta, \sigma^2)$. β is the Congressman's location of ideology and σ^2 is the ambiguity of ideology.

Congress of Industrial Organization. Those groups provide Congressional voting records on specific issues of concern to them with their own opinions on these issues. Usually, they rank Congressmen by the percentage of Congressmen's votes that coincided with their opinions. Most interest groups provide a narrow specific view of Congressmen's ideology through voting records; however, it is more interesting to judge a Congressman's overall ideology directly through analysis of whole voting records rather than votes on specific issues only. This approach may further reduce the bias that can result from using the typical interest groups' method of ranking in empirical studies identified by Herron (19).

Poole and Rosenthal (27) and Heckman and Snyder (17) provided two methods to evaluate Congressmen's ideologies based on estimation of Congressmen's latent function. Poole and Rosenthal (27)'s estimation was based on a spatial model and they used the maximum likelihood method to estimate Congressmen's ideologies through voting records. Their method is complicated and needs to estimate a huge number of parameters. Heckman and Snyder (17) proved that a linear model can be used to estimate Congressmen's preference parameters if shocks on preference are allowed to be drawn from different non-degenerate functions. They suggested applying factor analysis on the covariance matrix of voting records to estimate Congressmen's ideologies. Heckman and Snyder (17) method is analogous to the examination theory in education psychology: as the position to each bill is to the difficulty of each question in exams, so is examinees' ability to Congressmen's ideology. Although their estimation on preference parameters is similar to Rosenthal and Poole's result, it is difficult to link their linear model to the traditional spatial model directly.

In practice, Congressmen do not consistently vote following a fixed ideology. If they did, their Congressmen's voting behavior could easily be perfectly predicted. The unpredictability does not just come from missing dimensions of ideology. Both Poole and Rosenthal (27) and Heckman and Snyder (17) suggested that ideology can be decomposed into 2 to 6 dimensions. Adding more dimensions cannot improve much the success of the prediction on Congressmen's voting. Therefore, a more realistic assumption is that a Congressman's ideology is not fixed but follows a fixed distribution. Then ideological ambiguity can be defined as the dispersion of ideological distribution. We will provide empirical evidence to show that ideological ambiguity is an important characteristic of Congressmen's voting behavior, and will show that Congressmen choose their level of ideological ambiguity to maximize their campaign contributions.

In theory, ideological ambiguity plays an important role in an election game as well as in a lobbying game. Sheple (30), Glazer (14), Alesina and Cukierman (1), Aragonés and Postlewaite (4), and Wang (35) incorporated ideological ambiguity into their models. Without a measure of ideological ambiguity, it is impossible to test those theories empirically. Although some preference shocks are allowed in Rosenthal and Poole's and Heckman and Snyder's methods, neither can be extended to measure ideological ambiguity easily. Poole and Rosenthal (27) assumed that all error terms follow a logit function. Thus, they can write down a likelihood function easily. Clearly, this is an unrealistic assumption. Indeed, if the error terms of different Congressmen's utility follow different distribution, the likelihood function will be too complicated to estimate. In Heckman and Snyder's framework, error terms cannot be correlated across Congressmen nor across

roll calls. Therefore, it is impossible to think about ideological ambiguity in their framework. We will propose a simpler and more intuitive measure of Congressmen's ideologies from voting records directly based on a prevailing spatial model. The simplicity of this new framework makes measurement of the ideological ambiguity possible.

The spatial model in this paper is based on party affiliation only. There are two main reasons for doing this. First, a series of studies, including Poole (26), Poole and Rosenthal (27), and Heckman and Snyder (17), suggested that roll call voting behavior can be explained in a low-dimensional space, although there are some debates over how many dimensions are important. Second, party affiliation is always one of main factors used to explain Congressmen's voting behaviors. Snyder and Groseclose (31) and Cox and Poole (10) have measured party influence on voting in Congress. Although there are controversies over the procedure of estimation, their research reveals that political parties have tremendous influence on voting in Congress. In Section 2 we also provide evidence from direct observation on voting records that Congressmen's voting behaviors are highly related to party affiliation. Based on previous research and our own observation on voting records, party affiliation is shown to be the most important factor in explaining Congressmen's ideology. A specific spatial model will be used to show how to use party affiliation in explaining Congressional voting behavior.

Two important remarks are in order before proceeding further with this analysis. First, although we use party affiliation as the only explanation variable of Congressmen's voting behaviors, we have no intention of showing whether or not Congressmen's voting behavior is affected by party pressure, although it could well be. It is difficult to deny the possibility that a Republican Congressman tends to be on the right wing at heart

and a Democratic Congressman tends to be on the left wing at heart. Therefore, when voting records show that a Republican (Democratic) Congressman's voting behavior inclines toward the right (left) wing, it doesn't mean that the Congressman's voting is affected by the party's pressure. Since the present study does not involve any causality analysis, it is not appropriate to conclude anything about party pressure. Second, our measure is designed to describe how much a Congressman acts like a pure Democrat or a pure Republican. Democrat is thought a left-wing party and Republican is a right-wing party. While showing how much a Congressman acts like a pure Democrat or a pure Republican, the measure proposed by this paper is also good to demonstrate how much a Congressman's ideology is biased to the left or to the right. Our measures might not be coincident with the traditional definition of ideology.

Section 2.1 is the introduction of this paper; Section 2.2 proposes a spatial model as the basis of constructing a measure of Congressmen's ideology and a measure of ideological ambiguity; Section 2.3 is the estimation the measure of ideology and the measure of ideological ambiguity; Section 2.4 provides an example of the estimation result and comparison of our ideology measure and other two currently prevailing ones; Section 2.5 discusses two properties of ideological ambiguity using our estimation results; finally, Section 2.6 offers some extensions of our research and closing remarks.

2.2 Observation and a Guess on Voting Behavior in Congress

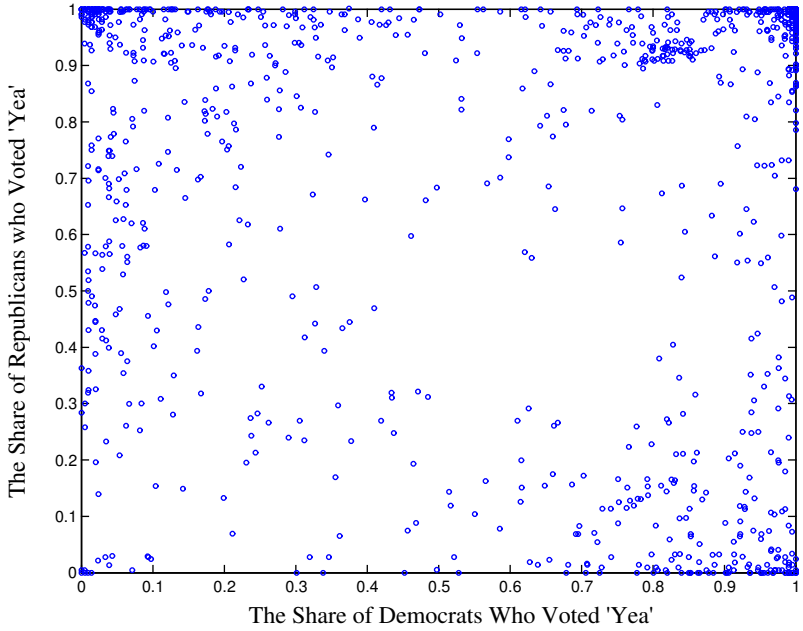
In this section, we provide one observation on voting behaviors in Congress and justify why party affiliation should be used to explain Congressmen's voting behaviors. Then we propose a spatial model to explain voting patterns we observed.

2.2.1 Stereotype of Voting Behavior in Congress

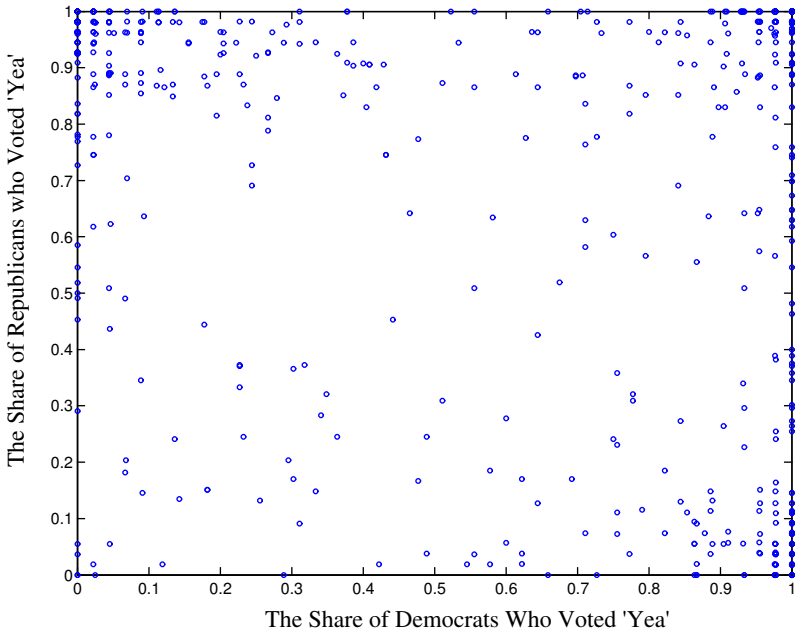
Figure 2.1 shows scatter diagrams of voting results in the 106th House and in the 106th Senate. (All scatter diagrams in different terms of the Congress are very similar; the 106th Congress is not a special case.) In both panels, the x-axis represents the ratio of Democrats who voted yea among Democrats who voted and the y-axis represents the Republicans' ratio. Each spot stands for one roll call. Most spots cluster at three corners: top-left, top-right, and bottom-right. A spot near the top-left corner means that Republicans strongly support the bill and Democrats dislike the proposal in the roll call. Conversely, a spot near the bottom-right corner means that Democrats strongly support the bill and Republicans dislike it in that roll call. Additionally, a top-right corner point signifies a bill supported by both two parties. Few bills no Congressman favors can appear in the agenda. Therefore, there are very few spots located at the bottom-left corner. Most spots are located around the upper and right boundaries of the diagram rather than the center. That is, only in very few cases, some of Republicans and some of Democrats support one bill together and the rest of their colleagues are against it. It can be concluded that there are only three major voting patterns in Congress:

- Both parties support one bill;
- Most Republicans support one bill, but some Democrats are against it;
- Most Democrats support one bill, but some Republicans are against it.

Based on the above observation, the U.S. Congress are considered to be highly one-dimensionally polarized, with Republicans at one end and Democrats at the other.



Panel A: The 106th House



Panel B: The 106th Senate

Observing the share of Democrats and Republicans who voted 'yea' in each roll call, we may conclude three stereotypes of voting behavior in Congress.

Fig. 2.1. Stereotype of Voting Behavior in Congress.

2.2.2 A Simple Spatial Model and Identification Problem

Since Congress is highly polarized by party affiliation, a one-dimensional model explained by party affiliation is the best in describing Congressmen's ideologies. Below is the model.

All Congressmen's ideologies lie on a real line. One Congressman's ideology can be represented by one point. Let's say Democrats tend to be on the left wing and Republicans tend to be on the right wing. A Congressman with a larger measure of ideology means that the Congressman acts more like a pure Republican: the Congressman tends to be right-wing (conservative). In contrast, a Congressman with a smaller measure of ideology means that the Congressman acts like a pure Democrat or the Congressman tends to be left-wing (liberal). Ideally, it should be found that Republicans cluster at the right half and Democrats stay at the left half. Each bill also corresponds to a (policy) position and the position can also be mapped on the line. The index of a bill's position reveals two pieces of information: first, which party supports this bill and second, how strong they support it. When facing a roll call, Congressmen whose ideologies are at the right of the bill's position should vote for Republicans and others should vote for Democrats. In contrast to a Congressman's ideology, if a bill's position inclines toward the right, more Congressmen support the Democrat's view of the bill. When facing a bill with a position inclining toward the left, more Congressmen take the Republicans' side.

Figure 2.2 illustrates how this model works. By varying a bill's position, our model shows why spots in Figure 2.1 should be located at those three corners and the boundary

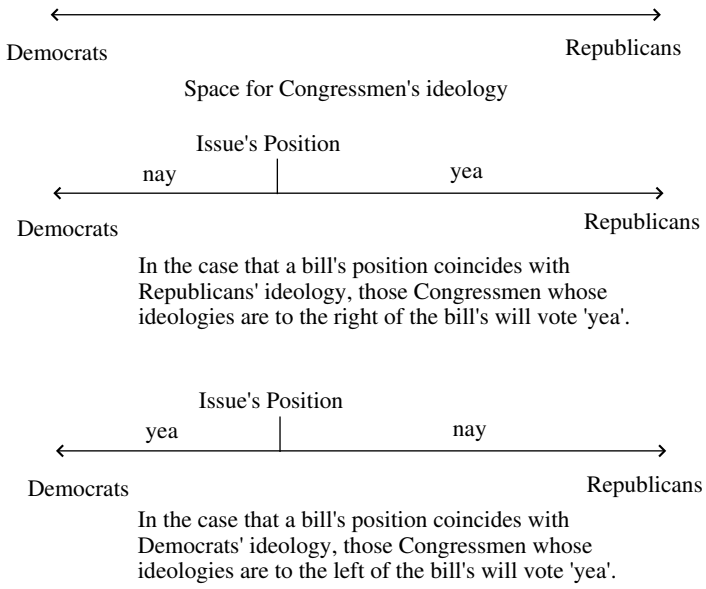


Fig. 2.2. How the model works

linking those corners. Deviations from corners and boundaries mean Congressmen do not always vote following a fixed ideology. Lobbying from interest groups, log-roll behaviors, and district concern could be the most important reasons explaining those deviations.

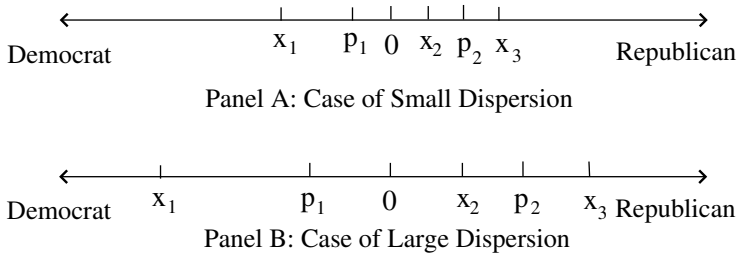


Fig. 2.3. Identification Problem

However, without further restrictions, the above setting cannot work because of the identification problem. Consider a hypothetical situation: There are three Congressmen in Congress, two roll calls, and no random factor in voting. The voting records are following: In the first roll call, Congressman 1 votes for the Democrat, Congressman 2 votes for the Republican, and Congressman 3 votes for the Republican. In the second roll call, Congressman 1 votes for the Democrat, Congressman 2 votes for the Democrat, and Congressman 3 votes for the Republican. In Figure 2.3, x_i is Congressman i's ideology and p_j is roll call j's policy position. Clearly, Panel A, Figure 2.3 can explain the above

voting record very well. However, if all Congressmen's ideologies and all bills' policy positions are spread out, the voting record can be still explained very well (as shown in Panel B, Figure 2.3). The key problem is that it is impossible to determine Congressmen's ideologies and bills' policy positions simultaneously without any restriction; that is, we cannot map intangible ideologies on a tangible space without a reference point. We will discuss how to solve the identification problem in Section 3.

2.3 Estimation of Congressmen's Ideologies and Their Ideological Ambiguity

We formalize the previous model and propose to use the method of maximum likelihood estimation to estimate our model in this section. We also propose a solution to the identification problem. Finally, we illustrate the procedure of calculating bootstrapped t value.

2.3.1 The Formal Model

To formalize the previous model, let x_{ij} denote Congressman i's policy position in roll call j. x_{ij} equals $x_i + \epsilon_{ij}$ and ϵ_{ij} is assumed to be drawn from a normal distribution, $N(0, \sigma_i^2)$, before roll call j. x_i is Congressman i's expected policy position for each roll call, and also represents Congressman i's expected ideology. A higher x_i means that Congressman i tends to be right-wing, or is more likely to vote Republican. σ_i^2, the variance of ϵ_{ij}, is Congressman i's ideological ambiguity. A Congressman's exact policy position in each roll call is more difficult to predict if he has a higher σ_i^2.

p_j is an index representing roll call j's position. It is assumed that the higher p_j is, the more Congressmen will vote Republican. Note that the sign of p_j here is opposite to the sign in Section 2. It is more convenient mathematically to the current setup. Congressman i votes for the Republican in roll call j if

$$x_{ij} + p_j \geq 0. \tag{2.1}$$

Otherwise, Congressman i votes Democrat. Recall that $x_{ij} = x_i + \epsilon_{ij}$. Equation 2.1 can be written as

$$\epsilon_{ij} \leq x_i + p_j.$$

Then the probability that Congressman i votes for the right wing, or Republican, in roll call j is

$$\Phi(\frac{x_i + p_j}{\sigma_i}),$$

where Φ is the standard normal distribution.

2.3.2 Party Orientation in Roll Calls

To estimate Congressmen's ideologies and ideological ambiguities, we need to know which party a Congressman supports in each roll call. We use Rice index (Rice (29)) to decide which result a party favors. Rice index is $D_{y,j} - R_{y,j}$, where $D_{y,j}$ is the proportion of Democrats who vote yea in roll call j and $R_{y,j}$ is the proportion of Republicans

who vote yea in roll call j. When the proportion of Democrats who vote yea is higher than the proportion of Republicans ($D_{y,j} - R_{y,j} > 0$), the Democrat are said to favor the yea vote and the Republican are said to be on the side of the nay vote. If a Congressman votes for what the Democrat favor in a roll call, we can conclude that the Congressman votes as a Democrat in that roll call.

2.3.3 Data

For comparison, we calculate Congressmen's ideologies from the 80th Congress through the 100th Congress, as Heckman and Snyder (17) did. In the earlier Congress, the number of roll calls was less than 200, but in the 90th Congress, the number of roll calls was more than 1500. The number of Senators was around 100 and the number of Representatives was more than 400. However, following Heckman and Snyder (17) and Poole and Rosenthal (27), some roll calls and Congressmen are excluded from data sets. Those roll calls in which the minority is less than 2.5% of the total are excluded[2]. Congressmen who cast votes in fewer than half of the total number of roll calls are also excluded[3]. Data of voting results, provided by Dr. Keith Poole, is downloaded from the Inter-university Consortium for Political and Social Research (ICPSR), which is maintained by the University of Michigan.

[2]Including unanimous roll calls will cause difficulty of estimation.

[3]Poole and Rosenthal (27) took away those votes and candidates and Heckman and Snyder (17) followed the same practice.

2.3.4 Estimation

The formal model is simply a Probit model which can be estimated by the method of the maximum likelihood estimation (MLE). Congressmen's ideologies, ideological ambiguities, and roll calls' policy positions can be estimated simultaneously. The likelihood function is

$$\prod_i \prod_j (\Phi(\frac{x_i + p_j}{\sigma_i}))^{I_{i,j,Rep}} (1 - \Phi(\frac{x_i + p_j}{\sigma_i}))^{I_{i,j,Dem}},$$

where $I_{i,j,Rep} = 1$ if Congressman i votes Republican in roll call j; 0, otherwise; $I_{i,j,Dem} = 1$ if Congressman i votes Democrat in roll call j; 0, otherwise. The log-likelihood function is

$$\sum_i \sum_j [I_{i,j,Rep} \cdot \log(\Phi(\frac{x_i + p_j}{\sigma_i})) + I_{i,j,Dem} \cdot \log(1 - \Phi(\frac{x_i + p_j}{\sigma_i}))]. \tag{2.2}$$

Suppose that there are c Congressmen and n roll calls. The number of parameters to be estimated is $2 \cdot c + n$. We may apply the Broyden, Fletcher, Goldfarb, and Shanno (BFGS) quasi-Newton method to maximize the log-likelihood function. Although the Probit model has been proved globally concave, it still takes time to do the calculations since we have many parameters to estimate.

We follow Lewis and Poole (22)'s method to provide the bootstrapped t value. Given the estimates of Congressmen's ideologies, Congressmen's ideological ambiguities, and bills' policy positions, the probability that each Congressman votes Republican Democrat in each roll call can be obtained. Let x_i denote Congressman i's ideology, σ_i^2

denote Congressman i's ideological ambiguity, and p_j denote roll call j's policy position. Then the probability that Congressman i votes for the right wing or with the Republicans in roll call j is

$$\Phi(\frac{x_i + p_j}{\sigma_i}),$$

where Φ is the standard normal distribution. Suppose that there are c Congressmen and n roll calls in Congress. We may apply the above voting probabilities to simulate 1000 voting results. Each voting record contains $c \times n$ entries. Using the simulated 1000 voting results, we can obtain 1000 sets of new estimates of Congressmen's ideologies, Congressmen's ideological ambiguities, and bills' policy positions. The standard errors of the estimates are the bootstrapped t values.

2.3.5 The Identification Problem

As mentioned in Section 2.2, our model suffers from the identification problem. Recall the log-likelihood function, Equation 2.2. If all x_i, p_j, and σ_i change proportionally, the log-likelihood function will remain the same. Clearly, our model cannot be identified. To solve the identification problem, we pick a Congressman arbitrarily and set his ideology as 0 and his ideological ambiguity as 1.

Due to the identification problem, our measure of ideology and our measure of ideological ambiguity cannot be compared over different terms of Congress without a fixed benchmark. Measures of other Congressmen's ideologies are the relative positions to the Congressman's ideology which is normalized to zero. Our measure of ideological

ambiguity is also an relative measure. We have to pick the same Congressman who is considered to have a hardline ideology as the benchmark in all terms of Congress, for example, Sen. Edward Kennedy (MA). Otherwise, we cannot have a unique benchmark for all terms of Congress.

Londregan (23) suggested modeling the agenda to overcome the identification problem. The basic idea is to use information about the proposers of each bill as a substitute for p_j. There are two reasons why we do not adopt his method. First, his method was used to overcome the identification problem in the traditional spatial model, as Poole and Rosenthal (27) did. However, after adding ideological ambiguities into the model, fixing p_j cannot solve the identification completely. Recall that in Equation 2.2, even if all p_js are fixed, for each set σ_i, we can find a set of x_i such as Equation 2.2 remains the same. Second, there is no empirical evidence to show that the agenda can be modeled well.

2.4 Estimated Results of Congressmen's Ideologies

In this section we provide the results of estimation of the indices proposed in this paper. We first provide the estimation result of the 100th Senate as an example of a polarized Congress. We also present accurateness of prediction on Congressmen's voting results and comparisons among different measures of Congressmen's ideologies.

2.4.1 An Example of the Polarized Congress: the 100th Senate

In Appendix B, we provide Senator's estimated ideologies and estimated ideological ambiguities in the 100th Senate. As expected, Democrats cluster on the left-hand

side and Republicans take the other, with few exceptions. Clearly, our estimation result confirms the observation of a polarized Congress. This result resembles Poole and Rosenthal's and Heckman and Snyder's. The 100th Senate is not a special example. This conclusion also can be carried over other terms of Congress.

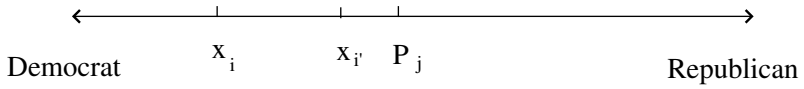


Fig. 2.4. Difficulty of Measuring Index around a Bill's Position

Those exceptions of the polarized 100th Senate are most visible in the middle of the spectrum of ideology. There are a few possible explanations for these exceptions. First, those Congressmen whose behavior was exceptional really have ideologies inclined to the opposite party and the exceptions simply reflect the reality. Second, those exceptions result from measurement errors. It is more difficult to measure the ideologies of centrist Congressmen. Other studies, e.g. Poole and Rosenthal (27), also pointed out this problem. Figure 2.4 shows the reason. Suppose that the position of bill j is p_j and two Congressmen's ideologies are x_i and $x_{i'}$. Ignoring random factors, two Congressmen will both vote with the Democrats. Now consider random factors. If $\varepsilon_{i'j} > p_j - x_{i'}$, Congressman i' will change his mind. Similarly, If $\varepsilon_{ij} > p_j - x_i$, Congressman i will vote Republican instead. Since $x_{i'}$ is closer to p_j, Congressman i' might change his or

her mind more readily. Therefore, it will be more difficult to measure $x_{i'}$ than x_i. Many bills' positions around the middle (that is why we need to take roll calls). Therefore, those Congressmen's ideologies which are located in the middle will be more difficult to measure. It is shown in Appendix A that the percentages of successful prediction are lower when Congressmen's ideologies are in the middle.

The biggest exception is former Sen. Wicker (R-CT). He was a Republican, but voted with the Democrats more often (according to our measure of ideology). Poole and Rosenthal's DW-Nominate scores also show a similar result. It is appropriate to conclude that his ideology is closer to the Democrat although his party affiliation is Republican. In the recent Presidential election, he even chose to support a Democrat candidate, Dean, instead of the Republican candidate, Bush. This exception simply shows the power of our ideology measure.

2.4.2 Accuracy of Prediction on Congressmen's Voting Results

The estimation method we use, MLE, cannot guarantee the highest accuracy of prediction. However, accuracy is still one way of judging the effectiveness of our ideology measure. We provide two indices of accuracy of prediction: the percentages of correct prediction on Congressmen's voting (PCT) and the proportional reductions in error (PRE). PRE is defined as

$$1 - \frac{\text{total errors}}{\text{total number of votes on minority side}}.$$

Types of Roll Call	total		close		lopsided	
Congress	PCT	PRE	PCT	PRE	PCT	PRE
80	0.833	0.504	0.837	0.643	0.829	0.330
81	0.793	0.426	0.776	0.524	0.805	0.315
82	0.806	0.449	0.796	0.557	0.814	0.318
83	0.812	0.454	0.821	0.626	0.807	0.280
84	0.789	0.389	0.801	0.570	0.778	0.110
85	0.784	0.358	0.780	0.521	0.787	0.216
86	0.785	0.328	0.732	0.419	0.812	0.241
87	0.813	0.438	0.800	0.565	0.819	0.321
88	0.772	0.276	0.724	0.388	0.792	0.193
89	0.805	0.402	0.817	0.603	0.800	0.231
90	0.778	0.267	0.729	0.405	0.801	0.147
91	0.788	0.343	0.767	0.491	0.800	0.176
92	0.788	0.350	0.766	0.484	0.802	0.196
93	0.809	0.371	0.761	0.470	0.830	0.290
94	0.821	0.412	0.788	0.526	0.836	0.320
95	0.807	0.379	0.761	0.473	0.826	0.308
96	0.789	0.335	0.738	0.420	0.817	0.246
97	0.812	0.408	0.791	0.540	0.825	0.253
98	0.804	0.357	0.774	0.506	0.818	0.217
99	0.810	0.410	0.790	0.540	0.823	0.253
100	0.840	0.455	0.820	0.605	0.848	0.323
Avg.	0.802	0.386	0.780	0.518	0.813	0.252

Types of Roll Calls:
total: all roll calls;
close: roll calls in which the majority is less than 60%;
lopsided: roll calls in which the majority is greater than 60%.

Indicators of Accuracy:
PCT: The percentage of accurate prediction of voting results;
$\text{PRE} = 1 - \frac{\text{total errors}}{\text{total number of votes on minority side}}$.

Table 2.1. Accuracy of Prediction (the 80th-100th Senates)

Tables 2.1 summarizes these two indices of the Senate respectively[4]. The first column shows the terms of Congress. Roll calls can be categorized as "close" and "lopsided". Close roll calls are those in which the majority is less than 60%; the majority in lopsided roll calls is between 60% and 97.5%. Columns 2 and 3 show PCT and PRE of all roll calls. Columns 4 and 5 show estimation results of close roll calls and Columns 6 and 7 show estimation results of lopsided roll calls.

Overall, PCTs are close to or higher than 80% even in close roll calls. Indeed, the accurate rate of prediction is as high as or higher than Heckman and Snyder (17) one-factor model and the results of regressions on party affiliation and region, but lower than their 6-factor model. Statistically, adding more factors to explain Congressmen's voting must be able to improve the prediction. However, Heckman and Snyder (17) could not name those extra factors are and they did not explain what they could be. Those extra factors are meaningless in the social science study. Similarly, Rosenthal and Poole also didn't provide explanations for their second dimension. Our measure of ideology should not be blamed for lower PCTs caused by 'failure' to provide meaningless extra factors or dimensions.

The average PREs of all roll calls is around .44. That is, compared to the naive guess that everyone votes for the majority, our measures can improve the accurateness of prediction by 44%. However, PREs are much lower in lopsided roll calls. There are strong majorities in those roll calls, so the naive guess cannot be too ridiculous. Therefore, our measures cannot greatly improve the prediction in lopsided roll calls.

[4]We have similar estimation results of the House.

It is also interesting that PCTs and PERs of close roll calls are higher than those of lopsided roll calls in some terms of Congress, such as the 88th Congress. Our guess is that party leaders exert more pressures in close roll calls and party discipline was strong in some terms of Congress. We can see all Republicans and all Democrats voted for opposite results in some roll calls. In such roll calls, it is easier to predict Congressmen's voting by party affiliation, even when voting results were close.

2.4.3 Comparison among Different Measures

Our measure of ideology is definitely not the first of its kind. In the empirical studies of Congress, the two most popular measures are Poole and Rosenthal's DW-Nominate Score and the Heckman-Snyder Score. These two measures of ideologies are known to be highly correlated (Heckman and Snyder (17)). It would be undesirable to see our measure report totally different ideologies. We calculate the correlation coefficients among our measures of Congressmen's ideologies, DW-Nominate Scores, and the Heckman-Snyder Scores. DW-Nominate Scores used here are downloaded directly from Keith Poole's web site and Heckman-Snyder Scores are calculated with the MATLAB program provided by James Snyder. The average of correlation coefficients is over 0.90 on average. In empirical studies, any of three indices could be used as the measure of Congressmen's ideologies. The only exception is the 88th Senate. The correlation coefficients between our measure of ideology and the Heckman-Snyder Score is as low as 0.58. This is a special historical case. Some southern Democratic Senators changed their minds dramatically before and after President Kennedy's death. In Appendix B, we rank Senators in the 88th Senate by their ideologies as shown in voting records

before and after President Kennedy's death. Before Kennedy's death, most southern Democratic senators, such as Hill(D-AL), Fulbright(D-AR), and *etc.*, were more inclined toward Republican ideology than they were after the President's death. It is very likely that the civil rights bills proposed by President Kennedy annoyed them initially, but they changed their minds later. In fact, the Congress in 1963 only approved 27% of the President's requests, although the Democrat held majorities in both chambers. After President Johnson took over the presidency, the Democrats united again. We can see again that Democrats stand on the left and Republicans stand on the right. In contrast to the low percentage of approval under Kennedy, the Congress in 1964 granted 58% of President Johnson's requests.

We may conclude that the low correlation coefficient in the 88th Senate came from the changes in the Democrats. Our measure of ideology is party-affiliation oriented. If either party changes its position dramatically during one term of Congress, our measure of ideology may report different results compared to others.

2.5 Estimated Results of Ideological Ambiguities

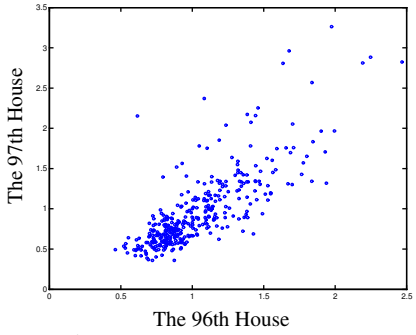
The most important contributions of this paper are not only the introduction of another way to measure Congressmen's ideologies, but also the presentation of a new means of measuring Congressmen's ideological ambiguities. Most Congressmen keep standing on the right or on the left across time. For example, Sen. Edward Kennedy (D-MA) is always recognized as a hard-line Democrat and no one will doubt it. Like ideology, ideological ambiguity is also an important characteristic of Congressmen's voting behaviors. First, we show that Congressmen's ideological ambiguities are not changed

often. Second, Congressmen do not choose their ideological ambiguities arbitrarily. Instead, it is most likely that Congressmen choose their ideological ambiguities to maximize campaign contributions.

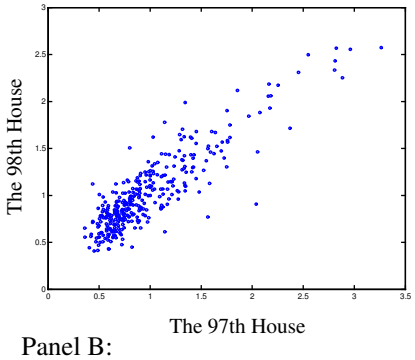
2.5.1 Consistent Ideological Ambiguity across Time

We are the first to provide a measure of ideological ambiguity. It would be controversial to assert that ideological ambiguity is also a characteristic of Congressmen's voting behavior. Some political scientists disagree with the claim that Congressmen's ideologies will vary with every roll call. However, comparison of ideological ambiguity across different terms of Congress will show that Congressmen keep consistent levels of ideological ambiguity, too. Ideological ambiguity should be as important a characteristic of Congressmen's voting behaviors as ideology is.

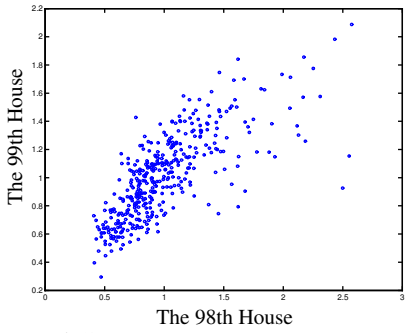
To show the consistency of ideological ambiguity, we may compare Congressmen's ideological ambiguities in one term of Congress and the following one. The correlation of a Congressman's ideological ambiguity in two sequential terms of Congress would confirm the persistency of a Congressman's ideological ambiguity. In Figure 2.5, we provide four sets of comparisons of ideological ambiguities between two sequential terms of Congress: the 96th House vs. the 97th House, the 97th House vs. the 98th House, the 98th House vs. the 99th House, and the 99th House vs. the 100th House. In Panel A, Figure 2.5, the x-axis is Congressmen's ideological ambiguities in the 96th House, the y-axis is Congressmen's ideological ambiguities in the 97th House, and the sample points include those Congressmen who served both in the 96th House and in the 97th House. The scatter diagram shows that a Congressman with a high ideological ambiguity in the



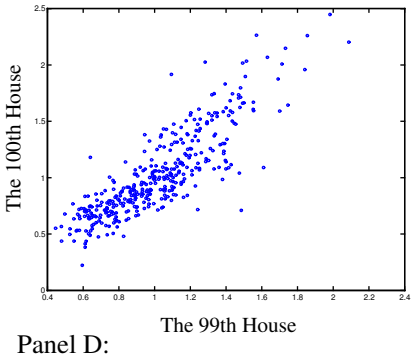
Panel A:
The 96th House vs. The 97th House



Panel B:
The 97th House vs. The 98th House



Panel C:
The 98th House v.s. The 99th House



Panel D:
The 99th House v.s. The 100th House

Comparing a Congressman's ideological ambiguity measured in sequential terms of Congress, we may conclude that Congressmen's ideological ambiguities will not be changed dramatically in a short while

Fig. 2.5. Comparison of Ideological Ambiguity across Time

97th House tends to have a high ideological ambiguity in the 98th House. Panel B, Panel C, and Panel D, Figure 2.5 also illustrate the same results.

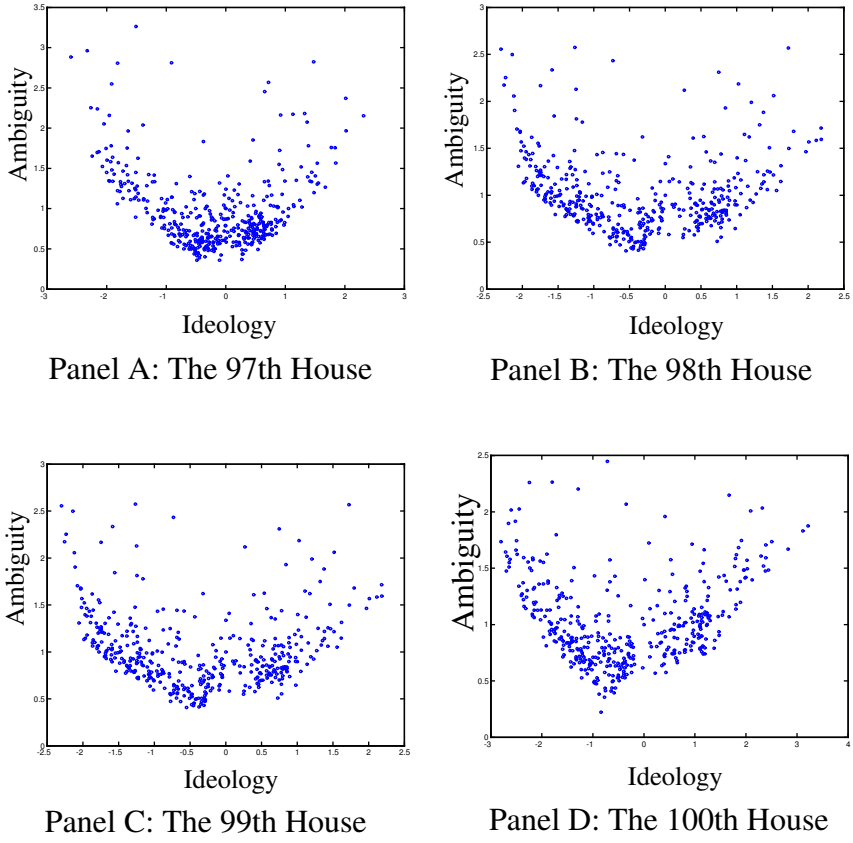
The high correlation represents the persistency of ideological ambiguity. That is, a Congressman does not change his level of ideological ambiguity often. Ideological ambiguity can be considered one important characteristic of Congressmen's voting behaviors.

2.5.2 Ideologies vs. Ideological Ambiguities

Wang (35) claimed that a Congressman with a biased ideology will choose a higher level of ideological ambiguity in an effort to maximize influence-motivated campaign contributions[5]. A biased Congressman can act ambiguously to convince lobby groups in the opposite end that he still can be bought and thus he can receive more campaign contributions from lobby groups on both sides. Otherwise, the Congressman will be considered intransigent and will receive few influence-motivated campaign contributions.

To test the hypothesis in Wang (35), we can draw ideology-ideological ambiguity scatter diagrams to explore the relation between ideology and ideological ambiguity. Figure 2.6 illustrates the the ideology-ideological ambiguity scatter diagrams from the 97th House to the 100th House. In each panel, the y-axis represents ideological ambiguity and the x-axis represents ideology. All four panels in Figure 2.6 confirm that a biased Congressmen tends to have a higher level of ideological ambiguity. However, Wang (35) also predicted that an unbiased Congressman will choose zero ideological ambiguity. But

[5]Campaign contributions can be categorized as influence-motivated and election-motivated by their purposes (Wang (34)).



All panels show that a Congressman whose ideology is extremely biased to the left or the right tends to have a higher ideological ambiguity

Fig. 2.6. Comparison of Ideology and Ideological Ambiguity

the four panels of Figure 2.6, and the data of the 100th Senate in Appendix A, show that no Congressman chose zero ideological ambiguity. Recall that the ideological ambiguity we measure is a relative ambiguity. Therefore, we may still conclude that a Congressman does not choose ideological ambiguity arbitrarily but chooses an optimal level of ideological ambiguity to maximize their influence-motivated campaign contributions.

2.6 Remarks and Conclusions

Our measure of ideology can show how much a Congressman acts like a pure Republican or a pure Democrat. Our one-dimensional model uses party affiliation as the explanation variable of ideology. Assuming that Democrats take the end of liberality and Republicans take the end of conservativeness, our measure can also map Congressmen's ideologies on the liberal-conservative spectrum. Our measure of ideology reports similar results to those of Poole and Rosenthal's DW-Nominate Score and the Heckman-Snyder Score. Since all three measures are highly related, any one can be the measure of Congressmen's ideology in empirical studies. Our measure also confirms that Congress is polarized and that Democrats and Republicans occupy opposite ends of the spectrum.

In addition to this measure of ideology, the most important contribution of this paper is to provide a measure of ideological ambiguity based on a united framework. Ideological ambiguity is shown to be another important character of Congressmen's voting behaviors. Using our measure of ideological ambiguity researchers, can proceed empirical studies about Congressmen's ideological ambiguity, such as Wang (34). We also

conclude that a biased Congressman tends to have a higher level of ideological ambiguity. This conclusion confirms that Congressmen choose the level of ideological ambiguity that maximizes their influenced-motivated campaign contributions.

Poole and Rosenthal's and Heckman and Snyder's measures can be inferred to the multi-dimensional case. But, we don't fault our measure for lack of meaningless extra dimensions. Different from Poole and Rosenthal's and Heckman and Snyder's methods, we can provide a measure of ideological ambiguity owing to the simplicity of our model. However, our model shares the identification problem with other spatial models. Due to the identification problem, our measure of ideology and ideological ambiguity are relative to the Congressman we pick to normalize. To directly compare Congressmen's ideologies and ideological ambiguities in different terms of Congress, we need to choose the same benchmark across different terms of Congress.

Chapter 3

Campaign Contributions and Ideology

3.1 Introduction

Campaign contributions are well known as a tool of lobby groups seeking influence in the political process. To alleviate the public's concerns about buying political influence, the law requires all records of donations to candidates be made public. Numerous excellent empirical studies have been done to explore the role of campaign contributions in the political process. Most of the literature has focused on whether campaign contributions have significant effects on the political process. The results have been controversial. To answer the above question, we may first ask, what kinds of candidates can receive more campaign contributions? It is an essential questions in the study of campaign contributions. Once we know who receives more campaign contributions, we are in a better position to understand how lobby groups use campaign contributions and whether it works.

Lobby groups often use a simple index, like the American Democratic Action (ADA) scores, to describe how close a politician's policy position or ideology is to their own. But is it true that only a Congressman who is definitely against gun control can receive campaign contributions from the National Rifle Association (NRA)? It is interesting to know how a lobby group allocates its donations to Congressmen. Suppose that a politician's ideology can be mapped on the liberal-conservative spectrum. We

are interested in knowing whether an unbiased politician (whose ideology is nearly in the middle.) or a biased politician (whose ideology is extremely liberal or extremely conservative) can receive more campaign contributions. In fact, NRA has made donations to candidates in both parties. Can this observation be generalized?

Sometimes a politician's location on the ideological spectrum is not clear. While Michael Dukakis was considered a liberal politician, he "sought to protect himself by specifying that he was choosing the liberalism of Kennedy, Truman and Roosevelt[1]." These three presidents' ideologies are ambiguous on the liberal-conservative spectrum. In contrast, some politicians, such as Sen. Ted Kennedy (MA), hold a clear ideology. It is interesting to know how ideological ambiguity affects campaign contributions. Lobby groups, generally risk-averse, tend to dislike ideological ambiguity. However, Wang (35) predicts that some ideological ambiguity might attract campaign contributions from lobby groups of opposing ideology. Until Wang (36), no study addressed measures of politicians' ideological ambiguities. There are no empirical studies focusing on the effects of ideological ambiguity on campaign contributions. Lack of empirical studies makes unclear the exact role of ideological ambiguity in determining campaign contributions.

The final results of a democratic political process are determined by voting. Those indices observed by lobby groups are based in part on voting records. Voting records always attract lobby groups' attention, and their allocation of campaign contributions must be affected by politicians' voting records. Indeed, a Congressman's ideology and his ideological ambiguity can be measured via the whole roll call voting records. We will focus on the relation of campaign contributions and Congressmen's voting records.

[1]Checkered Past of the Liberal Label, *San Francisco Chronicle*, Nov 1 1988.

Two main questions will be addressed. First, do campaign contributions flow to biased or unbiased Congressmen? The answer of the first question will help us to clarify the purpose of campaign contributions. Second, does ideological ambiguity help Congressmen to attract more campaign contributions? Assuming that Congressmen choose levels of ideological ambiguity to maximize their receipts of campaign contributions, the answer of the second question will help us to understand whether Congressmen choose the optimal levels.

Two major purposes of campaign contributions are to affect the legislation process directly and to bring candidates into office for ideological reasons. Following Helpman (18), we call campaign contributions of the first type *influence-motivated* campaign contributions and the second type *election-motivated* campaign contributions. Previous literature, such as Austen-Smith (5), Stratmann (33), Prat (28), and Barron (6), based on these two different assumptions, drew controversial conclusions on the relation between campaign contributions and ideology.

Influence-Motivated campaign contributions can buy accesses to politicians and the direct content of policies. Austen-Smith (5) showed that campaign contributions serve as a signal that lobby groups and the Congressman share similar ideologies. Then, lobby groups can buy the opportunity to gain access to the Congressman. Different from the canonic model, Austen-Smith (5) predicted that campaign contributions flow to those Congressmen who share similar ideologies with lobby groups. Stratmann (33) modeled the vote function as a function of a candidate's policy position and campaign contributions. A candidate maximizes his votes, and lobby groups can use campaign contributions to compensate a candidate's loss in votes if a candidate changes his policy

position in favor of the lobby groups. Using a switching regression model, Stratmann (33) showed that "contributors give the most money to legislators whose constituency interest suggests that they are likely to be undecided on how to vote." That is, campaign contributions should be donated to the swing voters whose ideologies are not far to the right or the left.

Election-motivated campaign contributions are used to increase a candidate's probability of winning an election. Following the strand of 'nondirectly informative advertising'[2], Prat (28) suggests that campaign contributions are only used to help candidates in clarifying their policy positions and getting elected. In Baron (6), campaign contributions provided by lobby groups are assumed to elevate vote counts from uninformed voters. In both Prat (28) and Baron (6), lobby groups donate more to the Congressman whose policy position or ideology more nearly matches their own.

Controversies are not limited to theoretical studies alone. Some empirical studies, such as Welch (37) and Gopoian, Smith, and Smith (15), confirmed the prediction of the election-motive theorem: lobby groups contribute more to the Congressmen whose ideologies are biased toward them. Clearly, those campaign contributions are not used to change the Congressmen's minds. The mismatch between empirical results and the prediction of the canonic access-buying model motivated Austan-Smith (5) to propose a new access-buying model. However, Langbein and Lotwis (21), Durden, Shogren, and Silberman (12), Stratmann (32), and Fleisher (13) clearly illustrated that campaign contributions do have a dramatic influence on Congressional voting.

[2]Stratmann (33) can be categorized in the strand of 'directly informative advertising' by Prat (28).

Most of past empirical studies focused on few narrow issues or on campaign contributions from few political action committees (PACs). Welch (37) dealt only with dairy PACs and voting on dairy price support; Gopoian, Smith, and Smith (15) collected only data on campaign contributions from the five largest donators in the 1982 House election; and Stratmann (33) focused only on the agricultural PACs. To gain a broad picture of campaign contribution allocations, and to understand the relationship between campaign contributions and Congressmen's ideologies more completely, it is worthwhile to conduct an empirical study using data that includes more campaign contributions and more voting records.

As well as the location of Congressmen's ideologies, their ideological ambiguities may also influence campaign contributions. In practice, Congressmen's ideologies may not be the same for all issues. Otherwise, a Congressman's vote in each roll call would be completely predictable[3]. There is always variance of ideology and such variance will affect the willingness of lobby groups to support candidates, as they seek to 'buy' Congressmen or as they help Congressmen to get elected. Both the influence-motive model, discussed in Section 2, and Wang (35), show that some ambiguity in a Congressman's ideology might attract more influence-motivated campaign contributions, even when lobby groups hate such ambiguity *per se*. The election-motive model in Section 2 suggests that ideological ambiguity might deter election-motivated campaign contributions.

In practice, Congressmen can barely choose their ideologies. It is difficult to imagine that a Congressman from a district where labor unions are influential is very

[3]If this unpredictability resulted from missing dimensions of ideology, adding dimensions of ideology would presumptively allow solution to this problem. However, no multi-dimensional measures of ideology can explain voting behavior completely.

conservative. In contrast, Congressmen have more freedom of choosing ideological ambiguities. Congressmen can choose a level of ideological ambiguity to maximize his receipts of campaign contributions. Our key interest is whether Congressmen already choose their optimal ideological ambiguities to maximize their receipts of campaign contributions. If Congressmen already choose their optimal ideological ambiguities, ideological ambiguity should has no more significant marginal effect on campaign contributions. Otherwise, a Congressman can adjust his ideological ambiguity to increase his receipts of campaign contributions. Based on the measure of ideological ambiguity proposed by Wang (36), we will be the first to examine empirically the relationship between ideological ambiguity and campaign contributions.

Section 2 presents two theoretical models to explore how a Congressman's ideology and ideological ambiguity affect influence-motivated and election-motivated campaign contributions; Section 3 presents the sources and the description of data; Section 4 will illustrate regression models used in relating campaign contributions to Congressmen's ideologies and their ideological ambiguities; Section 5 presents the empirical results and discussions; Section 6 presents the conclusion.

3.2 Influence-Motive vs. Election-Motive

Examined here are two separate models illustrating the mechanism of determining two types of campaign contributions. The first one is an influence-motive model, in which two lobby groups compete for one Congressman's vote by giving campaign contributions. The second one is an election-motive model, in which two lobby groups use campaign

contributions to support the Congressmen who favor them. Also included are empirical implications derived from the two models.

3.2.1 An Influence-Motive Model

Consider lobby groups, Group A and Group B, and one Congressman. Group A wants a 'yes' vote, Group B wants a 'no' vote, on a particular issue. The value of winning the Congressman's vote is v_A to Group A and v_B to Group B. For simplicity, assume symmetry: $v_A = v_B = v$. Let t_A denote the contribution given by Group A, and t_B by Group B. This is an all-pay auction model. Lobby groups pay the Congressman no matter whom the Congressman votes for. We also assume an administration cost for the lobby groups. Such lobbying cost is expressed in quadratic terms of the donation size.

The Congressman's instinct value for this particular issue is θ, which is drawn from a distribution function, F. It is assumed that F is a symmetric single-peaked function determined only by the first moment and the second moment. In reality, each Congressman may have a different F function and θ is drawn from F before each roll call. Only each Congressman knows his own θ before voting; lobby groups know F only, not the exact θ. Here lobby groups act neither like informed voters nor like uninformed voters in Baron (1994). Lobby groups have some information of the Congressman's instinct value, but not the exact value. θ stands for a monetary internal latent index for supporting Group A. A higher value of θ means that the Congressman is more likely to

vote in favor of Group A. The Congressman will vote 'yes' if

$$\theta + t_A \geq t_B.$$

Otherwise, the Congressman votes 'no[4].' In this one-period model, the Congressman has no incentives to do strategic voting. A Congressman is *unbiased* if the expected θ (according to F) is 0. The absolute value of θ is proportional to his bias. There is said to be a *high preference uncertainty* or *high ideological ambiguity* if the variance of θ is high. Note that both biased and unbiased Congressmen may have high or low ideological ambiguities, thus there are four kinds in all.

Group A's expected payoff is

$$v \Pr\{\theta \geq t_B - t_A\} - \frac{1}{2}t_A^2 = v(1 - F(t_B - t_A)) - c \cdot \frac{1}{2}t_A^2,$$

and Group B's expected payoff is

$$v \Pr\{\theta \leq t_B - t_A\} - \frac{1}{2}t_B^2 = vF(t_B - t_A) - c \cdot \frac{1}{2}t_B^2.$$

The first order conditions for maximization are[5]:

$$vF'(t_B - t_A) = c \cdot t_A,$$

[4]We assume that the probability of a tie is 0.

[5]We simply assume that internal solutions always exist.

and

$$vF'(t_B - t_A) = c \cdot t_B.$$

Thus, $t_A = t_B = t^*$, and t^* can be found as the solution to

$$vF'(0) = t^*.$$

The first order condition states that the money lobby groups are willing to pay is the product of the value of the Congressman's vote and marginal probability of shifting the cutting point. The result that two opposing lobby groups contribute the same amount to a campaign may be counterintuitive. Recall that this is simply one type of campaign contributions based on a simple assumption, $v_A = v_B$. However, even if v_A and v_B are different, Wang (35) shows the above empirical results are still sustained in the setting of a menu-auction game.

From the first order conditions we conclude that when $F'(0)$ is greater, contributions are greater (see Figure 3.1). Therefore, the contributions are maximized for the Congressmen 'in the middle,' with expected value of θ close to 0 under the assumptions of F. Then we can draw two conclusions:

RESULT 3.1. *Given a Congressman's ideological ambiguity, the greater his bias is, the lower the contributions are.*

RESULT 3.2. *The more important the Congressman's vote is to the lobby groups (i.e. the greater v is), the greater are contributions. Note that this result is not completely trivial.*

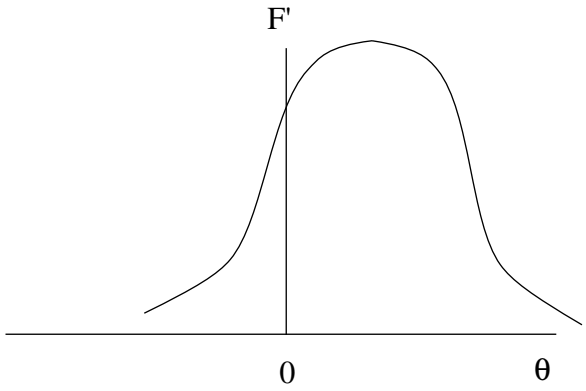


Fig. 3.1. Optimal Lobbying

It says that the more likely it is that this Congressman's vote is pivotal *in Congress, the more money he gets.*

What are the effects of ideological ambiguity? First, consider a biased Congressman- say to the left. The bell-shaped distribution has a peak (expected value of θ) to the far left. Clearly, keeping the bias (the peak) constant, greater variance might induce a greater $F'(0)$, and thus greater contributions[6]. In contrast, consider a biased Congressman (one whose expected θ is 0). The bell-shaped distribution will peak at 0. Clearly, keeping the peak constant at 0, greater variance must lead to smaller $F'(0)$, and hence smaller contributions. This yields:

[6]This conclusion does not mean that the amount of campaign contributions must be non-decreasing in the level of ambiguity all the way. It merely implies that the amount of campaign contributions must be increasing in the level of ambiguity within some range.

RESULT 3.3. *A biased Congressman may benefit from high ideological ambiguity*[7]. *An unbiased Congressmen must benefit from low ideological ambiguity.*

Note that a high variance in *voting records* is not the same as high preference uncertainty or high ideological ambiguity. An unbiased Congressman will be equally likely to vote 'yes' or 'no' on issues whose positions are close to zero, regardless of ideological ambiguity, so there will be high variance in his voting records. On the other hand, a biased Congressman will show more variance in voting records only when ideological ambiguity is higher. The voting behavior of an unbiased Congressman with low ideological ambiguity is highly predictable. There is no use in giving him money.

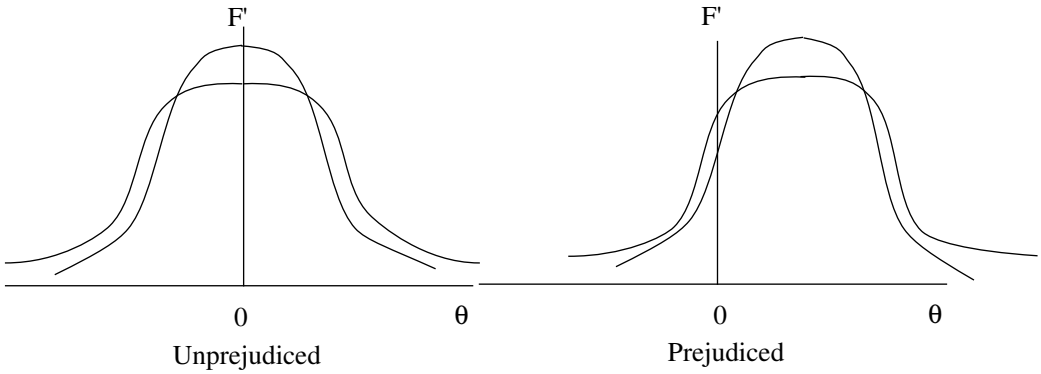


Fig. 3.2. Effect of Voting Ambiguity

[7] *Suppose that $F(\cdot)$ is Normal distribution. Congressman can be benefited by biased ideology only when the distance between the expected ideology and zero is more than one variance.*

3.2.2 An Election-Motive Model

As in the previous model, we have two lobby groups, Group A and Group B, and one Congressman with an instinct value, θ, drawn from a distribution F. Only the F function is known to the two groups. Recall that a higher θ means the Congressman favors Group A more. The values of the Congressman to two lobby groups, v_A and v_B, are contingent on θ. It is also assumed that lobby groups are not allowed to contribute a negative amount. Then, $v_A(\theta)$ is increasing in θ if $\theta > 0$ and $v_A(\theta) = 0$ if $\theta \leq 0$. Similarly, $v_B(\theta)$ is decreasing in θ if $\theta < 0$ and $v_B(\theta) = 0$ if $\theta \geq 0$. Again, a quadratic form of cost functions is assumed. Group i's pay-off is simply

$$\int v_i(\theta)dF(\theta) \cdot G(t_A + t_B) - \frac{1}{2} \cdot t_i^2, i = A, B,$$

where $G(\cdot)$ is the Congressman's probability of winning an election, which is increasing in the total receipts of campaign contributions. When the election is competitive, G' is high. For those elections in which the winner and the loser can be easily predicted, G' will be very low. A logistic function can approximate G well. Then the first order condition is

$$\int v_i(\theta)dF(\theta) \cdot G' = t_i. \tag{3.1}$$

For Group A, v_A is increasing in θ if $\theta > 0$. In addition, t_A should be increasing in G'. Then Group A will support those candidates whose θ is positive and high and who are in competitive elections. Conversely, v_B is decreasing in θ. Then t_B should be decreasing

in θ if $\theta < 0$ and increasing in G'; that is, Group B will support those candidates whose θ is negative and low and who are in a competitive election. Then we can conclude:

RESULT 3.4. *Congressmen biased extremely to the right or the left get more election-motivated campaign contributions.*

Ideological ambiguity will affect election-motivated campaign contributions if $v_i(\cdot)$ is not linear. The direction of effect depends on the concavity or convexity of $v_i(\cdot)$. It is assumed that v_i is concave. Namely, lobby groups are risk-averse and they don't want to support a candidate they are not familiar with to enter into Congress. Under this assumption, ideological ambiguity will deter the election-motivated campaign contributions .

RESULT 3.5. *High ideological ambiguity will deter the election-motivated campaign contributions.*

This model also predicts that a candidate in a close election will receive more campaign contributions. However, we will not focus on all factors of elections in this paper.

3.2.3 Summary

Influence-Motivated campaign contributions given to Congressmen whose votes can be predicted easily are useless. Therefore, a biased Congressmen with low ideological ambiguity will not receive enormous influenced-motivated campaign contributions. Influenced-Motivated campaign contributions should be given to unbiased Congressmen,

and some ideological ambiguity might be helpful to biased Congressmen in attracting campaign contributions.

Lobby groups hope for more Congressmen who share their ideologies to win elections in order for their favored bills to be passed into laws. Therefore, the right-wing lobby groups support the right-wing candidates and the left-wing lobby groups support the left-wing candidates in elections. Election-Motivated campaign contributions will be donated to biased Congressmen. Assuming that lobby groups are risk-averse, ideological ambiguity will deter election-motivated campaign contributions.

Ideological ambiguities have positive and negative influences on campaign contributions. If a Congressman is allowed to choose his ideological ambiguities to maximize his receipt of campaign contribution, he will choose a optimal level to balance two types of influences; that is, an optimal level of ideological ambiguity will have zero marginal effect on campaign contributions. Otherwise, Congressmen can adjust their ideological ambiguities to increase their receipts of campaign contributions.

3.3 Data

The legislative chamber studied in this paper is the House of Representatives. There are several reasons for choosing the House rather than the Senate: There are more members in the House and Representatives running in elections every two years. Thus, more sample points can be obtained. The whole data set is composed of three parts: (i) campaign contributions; (ii) voting records, (iii) Congressmen's activities in Congress. Details of each part will be provided later.

Recall Equation 3.2. Campaign contributions are determined by ideologies and ideological ambiguities shown in the previous voting records. We link data of campaign contributions in the period t to the voting records in the period $t-1$. For example, the voting records in the 105th House (1997-1999) will be used to explain the campaign contributions made in the 1999-2000 election cycle. However, the data of Congressmen's activities in Congress used in explaining campaign contributions between 1999 and 2000 are reflected in data for the 106th House (1999-2001). Due to the way of linking different data, Congressmen analyzed in this paper are only those incumbents who ran in general elections for the next term.

Most of the past empirical literature simply linked the data of campaign contributions with the contemporary voting records. That might create the problem of endogenicity. Since the contemporary voting records might be affected by campaign contributions, using the contemporary voting records will cause bias in estimation.

3.3.1 Descriptions of Data

Table 3.1 contains the descriptive statistics of the three data sets. Each data set includes a single election cycle. Data Set I links campaign contributions made in 1999-2000, the voting records in the 105th House, and Congressmen's activities in the 106th House; Data Set II links campaign contributions made in 1997-1998, voting records in the 104th House, and Congressmen's activities in the 105th House; Data Set III links campaign contributions made in 1995-1996, voting records in the 103rd House, and Congressmen's activities in the 104th House. Since data sets only include incumbent Congressmen who ran general elections to seek another term in Congress, the number of

Data Set	I		II		III	
	Mean	Std.	Mean	Std.	Mean	Std.
Total Contributions (in Thousands)	325.608	193.590	271.165	169.235	264.065	174.423
Square of Ideology	1.584	1.105	1.957	1.424	2.026	1.669
Ideology	.182	1.247	.246	1.379	-.100	1.422
Ideological Ambiguity	1.017	.295	1.022	.314	1.037	.309
Seniority	5.595	3.602	5.537	3.626	5.668	3.830
Floor Leadership	.020	.141	.016	.126	.025	.156
Subcommittee Leadership	.483	.500	.495	.501	.502	.501
Committee Leadership	.115	.328	.107	.309	.106	.308
Seniority in Committee of Appropriation	.773	2.337	.735	2.296	.820	2.611
Seniority in Committee of Commerce	.540	1.974	.540	1.981	.498	1.934
Seniority in Committee of Rule	.170	1.153	.155	1.082	.145	1.019
Seniority in Committee of Ways and Means	.489	1.773	.456	1.775	.420	1.677
Observations		348		309		283

Table 3.1. Descriptive Statistics of Data Sets

observations in each data set is less than the total number of the Representatives. Data Set I includes 348 Congressmen; Data Set II includes 309 Congressmen; and Data Set III includes 283 Congressmen.

Only campaign contributions from the PACs associated with corporations, labor unions, trade associations/membership organizations/organiztions in the health field, and cooperatives are included. A higher measure of index means that the Congressman voted more like a Republican. All seniority variables are the number of terms a Congressman has served in the House or in a committee. Floor Leadership is a dummy variable: 1 if the Congressman is the speaker, a floor leader, a party whip, the chair of Democratic Caucus, or the chair of Republican Conference; 0, otherwise. Committee Leadership and Subcommittee Leadership are dummy variables: 1 if the Congressman is the chair, the vice chair, or the ranking member in a subcommittee; 0, otherwise.

3.3.2 Campaign Contributions

Data of campaign contributions can be obtained from Federal Election Committee (FEC). The latest election cycle FEC provides is for 1999-2000. Three recent election cycles are included in this paper. Our concern here is that how lobby groups determine campaign contributions while they are seeking influence in the political process. Therefore, We are concerned only with campaign contributions made by certain types of PACs. Snyder (1990) measured investor contributions by the sum of campaign contributions made by only four types of PACs (corporations, labor unions, T/M/H groups, and cooperatives) and claimed non-connected lobby groups and lobby groups associated to cooperatives without stocks are more ideology-consuming. We also consider the

sum of campaign contributions made by the above four types of PACs, whose campaign contributions are considered a tool of investment.

3.3.3 Estimating Ideology and Its Ambiguity via Voting Records

Voting records are used to evaluate a Congressman's ideology and ideological ambiguity. The records used here are provided by Dr. Poole.

In this paper estimation of a Congressman's ideology and ideological ambiguity is completely based on voting records. Wang (36), discussed briefly below, is the first paper providing estimates of ideological ambiguity. Poole and Rosenthal (27) and Heckman and Snyder (17) provided two excellent ways of measuring Congressmen's ideologies via voting records. The measures they proposed are most popular in empirical studies about Congressmen's ideologies. However, it is difficult to expand their framework to measure Congressmen's ideological ambiguities.

Wang (36) method of estimating a Congressman's ideology and ideological ambiguity is based on a uni-dimensional spatial model. Assuming that Republicans and Democrats tend to support different results in roll calls (except for unanimous votes), that the Republican is a right-wing party, and that the Democratic is a left-wing party, each Congressman can be seen as supporting the right wing or the left wing in each roll call. Before roll call j, Congressman i's policy position, $\theta_{i,j}$ is drawn from a normal distribution, $N(\beta_i, \sigma_i^2)$. Let p_j denote the policy position of roll call j. Congressman i votes for the right wing in roll call j if $\theta_{i,j} + p_j \geq 0$ and votes for the left wing otherwise. The probability that Congressman i votes for the right wing in roll call j is $F(\frac{\beta_i + p_j}{\sigma_i})$, where $F(\cdot)$ is the standard normal distribution. By using MLE Congressmen's ideology,

β, and Congressmen's ideological ambiguity, σ^2, can be estimated. In fact, the estimated Congressmen's ideologies by Wang (36)'s method are highly correlated to the results of the other two methods [8]. However, Wang (36)'s method can provide a measure of a Congressman's ideological ambiguity.

Recall that this model has the problem of identification, like other spatial models. To overcome this problem, one arbitrary Congressman's ideology and ideological ambiguity were set to 0 and 1 respectively in each term of Congress. Therefore, Wang (36)'s index cannot be compared across different terms of Congress.

3.3.4 Congressmen's Activities

Congressmen's activities, including committee assignments, floor leadership, and chairmanship, can be found in the Library of Congress or the web site of the House of Representatives. The data of committee assignments in the 105th House and the 104th House, used here, were downloaded from Dr. Charles Stewart III's web site.

Only seniority, the number of terms a Congressman had served, in the following four committees is included in the data of committee assignments: Committee of Appropriations, Committee of Energy and Commerce (Commerce), Committee of Rule, and Committee of Ways and Means. Ansolabehere, Snyder, and Tripathy (2) classified those four committees as "powerful" committees since they have "power in board substantive areas or institutional power in the procedural matters." Since lobby groups are assumed

[8] The correlation coefficients among the ideologies estimated by these three methods are more than 0.90 on average.

to seek political influence, the members of these four committees should be 'targets' for most lobby groups.

Floor leaders include the speaker, two floor leaders, two party whips, the chair of Democratic Caucus, and the chair of Republican Conference. Those positions control two parties' activities in the House and the whole chamber. We also include chairs, vice chairs, and ranking members in each committee and each subcommittee in the data set.

3.4 Regression Models

It is assumed that lobby groups decide the allocation of campaign contributions according to past voting records and other determinants including seniority, floor leadership, chairmanship, and committee assignments. The amount of campaign contributions a Congressman receives should be a function of these factors. We emphasize the ideology and the ideological ambiguity. The function of campaign contributions is

$$C_{i,t} = g_t(I_{i,t-1}, AMB_{i,t-1}, X_t) + \epsilon_t,$$

where $C_{i,t}$ is the amount of campaign contributions received by Congressman i in the period t; $I_{i,t-1}$ is Congressman i's ideology shown in the voting records in the period $t-1$; $AMB_{i,t-1}$ is Congressman i's ideological ambiguity shown in the voting records in the period $t-1$; X_t: other determinants of campaign contributions; ϵ_t is the error term.

The empirical implications from theoretical models suggest that the curve of campaign contributions against ideology could be U-shaped or inverse U-shaped. An U-shaped curve suggests that more campaign contributions are given to biased Congressmen. On the other hand, an inverse U-shaped curve suggests that more campaign

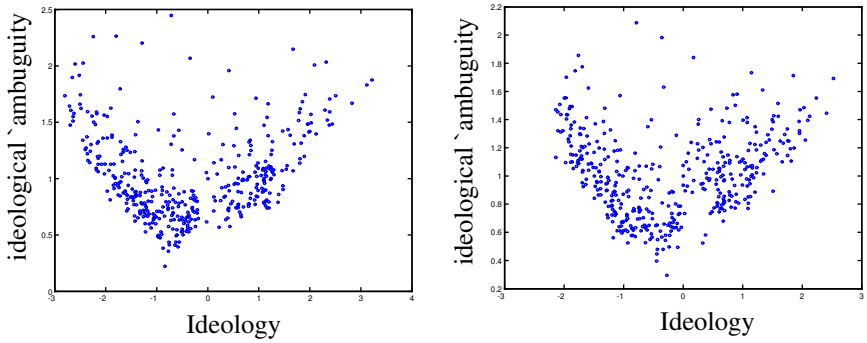
contributions are given to unbiased Congressmen. Therefore, we can consider a quadratic form of $g_t(\cdot)$[9]:

$$C_{i,t} = \beta_0 + \beta_1 I_{i,t-1}^2 + \beta_2 I_{i,t-1} + \beta_3 AMB_{i,t-1} + \beta_4 X_t + \epsilon_t \tag{3.2}$$

The sign of β_1 will determine the shape of the curve and β_3 will illustrate the marginal effect of ideological ambiguity on campaign contributions given the location of a Congressman's ideology.

Recall the discussion in Section 2. When Congressmen choose optimal ideological ambiguities, ideological ambiguity has no marginal effect on campaign contributions. Wang (35) showed that the optimal level of ideological ambiguity is increasing in the bias of ideology in most cases. Figure 3.3 illustrates the scatter plots of ideology and ideological ambiguity using the data of the 99th House and the 100th House. The x-axis is ideology and the y-axis is ideological ambiguity. Each panel in Figure 3.3 illustrates that a biased Congressman tend to have a higher ideological ambiguity empirically. Clearly, Congressmen did not choose their ideological ambiguities randomly. Hence, it is reasonable to set the null hypothesis as Congressmen have chosen their optimal ideological ambiguities and ideological ambiguities has no marginal effects on campaign contributions. To test this hypothesis, in Equation 3.2, the relation between campaign contributions and ideological ambiguities is assumed to be linear. If the marginal effect of ideological ambiguity on campaign contributions, β_3, is not significantly different

[9]In addition, using the Box-Cox regression model cannot deny the null hypothesis that the power of the index of ideology is two.



A Congressman whose ideology is extremely biased to the left or the right tends to have a higher ideological ambiguity

Fig. 3.3. Ideological Ambiguity vs. Ideology

from zero, the empirical result will suggest that Congressmen have chosen their optimal ideological ambiguities.

3.5 Empirical Results and Discussions

3.5.1 Empirical Results

Table 3.2 reports the regression results estimated by the method of Ordinary Least Squares (OLS). In each cell, we give the estimated coefficients and standard deviations. Standard deviations are reported in the parentheses. $**$ and $*$ mean 5% and 10% statistical significance respectively. Regression results are similar in three different data sets; that is, similar determinants and determining process of campaign contributions were at work in different election cycles. In the following subsection, we will discuss what the empirical results suggest.

In past literature, such as Chappell (8), the Tobit model was often used to estimate campaign contribution because past literature only focused on narrow issues and campaign contributions made by few lobby groups. Many congressmen who did not receive campaign contributions from the lobby groups included in the studies. The Tobit model was suitable to the above case. However, there are very few or no zero entries in our data on campaign contributions. The OLS method will suffice for our empirical study.

3.5.2 Discussions

We focus on the relation of campaign contributions to ideology, and the relation of campaign contributions to ideological ambiguity in this paper. We also provide the

Data Set	I	II	III
constant	406.316 (36.284)**	295.452 (32.823)**	296.772 (30.803)**
Square of Ideology	−34.339 (10.141)**	−26.431 (7.401)**	−20.655 (6.014)**
Ideology	12.395 (7.710)	6.575 (6.394)	3.544 (5.938)
Ideological Ambiguity	−41.735 (37.677)	7.238 (32.976)	−32.707 (32.328)
Seniority	−2.122 (3.830)	−3.005 (3.748)	1.832 (3.177)
Floor Leadership	559.270 (67.623)**	521.444 (69.537)**	639.733 (52.798)**
Subcommittee Leadership	−43.494 (19.299)**	−8.959 (18.888)	−20.294 (17.756)
Committee Leadership	72.827 (35.066)**	89.832 (37.352)**	39.071 (32.991)
Seniority in Committee of Appropriation	2.592 (4.234)	.740 (4.150)	2.590 (3.520)
Seniority in Committee of Commerce	17.230 (4.912)**	18.702 (4.636)**	21.555 (4.379)**
Seniority in Committee of Rule	−1.457 (8.057)	18.122 (5.255)**	23.315 (7.998)**
Seniority in Committee of Ways and Means	32.973 (5.566)**	18.122 (5.255)**	16.665 (5.068)**
R^2	.28	.24	.43

Dependant Variable: Total Contributions

Table 3.2. The OLS Results

relation of campaign contributions to Congressmen's other activities, beyond voting, in Congress.

3.5.2.1 Campaign Contributions vs. Ideology

Whether the curve of campaign contributions against Congressmen's ideologies is U-shaped or inverse U-shaped depends on the dominance of influence-motivated campaign contributions or election-motivated campaign contributions. In practice, two types of campaign contributions are mixed together and it is difficult to separate them. But Helpman (18) claimed that the influence-motivated campaign contributions are more prominent empirically. He cited four conclusions from Magleby and Nelson (24):

1. PACs give more to incumbents;
2. Incumbents receive more generally;
3. Over 60% of contributions are made early in an election cycle;
4. PACs switch contributions to the winner even if they initially supported the loser.

However, the above claims may not be as rigorous as appear. First, there is no reason to conclude that incumbents' receipts of campaign contributions must be influence-motivated simply because they are more likely to return to Congress. Since lobby groups might be unacquainted with challengers, prudence dictates that their election-motivated campaign contributions are given to incumbents. The fact supporting this idea is that the challengers who had previously served in Congress receive much more than first-time challengers. Second, Magleby and Nelson (24) also point out around 40% of campaign

expenditure is spent in the early part of election cycle. Therefore, it is inappropriate to conclude that early contributions are solely influence-motivated. Third, election-motivated campaign contributions might also withdrawn from losers if they appear to have no chance at all.

However, this paper can provide a more solid empirical backup of Helpman (18) claim. The coefficients of Square of Ideology in Table 3.2 are all significantly negative, that is, the curve of campaign contributions against Congressmen's ideologies has an inverse U-shaped shape. The coefficients of Ideology are not significant and the peaks of the curves are all close to zero[10]. The empirical results strongly suggest that unbiased Congressmen will receive more campaign contributions. This result is coincident with the prediction of the influence-motive model.

Past literature used the median voter theorem to explain why the Republican and the Democratic policy positions become closer and more moderate due to competition in elections. This paper provides an alternative explanation for the two parties becoming more alike. An unbiased politician can attract more campaign contributions and thus he can enhance his winning probability in elections. Politicians should choose an ideology as moderate as possible if possible. Then, the two parties' policy positions become closer.

3.5.2.2 Campaign Contributions vs. Ideological Ambiguity

Another focus in this paper is to investigate whether or not Congressmen have already chosen their optimal ambiguities. All coefficients of Ideological Ambiguity tend to be negative, but none is statistically significant. That is, conditional on the location

[10]The peaks of the inverse U-shaped curve are -0.180, -0.124, and -0.086.

of a Congressman's ideology, ideological ambiguity has no significant marginal influence on campaign contributions. We cannot reject the null hypothesis that Congressmen have already chosen their optimal ambiguities.

The reason for this insignificance is the self-canceling of two opposite effects. Assuming lobby groups are risk-averse, they will tend to support a less ambiguous Congressman. However, even if a Congressman's ideology is on the opposite side, lobby groups might use campaign contributions to buy his vote as long as his ideological ambiguity is within a suitable range.

As mentioned earlier, the two types of campaign contributions are mixed. We can only conduct an empirical study on the sum of two types of campaign contributions. If we can separate two different campaign contributions, we test the relation between each type of campaign contributions and ideological ambiguity. We might have stronger evidences to prove our theories.

3.5.2.3 Campaign Contributions vs. Other Activities

Floor leaders are very powerful and influential in the legislative process. Our empirical results confirms that floor leaders receive more campaign contributions than their colleagues. It is also true for leaders in each committee. The empirical results simply reconfirm the existence of the influence-motivated campaign contributions.

However, our empirical results also show that leadership in subcommittees and seniority only have slight influence on campaign contributions. In Data Set I, the empirical results even show that leaders in subcommittees tend to receive less in campaign contributions. The results seem counter-intuitive, but two things must be kept in mind: first,

not all subcommittees are important in the legislative progress; second, most leaders in subcommittees are senior, and a senior Congressman usually has a higher probability of winning elections. They might not be able to receive a huge amount of election-motivated campaign contributions. We didn't assign variables to describe the closeness of elections into regressors because of the potential problem of endogenecity, since election results are affected by campaign contributions. Therefore, the coefficients of Seniority and Subcommittee Leadership might not be able to reflect the real effect of seniority and leadership in subcommittees, especially when these two variables are highly correlated to the closeness of elections.

We also investigate whether or not the committee assignments have influence on campaign contributions. However, not all committees are powerful and not all members in the same committee share the same influence. Following Ansolabehere, Snyder, and Tripathy (2), our data sets include Committee of Appropriations, Committee of Energy and Commerce (Commerce), Committee of Rule, and Committee of Ways and Means; and we use seniority, instead of membership, in the committees to explain campaign contributions. It is interesting to find that Committee of Appropriation may not be as powerful as Ansolabehere, Snyder, and Tripathy (2) thought. One possibility is that too many Representatives are assigned to the committee. However, our empirical results confirm that senior members in the other three committees tend to receive more campaign contributions.

3.6 Conclusion

While reviewing theories on campaign contributions, introduced here are two models that address the role ideological ambiguity in a lobbying game and in an election-motive model. Following the predictions of two types of theories on campaign contributions, we investigate the relation of campaign contributions to Congressmen's ideologies and ideological ambiguities. Empirical results illustrate that unbiased Congressmen will receive more campaign contributions. This result suggests that the influence-motivated campaign contributions are more prominent, as Helpman (18) claimed, and provides another explanation for the two parties's converging policy positions.

We also showed that Congressmen have chosen their optimal ideological ambiguities to maximize their receipts of campaign contributions. However, we cannot show the roles of ideological ambiguity in determining different types of campaign contributions unless we can separate two types of campaign contributions. Ansolabehere, Snyder, and Tripathy (2) provided a good start. They used new data of lobbying expenditure to classify PACs into two categories: high demand and low demand. High demand PACs buy votes or accesses to Congressmen, and low demand PACs help sympathetic candidates to win elections. Though Ansolabehere, Snyder, and Tripathy (2) also investigated how campaign contributions under different purposes are determined, our aim is different from theirs. We focus on the role of Congressmen's ideologies and ideological ambiguities, but they seldom mentioned a Congressman's ideology in determining campaign contributions. Although it is difficult to say that all campaign contributions made by a high demand PAC are influence-motivated and vice versa, we can still tentatively classify

campaign contributions by different types of PACs and conduct similar empirical studies again, perhaps obtaining even better empirical results.

The measures of ideology and ideological ambiguity estimated by Wang's (36) method cannot be compared across differen terms of Congress[11] without a unique benchmark. In recent terms of the House, no Congressman can suitably serve as our benchmark. Therefore, we don't use panel data or include a congressman's complete past voting records into regressors.

[11]Poole and Rosenthal (27)'s DW-NOMINATE method can summarize a congressman's complete past voting records. However, their method cannot be used to estimate ideological ambiguity.

Appendix A

Seven Cases of Solutions in the Lobbying Stage and Congressmen's Expected Receipts of Campaign Contributions

Following are seven cases, given two lobby groups' willingness-to-pay and the distribution of the Congressman's ideology. However, the case of $a = A$ and $b = B$ will not happen generically. Hence, only six types of solutions obtain in most situations.

A.1 *Case 1*: Interior Solution

An interior solution happens when both reaction functions cross at sections which represent interior solutions. The two reaction functions in the interior solution are

$$\begin{cases} 2a - b = A - (x + y) \\ a - 2b = -B - (x - y). \end{cases}$$

Then, the interior solution is

$$\begin{cases} a = \frac{2A+B-x-3y}{3} \\ b = \frac{A+2B+x-3y}{3} \end{cases}$$

The interior solution is reasonable only when the above a and b are non-negative and not greater than the two groups' highest willingness-to-pay, A and B (please refer

to Figure A.1). The below conditions should be satisfied:

$$\begin{cases} 0 \le a < A \\ 0 \le b < B \end{cases} \Rightarrow \begin{cases} 0 \le \frac{2A+B-x-3y}{3} < A \\ 0 \le \frac{A+2B+x-3y}{3} < B \end{cases}$$

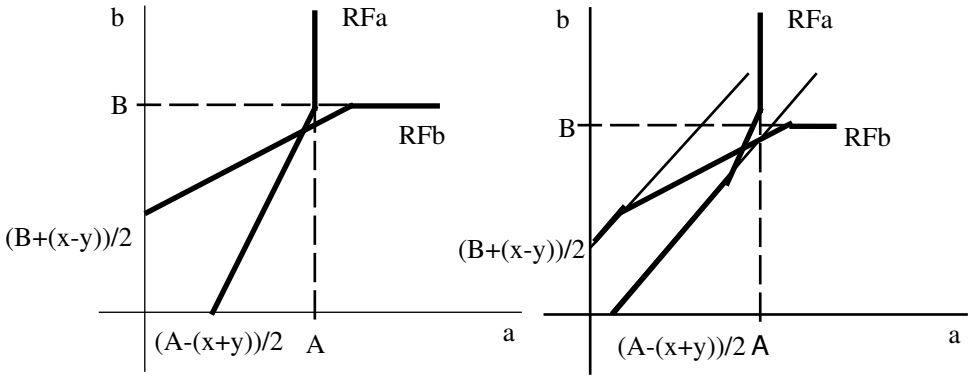


Fig. A.1. Interior Solution: $0 < a < A, 0 < b < B$

After rearranging, we can get the following conditions:

$$\begin{cases} 2A + B \ge x + 3y \\ A - B > -x - 3y \\ A + 2B \ge -x + 3y \\ A - B < -x + 3y \end{cases}$$

The above region is around $A - B = -x$, where Group G_a and Group G_b are on the same basis of lobbying the Congressman, and neither group has a strong advantage.

Two groups' winning probabilities, $\frac{(b-a)-(x-y)}{2y}$ and $\frac{(x+y)-(b-a)}{2y}$, must be between 0 and 1. In *Case 1*, conditions for interior solutions can guarantee the winning probability in the reasonable range. Therefore, the expected receipts from lobby groups can be calculated directly.

$$\begin{aligned} & \frac{(b-a)-(x-y)}{2y} \cdot b + \frac{(x+y)-(b-a)}{2y} \cdot a \\ = \quad & \frac{1}{18y} \cdot [(A-B)^2 - (A-B) \cdot x + 9(A+B) \cdot y - 2(x^2 + 9y^2)]. \end{aligned}$$

A.2 *Case 2:* $a = A, b < B$

Figure A.2 shows that the conditions for the case of $a = A, b < B$ should be the intersection of RF_a and $a - b = -(x + y)$, $(A, A + (x + y))$, below RF_b.

$$A - 2(A + (x + y)) \geq -B - (x - y) \quad \Rightarrow \quad A - B \leq -x - 3y$$

Not surprisingly, possible combinations of A and B will be allocated on the upper left corner of the $A - B$ plane when $x > 0$.

The bid from Group G_b can be solved with the intersection of $a = A$ and $a - b = -(x + y)$, $b = A + (x + y)$; that is, Group G_b just needs to announce a bid slightly greater than the sum of Group G_a's highest willingness-to-pay and the compensation to the Congressman, who decides not to support Group G_a. Unfortunately, The above condition may give a negative bid from Group G_b. In some cases, the Congressman's

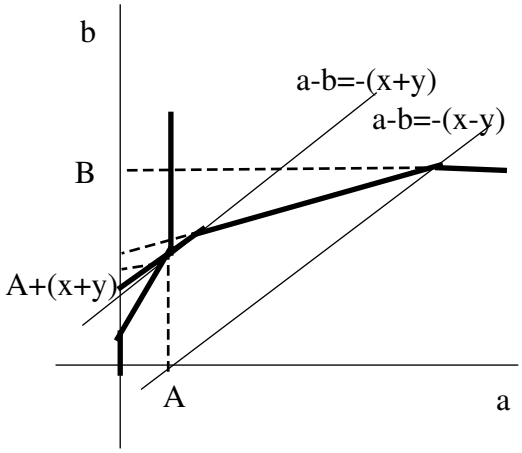


Fig. A.2. Solution: $a = A, b < B$

attitude tilts to Group G_b so much ($(x+y)$ becomes negative and very small) that Group G_b doesn't have to give anything. The bid from Group G_b, b, should be

$$\max\{0, A + (x + y)\}.$$

Group G_b's winning probability should be

$$\frac{(b-a)-(x-y)}{2y} = \max\{\frac{-A-x+y}{2y}, 1\}.$$

If $\frac{-A-x+y}{2y}$ is greater than 1, that is, $A < -(x+y)$, Group G_a has no chance to win the lobbying game. Group G_b's exact winning probability should be exactly 1. If $\frac{-A-x+y}{2y}$ is less than 1, Group G_b's winning probability is still 1 because Group G_b can send a bid to inch Group G_a out. Group G_a's winning probability is

$$\min\{\frac{A+x+y}{2y}, 0\}.$$

Following a similar argument, Group G_a's exact winning probability is 0. The Congressman's expected receipts is

$$\begin{aligned} & \frac{(b-a)-(x-y)}{2y} \cdot b + \frac{(x+y)-(b-a)}{2y} \cdot a \\ = \quad & \max\{0, A + x + y\}. \end{aligned}$$

A.3 *Case 3:* $(a < A, b = B)$

Case 3 is just the opposite of *Case 2*. The process of adjusting two groups' bids and winning probabilities is the same. Conditions for the case of $a < A, b = B$ are:

$$2(B - (x - y)) - B \leq A - (x + y) \quad \Rightarrow \quad A - B \geq -x + 3y.$$

The Congressman's expected receipts is

$$\begin{aligned} & \frac{(b-a) - (x-y)}{2y} \cdot b + \frac{(x+y) - (b-a)}{2y} \cdot a \\ = \quad & \max\{0, B - x + y\} \end{aligned}$$

A.4 *Case 4:* $a = 0, b = 0$

Figure A.5 shows that the a-axis intercept of RF_a and the b-axis intercept of RF_b need to be negative simultaneously. According to these conditions, all possible combinations of A and B will be at the bottom left corner of the $A - B$ plane when $x > 0$.

$$\begin{cases} \frac{A-(x+y)}{2} < 0 \\ \frac{B+(x-y)}{2} < 0 \end{cases} \quad \Rightarrow \quad \begin{cases} A < x + y \\ B < -(x - y) \end{cases}$$

Some implications follow from the above conditions:

1. $(x - y)$ must be negative since $(x - y) < -B < 0$;
2. $(x + y)$ must be positive since $(x + y) > A > 0$;
3. $A + B < 2y$, which means that the Congressman's ideological ambiguity is high enough to make both groups believe they have a high probability of winning;

4. For both groups' benefit from increasing their bids by one more dollar is lower than its cost[1].

Since neither group will contribute anything, the Congressman's expected receipts will always be zero.

A.5 *Case 5*: $a = 0, b = \min\{\frac{B+(x-y)}{2}, B\} > 0$

Left Panel, Figure A.3 illustrates that below conditions needs to be satisfied in this case.

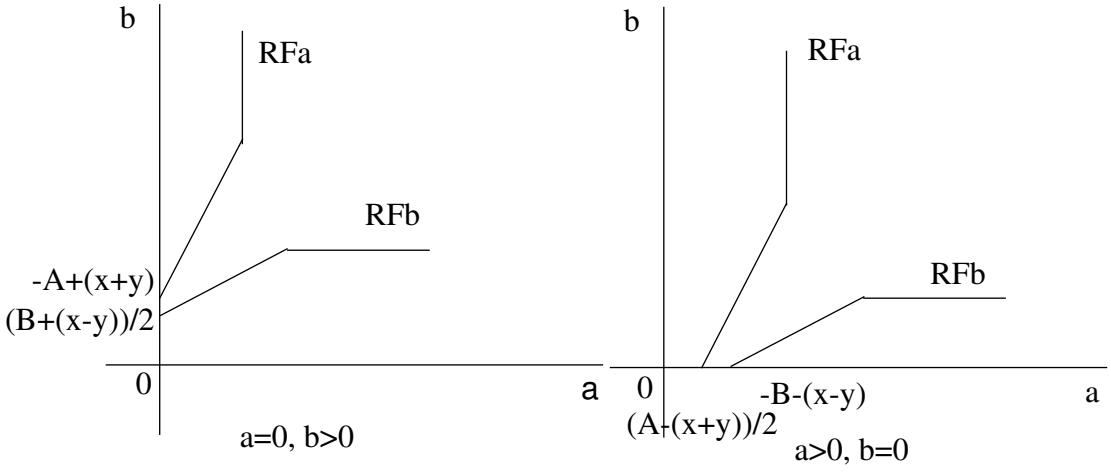


Fig. A.3. Solution: Only one group donates.

[1]This implication can be easily derived by inserting $a = 0$ and $b = 0$ into Equation 1.1 and combining two conditions, $A < x + y$ and $B < -(x - y)$.

$$0 \leq \frac{B+(x-y)}{2} < -A+(x+y).$$

The above condition means that both b-axis intercepts of two reaction functions must be positive and RF_a is higher than RF_b. Donation from Group G_a is zero and Group G_b should bid the Congressman by the amount represented by the b-axis intercept of RF_b, $\frac{B+(x-y)}{2}$. Those combinations of A and B satisfying those conditions were located nearby a-axis when $x > 0$. Although those conditions guarantee that Group G_b's bid cannot be negative, as in *Case 2* or *Case 3*, Group G_b's bid still could be higher than its highest willingness-to-pay when the Congressman strongly supports Group G_a ($(x-y)$ is too big). Therefore, an extra constraint is necessary.

After rearrangement, the above conditions imply

$$\begin{cases} B \geq -(x-y) \\ 2A+B < 2(x+y)-(x-y) \end{cases} \Rightarrow \begin{cases} B \geq -(x-y) \\ A < (x+y). \end{cases}$$

Group G_b's winning probability is

$$\frac{(b-a)-(x-y)}{2y} = \min\{\frac{B-x+y}{4y}, \frac{B-x+y}{2y}\}.$$

If $B-x+y<0$, that is, $B<(x-y)$, Group G_b cannot have any chance to win the lobbying game. Group G_b's winning probability is 0. Then, the Congressman's expected receipt is 0 since Group G_a can win without sending any bid. If $B-x+y>0$, Group G_b will bid $\frac{B+x-y}{2}$ and the winning probability is $\frac{B-x+y}{4y}$. Group G_a can still bid

nothing since Group G_a has a great opportunity to win and the improvement of winning probability by increasing bid is limited. Then, the Congressman's expected receipts is

$$\begin{aligned} & \frac{(b-a)-(x-y)}{2y} \cdot b + \frac{(x+y)-(b-a)}{2y} \cdot a \\ = \quad & \max\{0, \frac{B^2-(x-y)^2}{8y}\} \end{aligned}$$

A.6 *Case 6*: $a = \min\{\frac{A-(x+y)}{2}, A\} > 0, b = 0$

Case 6 is just the opposite to *Case 5*. Similar adjustments are done as above. Conditions for the case of $a = \min\{\frac{A-(x+y)}{2}, A\} > 0, b = 0$ are:

$$\begin{cases} A \geq (x+y) \\ A + 2B < (x+y) - 2(x-y) \end{cases} \Rightarrow \begin{cases} A \geq (x+y) \\ B < -(x-y) \end{cases}.$$

The Congressman's expected receipts is

$$\begin{aligned} & \frac{(b-a)-(x-y)}{2y} \cdot b + \frac{(x+y)-(b-a)}{2y} \cdot a \\ = \quad & \max\{0, \frac{A^2-(x+y)^2}{8y}\} \end{aligned}$$

A.7 *Case 7*: a=A, b=B

That $a = A$ and $b = B$ means no lobby group can win this lobbying game intuitively. Since this is a one-dimensional model and each of two groups stands for one side, there should not exist such cases that neither groups can convince the Congressman at all. Therefore, It generically impossible to find a solution such as $(a = A, b = B)$.

Following the previous analysis, the solutions of $a = A$ and $b = B$ should satisfy the below conditions (please refer to Figure A.4):

$$\begin{cases} A \geq B - (x - y) \\ B \geq A + (x + y) \end{cases} \Rightarrow \begin{cases} A - B \geq -(x - y) \\ A - B \leq -(x + y) \end{cases}$$

Since $-(x+y) < -(x-y)$, the above two inequalities contradict each other unless $(x + y) = (x - y)$, that is, there is no ambiguity in the Congressman's ideology and x has to be $B - A$. Therefore, I claim that this case generically impossible.

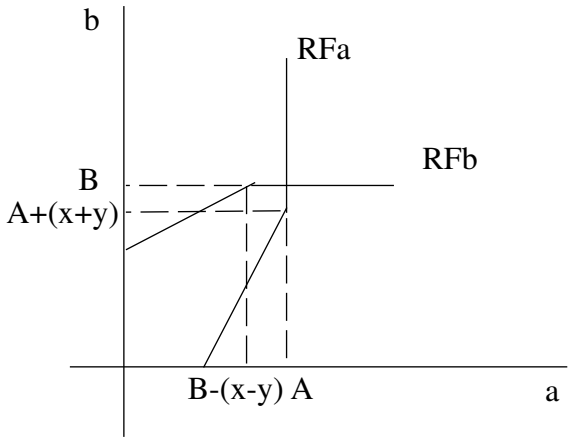


Fig. A.4. Solution: $a = A, b = B$

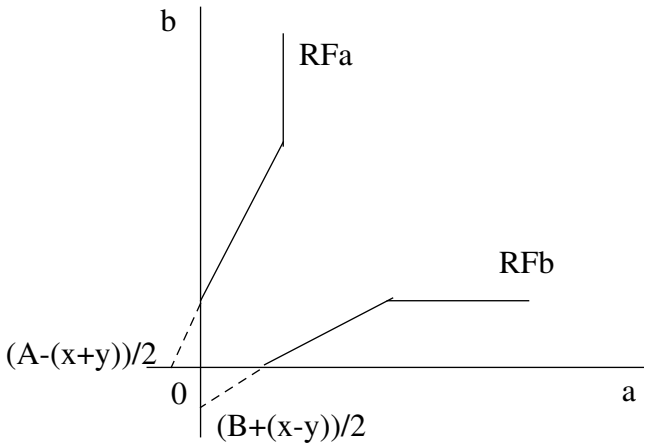


Fig. A.5. Solution: $a = 0, b = 0$

Appendix B

Samples of Estimation Result: The 100th Senate

Below are Congressmen's estimated ideologies, estimated ideological ambiguities, and percentage of correct prediction on voting in the 100th Senate. Congressmen are ranked by their estimated ideologies. A Congressman with low rank tends to vote more like a pure Democrat or has an ideology biased to the left. IDE is the measure of ideology and IDE-t is the bootstrapped t value of IDE. AMB is the measure of ideological ambiguity and IDE-t is the bootstrapped t value of AMB. PCT is the percentage of correct predictions on voting.

Rank	Name	Party	IDE	IDE-t	AMB	AMB-t	PCT
1	Gore	D	-4.541	0.406	3.513	0.298	0.882
2	Pell	D	-2.090	0.209	1.507	0.170	0.901
3	Kennedy	D	-1.832	0.187	1.113	0.145	0.912
4	Cranston	D	-1.798	0.187	1.090	0.148	0.903
5	Adams	D	-1.788	0.177	1.328	0.150	0.883
6	Harkin	D	-1.715	0.162	1.249	0.140	0.891
7	Weicker	R	-1.696	0.237	3.328	0.380	0.721
8	Leahy	D	-1.693	0.166	1.088	0.140	0.908
9	Conrad	D	-1.654	0.196	2.060	0.227	0.783
10	Matsunaga	D	-1.625	0.164	1.007	0.134	0.904
11	Proxmire	D	-1.619	0.232	4.028	0.451	0.674
12	Bradley	D	-1.597	0.154	1.335	0.146	0.851
13	Metzenbaum	D	-1.492	0.137	0.926	0.117	0.898
14	Lautenberg	D	-1.467	0.148	0.836	0.119	0.909
15	Levin	D	-1.432	0.124	0.944	0.111	0.889
16	Dodd	D	-1.426	0.132	1.116	0.125	0.859
17	Glenn	D	-1.387	0.126	1.037	0.118	0.872
18	Kerry	D	-1.383	0.126	0.845	0.106	0.901
19	Sarbanes	D	-1.378	0.139	0.736	0.107	0.929
20	Moynihan	D	-1.363	0.125	0.865	0.104	0.899
21	Mitchell	D	-1.350	0.121	0.814	0.105	0.902
22	Mikulski	D	-1.325	0.138	0.653	0.104	0.927
23	Sanford	D	-1.321	0.125	0.779	0.104	0.913
24	Inouye	D	-1.298	0.122	0.701	0.099	0.908

Rank	Name	Party	IDE	IDE-t	AMB	AMB-t	PCT
25	Bumpers	D	-1.290	0.109	0.908	0.104	0.881
26	Riegle	D	-1.267	0.127	0.631	0.096	0.921
27	Wirth	D	-1.204	0.108	0.969	0.107	0.871
28	Burdick	D	-1.201	0.107	0.829	0.101	0.877
29	Sasser	D	-1.138	0.100	0.791	0.097	0.893
30	Daschle	D	-1.120	0.092	0.728	0.088	0.903
31	Melcher	D	-1.081	0.101	1.023	0.108	0.823
32	Rockefeller	D	-1.075	0.092	0.568	0.082	0.913
33	Hatfield	R	-1.045	0.176	2.438	0.321	0.661
34	Baucus	D	-1.017	0.090	0.864	0.096	0.876
35	Pryor	D	-1.012	0.080	0.682	0.084	0.910
36	Reid	D	-0.986	0.088	0.840	0.093	0.860
37	Graham	D	-0.933	0.072	0.686	0.081	0.875
38	Fowler	D	-0.904	0.070	0.695	0.081	0.871
39	Johnston	D	-0.904	0.078	0.869	0.092	0.858
40	Byrd	D	-0.895	0.076	0.813	0.089	0.866
41	Chafee	R	-0.887	0.175	2.534	0.339	0.673
42	Chiles	D	-0.863	0.063	0.671	0.078	0.872
43	Stennis	D	-0.854	0.065	0.680	0.078	0.852
44	Ford	D	-0.800	0.069	0.826	0.090	0.852
45	Bentsen	D	-0.791	0.064	0.752	0.081	0.865
46	Breaux	D	-0.789	0.062	0.727	0.077	0.867
47	Bingaman	D	-0.784	0.065	0.778	0.082	0.842
48	Hollings	D	-0.704	0.114	1.516	0.187	0.756
49	Exon	D	-0.692	0.070	0.937	0.094	0.813
50	Nunn	D	-0.687	0.053	0.602	0.068	0.871
51	Deconcini	D	-0.671	0.075	1.031	0.106	0.790
52	Dixon	D	-0.668	0.064	0.873	0.089	0.828
53	Boren	D	-0.590	0.061	0.861	0.090	0.819
54	Stafford	R	-0.576	0.064	1.011	0.102	0.756
55	Shelby	D	-0.358	0.063	1.077	0.103	0.803
56	Heinz	R	-0.337	0.052	0.722	0.085	0.802
57	Packwood	R	-0.312	0.060	1.001	0.101	0.742
58	Cohen	R	-0.291	0.064	1.077	0.103	0.768
59	Durenberger	R	-0.287	0.062	1.069	0.105	0.729
60	Specter	R	-0.272	0.073	1.279	0.125	0.735
61	Heflin	D	0.000	0.000	1.000	0.000	0.711
62	Danforth	R	0.032	0.057	0.907	0.077	0.810
63	Kassebaum	R	0.113	0.061	0.959	0.082	0.789
64	D'amato	R	0.196	0.061	0.916	0.078	0.802
65	Stevens	R	0.265	0.063	1.059	0.087	0.793
66	Domenici	R	0.267	0.056	0.665	0.056	0.866
67	Boschwitz	R	0.304	0.065	0.886	0.071	0.823
68	Warner	R	0.324	0.056	0.759	0.060	0.818
69	Cochran	R	0.329	0.057	0.764	0.060	0.832
70	Evans	R	0.342	0.124	2.327	0.296	0.681
71	Roth	R	0.347	0.083	1.575	0.165	0.708
72	Lugar	R	0.372	0.067	1.020	0.082	0.807
73	Grassley	R	0.412	0.062	0.875	0.069	0.846
74	Rudman	R	0.412	0.066	1.109	0.091	0.773

Rank	Name	Party	IDE	IDE-t	AMB	AMB-t	PCT
75	Simpson	R	0.458	0.061	0.760	0.057	0.858
76	Dole	R	0.469	0.078	0.576	0.070	0.874
77	Trible	R	0.479	0.074	0.602	0.079	0.875
78	Pressler	R	0.507	0.067	0.946	0.076	0.845
79	McConnell	R	0.512	0.062	0.813	0.059	0.821
80	Karnes	R	0.611	0.098	0.681	0.072	0.887
81	Wilson	R	0.643	0.074	1.123	0.087	0.811
82	Kasten	R	0.650	0.077	0.845	0.064	0.837
83	Thurmond	R	0.667	0.082	0.824	0.067	0.861
84	Murkowski	R	0.693	0.077	0.910	0.068	0.834
85	Bond	R	0.704	0.071	1.000	0.077	0.804
86	McCain	R	0.736	0.073	0.957	0.073	0.846
87	Hatch	R	0.854	0.072	1.047	0.080	0.831
88	Quayle	R	1.149	0.088	1.178	0.098	0.844
89	Hecht	R	1.162	0.090	1.185	0.101	0.856
90	Garn	R	1.237	0.097	1.170	0.102	0.867
91	Nickles	R	1.271	0.099	1.140	0.105	0.882
92	McClure	R	1.405	0.117	1.387	0.134	0.831
93	Armstrong	R	1.491	0.123	1.412	0.136	0.849
94	Gramm	R	1.759	0.137	1.387	0.129	0.864
95	Wallop	R	2.085	0.210	1.498	0.163	0.881
96	Humphrey	R	2.355	0.265	2.601	0.308	0.798
97	Symms	R	2.438	0.431	1.679	0.291	0.879
98	Helms	R	2.896	0.274	2.545	0.261	0.848

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Vita

Chun-chieh Wang was born in Tainan, Taiwan. He left his hometown after entering into college. His major was Political Science in college. Along with training in the field of Political Science, he also minored in Economics. He earned his B.A. in Nation Taiwan University in 1994. Combining training in two disciplines, his current research focuses on studying political process and policies with the method of Economics. To sharpen his research skills of Economics, he enrolled in the master program in Department of Economics, NTU, in 1994 and receive a M.A. in 1996.

During 1996-1998, he served as the economist and an analyst for the KGI Security Ltc.. He had a better position to watch how our economy operates and also had chances to talk to entrepreneurs.

To pursue his career in academia, he enrolled in the Ph.D. program in the Pennsylvania State University in 1998. He learned more advanced research skills, especially in Game Theory and Econometrics, and his research fields are mainly Political Economy, Industrial Organization, and Economic Development. After graduation, he will serve in Chung-Hua Institution of Economic Research.