Who Speaks to Whom? Purpose and Bias in Legislative Information Networks

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Abstract

Theoretical models of congressional decision making have demonstrated the relationship between informational asymmetries among members of Congress and the lack of coherence in public policy output. Important institutional solutions to this problem have been proposed, solutions that have stressed the importance of congressional committees as an agent of specialization and a source of information for the Congress a whole. Yet, this work, known as the "information theory of legislative organization," tells us relatively little about the dynamics of information dissemination within legislatures or about the individual-level patterns of information consumption exhibited by legislators. To understand fully the ecological ramifications of uncertainty in legislatures and its institutional institutional solution, we first must begin to heighten our knowledge of the informative behavior of individual legislators. This paper argues that a legislator's search for information is governed by the electoral benefits that such activities might procure. However, in acquiring information, a legislator can regulate information costs through the development and maintenance of legislative information networks. These networks are a product of purposive behavior, although they may be biased by the strength of ties linking members to informants. By examining the microfoundations of information exchange in Congress and how it may lead to information asymmetries, this paper calls into question many of the underlying assumptions of the informational theory of legislative organization.

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"Institutions are... humanly devised constraints that shape human interaction... [t]hey structure incentives in human exchange" (North 1990, 3). Institutional mechanisms condition human preferences and/or behavior, making political outcomes the product of both human desires and the "rules of the game" that constrain them. Yet, as Douglass North (1990) keenly asserts, these institutions may be either formally defined or informally constructed. However, we are fundamentally disadvantaged when studying informal institutions compared to their formal counterparts. Indeed, the informal nature of these institutions requires that we take several important steps when making claim of their existence: 1) we must identify those actors who are governed by the informal institution and those that are not; 2) we must define the commodity and means of exchange between actors; 3) we must define the nature of externalities – gains or costs to society that are not reflected in market prices; and, finally, 4) we must ask how and why these informal institutions came into being.

In this paper, I examine the development of one such informal institution, what I term the "legislative information network." Fundamentally, members of Congress face a variety of information demands, and they possess a limited ability to meet their informational needs. Members must make rational decisions about how to allocate their time and resources toward meeting their objective of becoming informed (Gomez, 1999). Yet, members of Congress, like all individuals, can reduce the cost of information. As Anthony Downs (1957) pointed out, much of information search activity can be delegated to others as a means of lowering the average cost of information. These *transferable costs* include the costs of information procurement, analysis of the information, and its evaluation. Of course, the delegation of information gathering does create additional transaction and information costs. Members now must absorb the costs resulting from the common problems of adverse selection and moral hazard. However, the time and opportunity costs associated with information search activities are greatly allayed by relying upon the information cues of other actors. Thus, the logic of the legislative information network suggests that, in the market for information, members of Congress systematically acquire and maintain relational contacts with individuals who either currently provide or may provide them with new information.

As an informal institution, the legislative information network is not explicitly definable. That is, we cannot readily say that legislator A regularly obtains policy information from legislator B, and so on. There obviously would be great difficulty in defining all possible relationships between individual legislators. Yet, despite this difficulty, previous evidence from legislative research suggests that information networks do, in fact, exist.

Cue giving models of congressional voting, for instance, identify the range of actors involved in information exchange (Matthews and Stimson 1975; Kingdon 1989). In *Congressmen's Voting Decisions*, John Kingdon identifies seven "actors" as potential sources of legislative information: the constituency, fellow congressmen, party leadership, interest groups, the administration and executive branch, legislative staffers, and the media. Donald Matthews and James Stimson, in *Yeas and Nays*, identify the same actors as Kingdon, but the authors seek generalizability by organizing these cue givers on the basis of them being *initial* and *intermediary* sources of information. The identification of these actors, in part, substantiates the basic premise of the legislative information network: members of Congress transfer the cost of information gathering by seeking information from other legislative actors.

While the cue giving models do affirm the existence of information exchanges between legislators and informed sources, is it fair to say that these contacts are a product of a regularized system? After all, the premise of a legislative information network not only hypothesizes information exchange between actors, it further assumes that these relationships are *systematically undertaken and maintained*. Fortunately, another line of research does provide evidence of protracted relationships of exchange between legislators. Gregory Caldeira and Samuel Patterson (1987) demonstrate that legislators' bonds of "friendship" provide long-term channels for information and voting-cue transactions.

Previous observations and research do allude to the existence of a legislative information network. Yet, it is easy to see that actually developing a generalizable and predictive model of homophily is equivalent to an experiment in matchmaking. Actually defining "who speaks to whom" is a near impossibility, and, consequently, it will not be attempted here. Moreover, I believe that specifically stipulating "who speaks to whom" is unnecessary for understanding the logic behind the development of this informal institution that I call the legislative information network. These networks exist both in theory and in reality. What remains is that we determine the answers to three important questions: What are the rules by which these networks are formed and maintained? What is the cost of exchange within the network? And, finally, are these information networks beneficial and efficient for the legislature as a whole?

1. The Legislative Information Network

The legislative information network model is founded on two principles. First, though constrained by time, *members of Congress seek to maximize their chances of being informed on issues*. As I have argued elsewhere (Gomez 1999, Chapter 2), becoming informed is electorally beneficial, and it has been demonstrated formally that members of Congress initiate and extend their information searches on the basis of this electoral connection. Yet, legislators also wish to "maximize their chances of being informed because being informed (and having the reputation for being informed) is a critical element of credibility generally" (Esterling, et al. 1997).

Credibility is a necessary precondition for informational influence. As David Austen-Smith (1992, 47) argues, "for a speaker to be able to persuade the listener to act in a particular way... it is clearly essential that the listener believe the speaker knows something that the listener does not." Arthur Lupia (1999) makes a stronger argument, stating that *all cue giver attributes* – such as ideology, partisanship, etc. – "affect a cue's persuasiveness *only if* they are *necessary* to inform a cue seeker's perceptions of a cue giver's knowledge or interests" (Lupia's emphasis). Fundamentally, a cue giver's knowledge and interests determine a cue's persuasive power. Thus, for members of Congress, the acquisition of information is not merely electorally beneficial; information is instrumental for developing and maintaining credibility and influence within the Congress. Indeed, though implicit, the assumption of credibility is at the heart of all cue giving models of legislative behavior.

The second principle that governs this model as well as other network models, is that *information is socially disseminated*. That is, information is distributed, and influence is garnered, through a series of social relationships. This principle, of course, is characteristic of cue giving models of exchange. However, the assumption is not an explicit component of many legislative signaling models. Take, for instance, the Gilligan and Krehbiel model (1990; Krehbiel 1991) of informative committees, where the legislation forwarded to the floor by a representatively appointed committee is considered to be an informative signal. Yet, the transaction partners in this signaling game are the committee of jurisdiction and floor, viewed as aggregate entities. No mechanism of individual exchange is defined within these models.[1]

By focusing on information dissemination as a social process composed of individual relationships, I believe that we can learn greater insight into the consequences of who speaks to whom in legislatures. First, the strength of these relationships helps to determine the degree of credibility and influence the individual possesses within the legislature. Second, these relational ties also help to determine the costs associated with information acquisition. Finally, the social nature of information dissemination suggests that social costs and benefits, as well as efficiencies and inefficiencies, may also exist and can be determined.

My general argument is that information gathering within legislatures is a social enterprise. When members of Congress choose to acquire information, they also must choose from whom to acquire information.[2] Following Scott Boorman's (1975) combinatorial optimization model, I will argue that legislators follow one (or a mixture) of two strategies. First, legislators may invest their time "in gaining

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[1] See William Bianco (1997) for a similar criticism of these models.

[2] For the purposes of this analysis, I will assume that the legislature is a self-contained information environment. Though external sources of information such as interest groups or the executive branch do exist, I want to know whether the legislature as an organization can meet its own informational demands. Therefore, these informational sources are not directly incorporated into the model.

acquaintances in a 'loose network' of contacts about the policies in which they are interested" (Esterling 1997, 4). This weak tie strategy is referred to as a *cocktail strategy*. Alternatively, legislators may choose to invest their limited time in developing strong ties with other members, "trusted friends *in whom* they will invest more time and *from whom* they expect to receive more information and trust in return" (Esterling 1997, 4). The model that is developed seeks to determine the optimal tradeoff in the mixture between the two pure strategies or whether the pure strategies, themselves, are most rational to follow.

Boorman, as well as Kevin Esterling and his colleagues (1997), have demonstrated that when the demand for information is low, a *cocktail equilibrium* holds. They interpret this equilibrium result in the following manner:

> The idea we adopt is Granovetter's "strength of weak ties" hypothesis. In a world composed of cliques of tightly-knit persons, individuals are better off investing time in acquaintances (or "weak ties") because it is through acquaintances that cliques are bridged and it is through these "weak ties" that information diffuses in a network. From a social efficiency perspective, weak ties help to make the information network more efficient or effective. Since this efficiency is a property of a network as a whole, weak ties have the qualities of a public good for all levels of information demand (Esterling, *et al*. 1997).

Yet, the development of weak ties is only individually rational at low levels of information demand. When the demand for information is high, such as when legislation is directly pertinent to the member's constituency, a legislator is more likely absorb the cost of investing in strong ties. Unfortunately, in the aggregate, information networks composed of strong ties are prone to social inefficiencies, such as informational asymmetries between those with strong ties and those with weaker ones, and, as previous theorists (Austen-Smith and Riker 1987) have asserted, these asymmetries can greatly effect the coherence of legislation.

2. A Combinatorial Optimization Model of Legislative Information Networks

From a broad perspective, the purpose of Boorman's (1975, 218) combinatorial optimization model is to demonstrate that "at least some parts of informal organizational structure may be modeled from an optimization standpoint similar to that customarily reserved for the analysis of formal structures." Specifically, Boorman's model presents a rational choice approach to social network analysis. The network component of the model represents a one-stage communication dissemination problem only (i.e., no "chaining effects" will be considered), and the ties between individuals are assumed to be symmetrical. By presenting this network analysis as a maximization problem, however, "familiar ideas drawn from economics and *n*-person game theory, particularly Nash equilibria and allied concepts" can be explicated (Boorman 1975, 218).

In order to facilitate comprehension of the model, I will provide a brief overview of the mechanics of the combinatorial optimization model.

Assume that each legislator can establish an informational contact with any other legislator of one of two forms: a strong or weak tie. These two types of ties are analogous to that of a trusted friend or an acquaintance, respectively, and it is assumed that it takes more effort to maintain a contact with a strong tie than a weak tie. Assume further that each legislator possesses a finite time budget for which to establish ties with other legislators. The constrained maximization problem facing each legislator is to allocate her budgeted time between making weak and strong ties so as to maximize the probability of receiving information through a contact.

The mechanism of the model assumes that a contact (informant) possesses new information about a policy and is willing to provide it to another legislator. According to the model, the informant will only provide the information to one legislator. In disseminating the information, the informant first will select randomly among his strong ties and inquire as to whether they are interested in the issue. If so, then the informant will provide that legislator with the new information. If not, the informant will continue to select randomly among strong ties until someone needs the information. Assuming that none of the informant's strong ties is in need of the information, then, and only then, will he begin to offer the information to weak tie legislators in the same manner as before. This restriction is termed the *priority rule*.

Again, the legislator's problem is to determine how best to allocate her time amongst weak or strong ties. This determination is conditioned upon how many other legislators the member of Congress expects will be interested in the issue, since the expected number depends upon the level of interest in the issue. "As the demand for information is higher (that is, the more important the issue), the less likely the information will pass through the 'barrier' comprised of the [informant's] strong ties, and so the less likely that any acquaintance will even have a chance to hear it" (Esterling, *et al*. 1997, 5)

Of course, like all models of social systems, the assumptions of the combinatorial optimization model necessitate that equivalence to reality will not be met. The absence of chaining effects, where legislator A passes information to legislator B and then B passes it to C and so on, is one obvious limitation of the model. The assumption that only one possible informant possesses the new information is another. Yet, these limitations should not overshadow the possible contribution of the model. Legislative information networks are informal institutions, and any leverage that we can obtain about how they are constructed and maintained, or about their effects on legislative behavior and public policy, constitutes an advancement over our current state of knowledge.

2.1 Specification of the Model

Each legislator L is assigned a time budget $T > 0$, which is identical for all actors, x. The legislator is required to allocate all of his time budget toward creating a number of either strong S or weak ties W with other members of the legislature. Because ties between legislators are assumed to be symmetrical, "no single individual may be *both* a strong *and* a weak tie of [L]" (Boorman 1975, 220). The time expenditure cost of creating and maintaining a weak tie equals 1, while $\lambda > 1$ is the corresponding amount of time required to maintain each strong tie. With these conditions, the legislator's budget constraint for the allocation of ties within the network is defined as

$$T = W + \lambda S \qquad (1)$$

For purposes below, I shall define β, $0 \leq \beta \leq 1$, as the proportional cost of all S to the total T, so that

$$W = (1 - \beta)T \qquad (2)$$

and

$$S = \frac{\beta T}{\lambda} \tag{3}$$

In addition to the time budget constraint defined above, two additional parameters are defined as a means of describing the market for information. Let μ be the probability that L needs the information in a particular policy domain, where μ is equivalent to the legislator's "demand for information." Let δ be the probability that L hears the information in the current round *before* it has been transmitted socially to anyone else. In a series of numerical simulations, T, λ, δ, and μ will be fixed parameters, while the parameter S defining the allocated number of strong ties is allowed to vary.

The dynamics of the information dissemination process are set forth by two rules:

1. *One-informant-one-receiver assumption*: There exists only one informant possessing new information and that informant will transmit the information to only one other legislator.

2. *The priority rule*: When disseminating information, an informant...

(a) surveys his strong contacts and their information needs; if any of these strong ties needs the information, the informant randomly selects one of these contacts provides the with the information; or,

(b) if none of the informant's strong ties needs the new information, (a) is repeated using the informant's weak ties.

In stipulating these rules, Boorman (1975, 221) notes that the one-informant-one-receiver restriction "is not fundamental to the theory, but its adoption greatly simplifies the combinatorics." Esterling, et al. (1997, 6) further justify this restriction, stating that "the value of information in politics is strictly (and steeply) decreasing in the number of people possessing it."

2.2 The Legislator's Problem

When establishing an information network, the legislator's problem is to choose a strategy profile, consisting of the double (S, W) constrained by Eq. 1, so as to maximize the probability of obtaining political information through the legislator's information network. This is done by letting P be the probability that L will receive the desired political information through his network of contacts,

$$P \equiv 1 - Q = 1 - Q_S Q_W, \tag{4}$$

where

Q_S = probability no political information is obtained through strong ties;

Q_W = probability no political information is obtained through weak ties;

Consider the first case, where a strong tie contact of L acquires new political information. The probability that L will obtain this information from the informant is the probability that the informant hears the information (δ), does not need the information (1 - μ), and then passes the information to L instead of another strong contact. Hence, Q_S is

$$\begin{aligned} Q_S &= \{(1 - \delta) + \delta\mu + \delta(1 - \mu)(1 - \sigma)\}^S \\ &= \{1 - \delta(1 - \mu)\sigma\}^S\} \end{aligned} \tag{5}$$

Similarly, Q_W can be defined as

$$\begin{aligned} Q_W &= \{[1 - \delta] + \delta\mu + \delta[1 - \mu][1 - (1 - \mu)^S] + \delta[1 - \mu]^{S+1}[1 - \Omega]\}^W \\ &= \{1 - \delta[1 - \mu]^{S+1}\Omega\}^W \end{aligned} \tag{6}$$

where Ω performs the same function for weak ties as σ does for strong ties.[3]

In completing the formal description, σ and Ω will be expressed in terms of the exogenous parameter set (T, λ, δ, μ). This is done through combinatorial calculation. Assume that L is in a set of x legislators, and that μ is the probability that one of the remaining x-1 legislators also needs the information possessed by an informant. The probability that L will receive the information is (1) the probability that none of the other legislators needs the information (in which case L receives the information with certainty), plus (2) the probability that L will receive the new information if a set $\mathbf{X} \neq \emptyset$

[3] In establishing these probabilities, Boorman (1975, 224) notes an additional assumption, the *absence of triads*. "There are no triads (A, B, C) in the network such that A is a contact of B, B is a contact of C, where each 'contact' may be either strong or weak."

of the other legislators also needs the information, summed over the appropriate probability weights. This is expressed formally:

$$
\begin{aligned}
f(x) &= (1-\mu)^{x-1} + \sum_{k=1}^{x-1} (1-\mu)^{x-k-1} \mu^{k} \left(\frac{[x-1]!}{k![x-k-1]!} \right) \left(\frac{1}{k+1} \right) \\
&= \frac{1-(1-\mu)^{x}}{\mu x}
\end{aligned}
\tag{7}
$$

When $x = 0$, the probability is stated as

$$
f(0) = \frac{-\ln(1-\mu)}{\mu} \tag{8}
$$

by l'Hospital's rule. Thus, returning to σ and ω,

$$
\sigma = f(S) \tag{9}
$$

$$
\Omega = f(W) \tag{10}
$$

The legislators problem is now a well defined maximization problem. Specifically, given the parameters (T, γ, δ, σ) and the linear constraint defined by Eq.1, the problem is to maximize P as a function of S (equivalently, as a function of W, since S and W are affine transformations).

In defining P, Boorman also identifies this maximum as the *symmetric group optimum* (SGO). Since the assumed network stipulates identical strategic breakdowns for all legislators, Boorman (1975, 226) notes that the SGO may also be a Pareto optimum. Boorman does not fully identify the conditions in which this claim is true, rather he simply admits that additional Pareto optima may exist off the diagonal, i.e., where asymmetric ties are allowed. Nevertheless, the general converse is valid: "if a particular solution (S, W) is *not* a symmetric group optimum, the a uniform network with these connectivities will certainly *not* be Pareto optimal.

2.3 Stability under Individual Maximization (Results from Boorman)

In his formal statement of the combinatorial optimization model, Boorman sets forth the conditions under which network structures correspond to stable Nash equilibria. In doing so, Boorman relaxes the assumption of symmetrical (S, W) strategies. Instead, Boorman allows L to deviate from the uniform (S, W) allocation across legislators, so that L possess the option of converting strong ties to weak or vice versa. For example, if a legislator allocates her time budget so as to establish two strong ties and one weak tie ($\Rightarrow T = 7$, if $\lambda = 3$), she is now allowed to convert one of her strong ties into three new weak ties. Of course, her limited budget does not allow her to acquire any additional strong ties.

Let a symmetric strategy $\left(\hat{S}, \hat{W}\right)$ be given and let $\hat{\beta}$ be defined from Eqs. 2 and 3. For the moment, we shall assume that $\hat{S}$ and $\hat{W}$ are both strictly positive, as the case of endpoint stability $\hat{S}$ = 0, $\hat{W}$ = 0) will treated separately below in Cases 3 and 4, respectively.

Case 1: Weak-Tie Deviations

If the legislator decides to alter his tie allocation by creating more weak ties $\left(W > \hat{W}\right)$, then $W = \hat{W} + (\hat{\beta} - \beta)T$, where β is given by Eqs. 2 and 3 and $\hat{\beta}$ is defined similarly using $\left(\hat{S}, \hat{W}\right)$.

Therefore, each of the set of $(\hat{\beta} - \beta)T$ individuals who are new weak ties of the legislator L will now have $W + 1$ incoming weak ties.

For legislator L, $P = 1 - Q_S Q_W$, where now

$$Q_S = (1 - \gamma f(\hat{S}))^{S - (\hat{\beta} - \beta)T/\lambda}, \tag{11}$$

$$Q_W = (1 - \gamma[1 - \mu]^S f(\hat{W}))^W (1 - \gamma[1 - \mu]^S f(\hat{W} + 1))^{(\hat{\beta} - \beta)T}, \tag{12}$$

and,

$$\gamma \equiv \delta(1 - \mu) \tag{13}$$

The strategic breakdown $\left(\hat{S}, \hat{W}\right)$ will then be unstable with respect to an increase in weak ties when

$$\hat{Q} > Q \Leftrightarrow$$

$$1 > (1-\gamma f(\hat{S}))^{-(\hat{\beta}-\beta)T/\lambda}(1-\gamma[1-\mu]^{\hat{S}} f(\hat{W}+1))^{(\hat{\beta}-\beta)T} \quad (14)$$

$$\Leftrightarrow 1 > \left\{\frac{1-\gamma[1-\mu]^{\hat{S}} f(\hat{W}+1)}{[1-\gamma f(\hat{S})]^{1/\lambda}}\right\}^{(\hat{\beta}-\beta)T}$$

$$\Leftrightarrow 1-\gamma f(\hat{S}) > \{1-\gamma[1-\mu]^{\hat{S}} f(\hat{W}+1)\}^{\lambda} \quad (15)$$

By the uniformity assumption, if Eq. 13 holds for legislator *L*, it holds for all legislators in the network. Further, if the system is unstable with respect to the proposed weak tie increase, Eq. 14 demonstrates that the propensity for a legislator making a weak-tie deviation will be to go to the all weak tie extremum ($S = 0$, $W = T$).

Case 2: Strong-Tie Deviation

We now consider the case where the legislator chooses to attain more strong ties $(\beta > \hat{\beta})$, gaining $(\beta - \hat{\beta})T/\lambda$ strong ties. Then,

$$Q_S = (1-\gamma f(\hat{S}))^{\hat{S}}(1-\gamma f(\hat{S}+1))^{(\beta-\hat{\beta})T/\lambda} \quad (16)$$

$$Q_W = (1-\gamma[1-\mu]^{\hat{S}} f(\hat{W}))^{\hat{W}-(\beta-\hat{\beta})T} \quad (17)$$

The strategic allocation $(\hat{S},\hat{W})$ will be unstable with respect to an increase in strong ties when

$$\hat{Q} > Q \Leftrightarrow$$

$$1 > \{1-\gamma[1-\mu]^{\hat{S}} f(\hat{W})\}^{-(\beta-\hat{\beta})T}\{1-\gamma f(\hat{S}+1)\}^{(\beta-\hat{\beta})T/\lambda}$$

$$\Leftrightarrow 1 > \left\{\frac{[1-\gamma f(\hat{S}+1)]^{1/\lambda}}{1-\gamma[1-\mu]^{\hat{S}} f(\hat{W})}\right\}^{T(\beta-\hat{\beta})} \quad (18)$$

$$\Leftrightarrow \{1-\gamma[1-\mu]^{\hat{S}} f(\hat{W})\}^{\lambda} > 1-\gamma f(\hat{S}+1) \tag{19}$$

In conjunction, we see from Cases 1 and 2 that an interior configuration $\left(\hat{S},\hat{W}\right)$

$(\hat{S},\hat{W} \neq 0)$ will be stable under uncoordinated individual optimization behavior if and only if < holds in Eqs. 15 and 19 simultaneously. That is,

$$1-\gamma f(\hat{S}) < \{1-\gamma[1-\mu]^{\hat{S}} f(\hat{W}+1)\}^{\lambda} \tag{20}$$

and

$$\{1-\gamma[1-\mu]^{\hat{S}} f(\hat{W})\}^{\lambda} < 1-f(\hat{S}+1) \tag{21}$$

Case 3: The Stability of a "Cocktail" Equilibrium

A legislative information network with all weak ties ($S = 0$) will be stable if and only if

$$\{1-\lambda f(T)\}^{\lambda} < 1-\gamma f(1) \equiv 1-\gamma \tag{22}$$

This, of course, follows from substituting $S = 0$ into Eq. 21.

Case 4: The Stability of a "Trust" Equilibrium

A network composed solely of strong ties ($W = 0$) will be stable if and only if

$$1-\gamma f\left(\frac{T}{\lambda}\right) < \{1-\gamma[1-\mu]^{T/\lambda}\}^{\lambda} \tag{23}$$

This follows from substituting $S = T / \lambda$ into Eq. 20.

3. Simulation and Numerical Analysis Using the Combinatorial Optimization Model

The behavior and predictions of the combinatorial optimization model are investigated using a simulation analysis.[4] Once again, the problem facing the legislator L is to choose strong or weak ties,

[4] The simulations were conducting using SAS, and the code is available from the author upon request.

subject to a time budget, so as to maximize the probability of obtaining new information from an informant. The optimal allocation of the time budget between strong and weak ties is a function of four parameters: the demand for information μ (which is assumed to vary across issues), the total time budget T (assumed constant), and the proportional constant λ that relates the cost of a strong tie to a weak tie. The computational model provides predictions based upon individual rationality assumptions conforming to the Nash equilibrium, as well as a social (Pareto) network efficiency criterion, based upon the number of strong contacts made by L.

The general findings from the simulated combinatorial optimization model provide us with several predictions about the organization and efficiency of information networks within the United States Congress. As in previous analyses of the model (Boorman 1975; Esterling, et al. 1997), both individually rational and socially efficient solutions appear to be a function of the level of policy interest exhibited by individuals within the network. However, unlike previous treatments, the current simulation also demonstrates that these solutions appear to be sensitive to both the size of the network and the cost of information exchange.

According to Boorman's initial numerical analysis of the model, two results are most prominent.[5] First, when the demand for new information is low, an all weak ties network is a stable, unique equilibrium with Pareto optimal properties. Yet, as the demand for information increases, it is rational for individual actors to increase the number of strong ties they maintain. Indeed, this second result goes even further by demonstrating that, under high levels of information demand, an all strong ties strategy is most rational. However, unfortunately, Boorman shows that this individually rational solution is not socially efficient.

If the predictions made by Boorman were to be deemed an accurate reflection of legislative behavior, the implications would be no less than troubling. Boorman's network analysis would suggest

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[5] It is interesting to note that the Esterling, et al. analysis stipulates the exact parameter values used by Boorman, and, of course, their findings are identical.

that legislators with greater levels of interest in an issue would are more likely to establish strong ties with potential informants than those with lower interest. It follows from this result that "high-demand legislators" – those legislators who expect greater distributional benefits from a policy – would have a greater probability of acquiring policy information and would hold a clear informational advantage over their "low-demand" counterparts. This would create an asymmetry of information within the legislature, an asymmetry that might affect the coherence of legislation by creating a policy that is more reflective of the desires of an interested few. It is an asymmetry of information caused not simply by institutional privileges, rather the asymmetry arises out of the purposive behavior of election-minded legislators.

To continue on this point, it is important to note that the prediction of informational asymmetries and inefficiency is not limited to the relationship between legislative committees and the floor. In *Information and Legislative Organization* (1991), Keith Krehbiel provides an extensive discussion of the potential for informational asymmetries between congressional committees and their colleagues on the floor. Krehbiel argues that this potentiality can be remedied through concoction of heterogenously composed committees and closed rules on the floor. However, the network approach clearly demonstrates that information asymmetries can also arise at the individual level and may not be simply a function of committee membership.

What remains to be seen is whether Boorman's simulated predictions hold when the combinatorial optimization model is expressly simulated to represent legislative behavior.[6] In order to do this, it is necessary that the parameter values be changed to provide a model which is more reflective of the legislative arena. In his original analysis, Boorman specified the parameter values in the following manner: $T = 100$, $\lambda = 10$, and $\delta = 0.05$. These parameters and the predictions that are derived from them are satisfactory for a medium-sized legislature, such as the U.S. Senate. Alternatively, I set $T = 434$, which, in this example, allows legislator L the opportunity to create a weak tie ($W = 1$) between himself

[6] Boorman's original model was aimed at explaining the exchange of employment information within a social network.

and the 434 other members of the House of Representatives. I then set $\lambda = 7$, because it is a factor of 434. This value sets the maximum number of strong ties to 62, thereby making an all strong tie strategy (62, 0) and an all weak tie strategy (0, 434). Lastly, I provide each of the 434 remaining members of the legislature with a roughly equal chance of obtaining the new information ($\delta = .0023$).

Figure 1 summarizes the results of my simulation of the legislative information network using the combinatorial optimization model. Several pointed features of the model's behavior are noteworthy. First, at very low levels of information demand ($\mu = .01, .02$), the probability of acquiring the new information is maximized by following an all weak tie strategy, as represented by the symmetric group optimum. The finding is similar to Boorman's, and it implies that the most socially efficient network configuration when information demand is low is one composed solely of weak contacts. From the perspective of the legislature, this intuitive finding suggests that the legislative body is "better off" if its membership does not invest its time in issues that are of little importance. When legislators deviate from this all weak ties strategy, they may be creating negative externalities for the body. That is, abandoning an all weak tie strategy in this case would mark a decrease in the informational efficiency of the network as a whole, creating an unnecessary allocation of network resources.

[Insert Figure 1 About Here]

Yet, despite this obviously beneficial group strategy, an all weak ties strategy may not be entirely rational from an individual perspective. In fact, the all weak ties strategy at this extremely low level of interest is not Nash Stable. Individual legislators may benefit from changing their (S, W) strategies by increasing the number of strong ties they possess. An example of this type of behavior might be termed information prospecting. Imagine the case where a member of Congress increases the strength of his information network on a presently unimportant issue in the hope that the issue will gain in importance over time. If the issue were to attain importance, the member clearly would be in a position to benefit from his informational advantage over his colleagues.[7]

A second notable feature of the simulation, is the relationship between the maximum and the demand for information μ. While an all weak ties strategy is optimal at extremely low levels of interest, the optimal number of strong ties quickly increases as μ increases, only to decrease in number as μ becomes greater than the .04 level. The nonlinear relationship between the SGO and μ is interesting. A similar finding was made by Boorman, but he inexplicably gives it little interpretation. This initial positive relationship between the two variables follows individual logic, but the results of the simulation warn against continuing along this linear path. Indeed, such behavior appears to be irrational. Alternatively, legislators maximize their probability of obtaining important new information by maximizing the number of contacts they possess through the acquisition of weak ties. Also, I believe that it is important that we remember that the SGO is not simply an individual-level prediction; it is also a group-level prediction by means of the symmetrical assumption. With this in mind, the efficiency of a loosely configured network when interest is high seemingly provides a normative declaration: When an issue is important, the legislature is better off if no one holds an informational advantage.

Are these results stable from the perspective of individual rationality? According to the simulation, the general answer is yes. As shown in Figure 1, multiple Nash equilibria exists over a broad range of demand for information. The number of equilibria appears to be conditional upon the number of strong ties and/or the level of information demand. Importantly, all but three of the symmetric group optima coincide with a Nash equilibrium point. At the very ends of the interest continuum, however, Nash equilibria do not exist. This finding suggests that, when the demand for information is at its highest or lowest, the strategic (S, W) profiles of individual legislators will by highly unstable.

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[7] It is logical that an individual may wish to abandon all ties ($S = 0$, $W = 0$) when interest in a policy is extremely low. Such a position would be consistent with a proposition that I have derived elsewhere (Gomez 1999, Chapter 2): On issues that do not relate to the interest of their constituents, members of Congress will not initiate information search activities. Unfortunately, this behavior is not allowed within the constructs of the present model; its possibility, however, should be noted.

4. The Ties that Bind: An Empirical Analysis

Based upon what we have learned from the combinatorial optimization model, this section empirically examines the cultivation of weak and strong ties in the legislative setting. Specifically, I will construct a statistical model for determining the number of strong and weak ties undertaken within a legislative information network. The predictions from this model will then be compared to the predictions of the combinatorial optimization model

4.1 Data and Measures

One might expect that the availability of data on the information exchange patterns of members of Congress is virtually nonexistent. Unfortunately, that would be correct. Presently, and to the best of my knowledge, no such data exist. Yet, while this greatly limits our ability to study information exchange networks between legislators; I believe that it does not strictly prohibit it.

As an alternative to directly examining information exchange between members of Congress, I propose to study the informational ties established by their staffs. Three main justifications for studying congressional staff as an appropriate proxy can be made. First, since the close of the 1950s, the total number of congressional staff members has more than tripled (Ornstein, Mann, and Malbin 1998). With an ever expanding workload in Congress, staffers have become the eyes and ears of members – the search engines, if you will. Second, if compliant, the congressional staff working as the agent of the member – in combination, known as the "congressional enterprise" (Salisbury and Shepsle 1981; Whiteman 1995) – may in fact mimmick the behavioral patterns of the member of Congress, choosing and/or conferring importance on similar issues and information sources.[8] Lastly, another reason to study the behavior of staff members, and one not to be taken lightly, is that network data on congressional staff are available for study.

[8] Whiteman argues that staff, particularly committee staff, frequently demonstrates a great deal of autonomy from the member.

The data used in this analysis were made available by David Whiteman and were used in his study *Communication in Congress: Members, Staff, and the Search for Information*.[9] Whiteman's study focuses on the informative behavior undertaken by congressional enterprises on four issues: Medicare physician payment reform, childhood vaccine injury compensation, airport gate allotments, and the transportation of hazardous materials. Whiteman's design consisted of three stages. First, Whiteman conducted an initial set of interviews with committee and personal staffers working on the respective issues in both the House and Senate. In the second stage, Whiteman immersed himself in the policy process, identifying and interviewing active participants from within Congress, the executive branch, and interest groups. Finally, during the third stage, Whiteman conducted follow-up interviews of those individuals who participated in stage one interviews. It was during these follow-up interviews with staffers that Whiteman also asked them to complete a network roster. The roster consisted of a list of the names of all individuals identified by Whiteman – through interviews and personal knowledge attained during the previous stages – as being involved on the issue that the staff member was working on. Whiteman asked the staffers to provide some indication of their communication pattern with each actor according to the following scheme:

5 = Very Frequently (Daily at peak periods/Weekly otherwise)

4 = Frequently (Weekly at peak periods/Monthly otherwise)

3 = Infrequently (Monthly or less)

2 = Never (Only recognize name)

1 = Never (Don't recognize name)

In order to complete this analysis, the roster data has been combined with the final interviews so that attitudinal and demographic measures can be used to predict network strategies. Assuming the equivalence of tie strength and frequency of contact, the roster data also has been recoded so that

[9] I would like to thank David Whiteman for the use of his data. Of course, responsibility for errors in analysis and interpretation is mine.

categories 5 and 4 are considered to strong tie contacts and category 3 is considered a weak tie of the staffer. Categories 2 and 1 were eliminated from the analysis.

Table 1 present the summary statistics associated with the number of strong tie and weak tie contacts made by staffers; the table also present statistics for the full network. Despite the relatively low salience of Whiteman's chosen issues, the size of the information networks is fairly large. The average network size contains roughly 41 contacts and ranges from a minimum sized network of 6 to the largest network of 61 individuals. An examination of the minimum values brings forth another interesting observation: both all strong tie and all weak tie network exists, in line with the behavior of the combinatorial optimization model in cases 3 and 4. Perhaps the most interesting finding from the summary statistics is the fact that the average number of strong ties is greater than the average number of weak tie contacts. Staffers appear to invest more time in developing trusted contacts rather than acquaintances. Finally, the correlation between the number of strong and weak ties is -.2647 ($p < .01$). The strength of this linear relationship is only moderately strong and does not appear to be a direct affine transformation. However, the statistically significant relationship between the types of ties does substantiate the combinatorial optimization models assumption of a constraining time budget.

[Insert Table 1 About Here]

Finally, the final interviews conducted by Whiteman allow me the opportunity to examine several factors that might affect the allocation of weak and strong ties. Foremost among these variables are three measures which convey the level of interest each congressional enterprise associated with the respective issues. For the measure, DISTRICT, staffers were asked "How important is [issue] for your member's district?" PRIORITY asks "How important is [issue] to your member's legislative priorities?" Lastly, the variable INFLUENCE asked staffers "To what extent is this issue one on which your member wants to make a special mark – demonstrating influence in policy-making?" I associate these three variables most closely with the demand for information μ concept articulated in the combinatorial optimization model.

4.2 A Model of Strong Tie – Weak Tie Allocations

The dependent variables used in these analyses, the number of strong ties and weak ties respectively, are both non-negative integers. Under these conditions, conventional Ordinary Least Squares techniques can be "very inefficient, [can] have inconsistent standard errors, and may produce negative predictions for the number of events" (King 1989a, 763). Consequently, event count regression techniques will be used in order to estimate the number of ties maintained by legislative staffers.

Both analyses utilize Gary King's (1989a; 1989b) Generalized Event Count (GEC) model.[10] The model is an unique estimation tool for event count data, in that it allows for alternative functional forms to be specified. If the number of ties are independent of one another – for example, the creation of a weak tie increase the probability of the adoption of another weak tie – then the GEC model defaults to the Poisson distributional form. Alternatively, if the dependent variable is over-dispersed (i.e., variance greater than the mean), the negative binomial functional form is used; the continuous parameter binomial distribution is employed in cases of under-dispersion (variance less than the mean). Hypothetically, the social network thesis of *connectivity* would suggest that over-dispersion will be evident.

The models estimated assume that Y_{ij} (j = 1 for the number of strong ties; j = 2 for the number of weak ties) is distributed as a generalized event count random variable:

$$Y_{ij} \sim f_{\text{gec}}(\, y_i \mid \lambda_i, \sigma^2\,),$$

$$\lambda_i = exp\{\beta_0 + \beta_1(\text{District}) + \beta_2(\text{Priority}) + \beta_3(\text{Influence})$$
$$+ \beta_4(\text{Victory Margin}) + \beta_5(\text{Extreme Ideology})$$
$$+ \beta_6(\text{Party}) + \beta_7(\text{Chamber}) + \beta_8(\text{Staff Type})$$

[10] King (1989) suggests a alternative event count model, which, in principle, should be more applicable to my needs, the Seemingly Unrelated Poisson Regression Model (SUPREME). The SUPREME model allows for the estimation of two contemporaneously correlated event count equations and would allow me to examine the nature of the budget constraint when creating a (S, W) strategy. Yet, while the SUPREME model does provide gains in efficiency when compared to poisson regression or seemingly unrelated regression estimation (SURE), the model often very difficult to optimize. Indeed, after repeated trials, no satisfactory convergence criterion for my application of the SUPREME model could be found. Therefore, I employ the GEC model as the next best alternative.

$$+ \beta_9(\textsc{Gender}) + \beta_{10}(\textsc{Race}) + \beta_{11}(\textsc{Experience})\} \tag{24}$$

where the number of (strong, weak) ties is a function of the three information demand variables, factors associated with the congressional enterprise, and staff member specific variables.

Certain political variables associated with the member of Congress should effect his/her entire congressional enterprise. First, the member of Congress' margin of victory in the last election should affect the size of the information network. Members from marginal districts should seek out more information in order to minimize future electoral risks. Therefore, as the VICTORY MARGIN increases, network size should decrease. Second, ideological extremist should also have substantially small information networks. Extremists generally acquire clear signals from the information stream and, consequently, have little need to maintain alternative sources of information. Lastly, I add two control variables associated with the congressional enterprises, PARTY and CHAMBER, in order to control for partisan or institutional differences in networks.

Factors specific to the legislative staffer must also be accounted for. First, the data are composed of information from both personal and committee staffers. Because of their institutional role, committee staffers should possess significantly more network contacts than their personal staff counterparts, but the bulk of these ties should be weak in nature. Committee staffers frequently work at the behest of both political parties, and they generally maintain a greater degree of independence than personal staffers. Second, staffers with more years of EXPERIENCE in the Congress should have a larger reservoir of information sources, making them more likely to possess ties than their junior colleagues. Finally, I include controls for both GENDER and RACE in order to examine whether women and blacks are systematically excluded from developing network ties in a predominantly white, male environment.

4.3 Findings

The results from the Generalized Event Count models provide a good deal of insight into the decision making processes and strategies used when establishing a legislative information network.

Overall, as can be seen in Table 2, the two models perform very well. A majority of the variables in the strong tie equation are statistically significant at the .10 level, and four of the variables are similarly significant when predicting the number of weak ties. Also, in both equations, the GEC model suggests that both strong tie and, to some extent, weak tie acquisition are over-dispersed, indicating that the maintenance of a tie increases the probability of acquiring another tie – this finding is consistent with the social network notion of connectivity, whereby existing contacts assist in establishing additional contacts.

The combinatorial optimization model asserts that the number of strong ties maintained within the legislative information network is, in part, a function of the actor's demand for information. The empirical models provide some substantiation of this assertion. I've included three variables that suggest a "demand" for information, and one of these variables is statistically related to the acquisition of strong ties. Indeed, the result is very interesting. Theory tells us that strong tie relationships should be the most influential, since they require a greater degree of credibility and allow for the dissemination of more information. However, the staffs of members who are seeking influence are significantly less likely to enter into strong tie relationships (D = -9.244). While such a result initially does not appear intuitive, we must recall that, in fact, the result is consistent with the declining number of strong ties predicted for higher values of information demand. Instead of broadcasting their message (the variable is not significantly increase the number of weak ties), members seeking influence appear to concentrate their efforts at persuasion on only a few strong ties.

The demand for information manifests itself in the form of constituency interest when we examine the number of weak tie contacts. In fact, the DISTRICT variable is the only measure of demand that significantly predicts weak tie acquisitions. Congressional staffers are more likely (D = 9.160) to accumulate weak ties when the constituency's interest is involved. Interestingly, we cannot view these acquaintance contacts as being potential points of influence due to the contemporaneous inclusion of the INFLUENCE variable. Instead, these weak tie contacts would appear to be held as a vehicle for information acquisition. Since the information disseminated through weak ties is probably not highly substantive, these weak ties presumably convey political information, transmitting information about the distribution preferences within the legislative environment.

Not surprisingly, factors associated with staff members themselves greatly effect the number of strong ties that are maintained. All four staff variables reach statistical significance. First, as expected, committee staffers systematically possess fewer strong ties than personal staffers (D = -4.097). Since the mission of committee staffers is generally committee specific, this finding seems to indicate that they need fewer ties than staffers working for all of the member's interests. Alternatively, the finding may provide some confirmation of the idea that committee staffers wish to remain independent of other actors. The evidence might also suggest that committee staffers simply rely on their own personal research and not second hand information. This is not to say that committee staffers do not maintain contacts. Indeed, committee staffers are more likely than personal staffers to possess weak tie contacts (D = 8.151). However, the symmetrical nature of these ties must remain suspect. The weak tie relationships with other legislative actors may be one-sided. It may be that committee staffers are the informants in these relationships and not the information seekers. Unfortunately, evidence on this point does not exist, leaving future research to investigate this point.

It was originally hypothesized that the number of maintained ties would increase with the legislative staffers tenure of service. Since both strong and weak ties are the product of the allocation of time, it follows that staffers with more years of experience in Congress would have had the opportunity to acquire a greater number of contacts than junior staffers. However, the evidence indicates that senior staffers do not differ from less experienced colleagues with regard to the number of weak tie contacts. Moreover, the evidence also suggests that senior staffers may "close ranks" by maintaining only a few trusted contacts (D = -7.517) later in tenure. Since one would assume that senior staffers have the greatest policy influence, the evidence presented here points to the existence of "tighter" – both small and strong – networks at the highest ranks. These oligarchical tendencies, and their possible impact on policy making, deserve further examination.

That access within networks is frequently limited is certainly not surprising. Possibly the clearest demonstration of this fact is provided by the association of the GENDER and RACE variables to the number of strong ties. Access to strong ties within networks appears to be systematically biased against women (D = -2.575) and blacks (D = -3.729). In both cases, the minority groups possess significantly fewer strong ties than males and whites. Combined with the effect of the EXPERIENCE variable, the evidence provided here attests to the existence of a quintessential "old (white) boys network." Minority groups do appear to be included in weak tie networks, but they are not given close access.

5. Discussion

In this paper, I have examined the rational foundations of the legislative information network. These networks are an institutionalized means by which rational members of Congress can allay the costs associated with information acquisition through the transference of these costs to other legislative actors. That the legislative arena is a forum for information transaction is in little doubt; it has long been noted that members of Congress engage in cue-exchange relationships. However, this paper has expanded upon this precept by claiming that these informative relationships are informally institutionalized. "Who speaks to whom" is not simply a matter of individual choice; it is also a matter of legislative efficiency.

The findings from the combinatorial optimization model point to both the micro-foundations and social optimality of the legislative network. Both individually rational and socially efficient solutions appear to be a function of the level of policy interest exhibited within the network, and, for the most part, both qualities seem to coexist. However, an important deviations between the two desirable qualities do occur. At very high levels of interest, for instance, it is socially beneficial for the legislature if the information network is composed predominantly of weak ties, but such a configuration is not necessarily individually rational. Under these conditions, individual legislators have an incentive to acquire additional strong ties, thereby creating an informational advantage for themselves, but inadvertantly creating inefficiencies within the body. The resultant externality demonstrates the potential perils of these informal institutions. While the legislative information network is founded upon the rational actions of individual legislators, the network, which is not formally defined, is also a potential catalyst for informational asymmetries and incoherent public policy.

Empirically, the legislative information network behaves in a manner consistent with the combinatorial optimization model. For instance, both strong and weak ties are acquired as a function of the legislator's interest in the policy at hand, although each for different reasons. However, the most interesting implication of this research is the potential for informational asymmetries. The empirical evidence demonstrates that access to strong ties within the legislative information network – the type of contacts which transfer the most information and allow for the most influence – is systematically restricted. Junior staffers, women, and blacks apparently do not find the legislative information network to be a permeable institution; each is significantly less likely to maintain strong ties than they counterparts. The implication from this finding is that the legislative information network may have a conservative effect on public policy making by limiting the emergence of new and/or diverse ideas.

Table 1. Summary Statistics for the Legislative Information Network.

	Weak Ties	Strong Ties	Total Network
Minimum	0	0	6
Maximum	44	61	61
Average	15.8	22.1	40.9

Correlation between Weak and Strong Ties = -.2647, significant at .01

Table 2. Generalized Event Count Models of Strong and Weak Tie Allocations.

Independent Variables	**Strong Ties** β (S.E.)	*D*	**Weak Ties** β (S.E.)	*D*
Constant	3.830 (.171)		1.091 (.358)	
District	- .020 (.031)	-1.316	.239 (.059)	9.160
Priority	.026 (.036)	- 1.660	.124 (.082)	4.918
Influence	.138 (.041)	- 9.244	.080 (.067)	3.239
Victory Margin	- .001 (.002)	- 1.203	.008 (.004)	6.148
Extreme Ideology	- .002 (.001)	- 1.708	- .003 (.003)	- 2.332
Party	.009 (.039)	.187	- .209 (.176)	- 2.917
Chamber	- .408 (.061)	- 8.689	.405 (.160)	5.699
Staff Type	- .203 (.072)	- 4.097	.502 (.107)	8.151
Gender	- .121 (.051)	- 2.575	- .031 (.103)	- .424
Race	- .185 (.066)	- 3.729	.142 (.120)	2.053
Experience	- .021 (.006)	- 7.517	.017 (.010)	4.469
σ^2	1.187 (.091)		1.869 (.101)	
Log Likelihood =	12478.656***		7470.606***	
n =	257		257	

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