Models of Metropolitan Cooperation

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In the mid-1990s, issues of metropolitan governance and the possibility of cooperative agreements among cities were raised by several journalists and public officials (Pierce, 1994; Rusk, 1993; Orfield, 1997). Academics began writing on the topic as well, though more often to point out the limitations and political infeasibility of achieving these changes on a wide scale (Downs, 1994). Topics and policy recommendations have evolved partly in response to those criticisms. Attention has shifted from metropolitan government efforts that would establish new area-wide government units to metropolitan governance with an emphasis on informal or limited service arrangements -- e.g. intergovernmental compacts, special districts (Hamilton, 1999; Wallis, 1994). But for all the recent attention, we still have a limited understanding of the conditions under which cities are likely to cooperate.

There have been two major problems with this previous research. First, regional governance efforts have focused on very different types of services or issues, but the same generic explanations have been applied to them. The fact that characteristics of the different services, such as exclusion or rivalry in consumption, or characteristics of different cities, such as relative size and diversity of preferences, could influence the likelihood of cooperation has rarely been explicitly recognized. Second, while studies of cooperation in other areas of political science have exploded in the last decade, little of
this work has been used to analyze cooperation in metropolitan politics. Regional interactions are rarely explicitly modeled, and when they have been, typically the same model has been used regardless of the underlying characteristics of the services or cities involved. The goals of this paper are first to describe the significant differences among cities and policy areas that would affect likely levels of cooperation, then to review several commonly used models of cooperation to assess their appropriateness for modeling metropolitan relationships.

**Characteristics of cities and local issues:**

I identify four characteristics of cities and local issues that are critical in efforts to achieve cooperation. The models discussed in the second section differ on how they incorporate these characteristics and therefore which would be most appropriate to any given situation.

First, there must be joint gains from cooperation. This is a simple rationality claim, that cities will not change service arrangements unless each benefits from doing so. The more serious the underlying problem, the larger the aggregate gains from resolving it, and the greater the likelihood of cooperation to do so. This condition has most often been noted in the resolution of common property resource problems. As losses from overconsumption increase, it is more likely that all parties involved will seek some agreement to restrict use (Lipecap, 1989; Lubell, et.al., 2002; Ostrom, 1990; Ostrom, Gardner, and Walter, 1994). Work on public goods provision also note the necessity for aggregate gains to exceed aggregate costs of provision, with the greater the margin, the greater the ability of the collective to provide selective incentives or attract a
political entrepreneur to organize the group (Olson, 1971; Hardin, 1982). Joint gains require that a Pareto-optimal outcome exists and is realizable -- that another outcome can be achieved where no one is made worse off and at least one participant is made better off.

However, even when the potential for aggregate gains are large, conflict over the distribution of the gains can prevent any change. Allocation of these joint gains will be affected by the level of asymmetry between players in terms of their preferences and political strengths. The greater the heterogeneity of the participants, the more clear-cut which players win the most, and the higher the political opposition to any cooperative solution may be. Joint gains are necessary but far from sufficient in establishing cooperative relationships. (Lipecap, 1989; Riker and Sened)

This leads to the second critical feature affecting the probability of cooperation, the diversity in preferences among the participants. Diversity of preferences can exist at two levels. First, participants may disagree over the policy goal. Second, they may agree with the overall goal but then disagree over division of the policy outcome. Disagreement over the goal itself is likely in zero-sum situations. Where one city's win means the other must lose, conflict and competition will define the situation. The participants' preferences diverge over the policy goal itself in that each prefers the outcome favorable to himself. Note that it is still possible that there are joint gains to be had in this case, but if the good is indivisible and rivalrous in consumption then only one participant can receive the prize. The other participants benefits only through reduced costs by not engaging in competition for the good.
Economic development has often been treated as this type of policy. Cities are in competition with each other over the 'good' -- the new businesses and tax base that they can attract. If one wins, the others lose. The new firm location is both exclusive and rivalrous in consumption. While less often characterized this way, debates over public 'bads' or locally unwanted land uses, including affordable housing, also fall into this category. The community forced to accept the unwanted land use suffers a loss while other communities benefit. Both these cases --competition to attract the good and to avoid the bad -- suggest land use decision in general may fall into this 'total conflict' category.

The second possibility is that all participants agree with the overall goal, but disagree with division of the outcome. Club goods -- rivalrous in consumption but with limited exclusion -- are likely to fall into this class. Participants may agree to jointly provide a service for members of the coalition only, establishing exclusion between those who join and those who do not. However, the indivisible nature of the good means that within the jurisdictions, exclusion is not complete. Police and fire services exhibit these characteristics. The participants may all agree that coordinated action will lead to a higher overall level of safety, but the rivalrous nature of the good and lack of exclusion within the compact make it difficult to determine how that larger level of benefits will be divided or how new costs will be shared. Preferences are similar at the first level, but then diverge at the second. Cooperation in these situations is dependent on the relationship between the value of the cooperative outcome and each player's ideal point. A player would choose cooperate if the gain from the cooperation outcome over the
status quo is greater than the foregone gain between the cooperative outcome and his ideal point (Alesina)

Finally, participants could be in agreement on both the level and division of the service, so preference convergence is complete. This can occur for some system maintenance services, such as sewer and water or refuse collection. Because the amount of service received is divisible, easily measured, and rivalrous in consumption, the equivalent of a market within the regional compact can be created. Costs are allocated on the basis of benefits received through user fees. Total benefits levels may vary across jurisdictions, possibly due to differences in size, but total fees paid also vary in accordance. Preferences on providing the service and then on its benefit/cost distribution are likely to be similar for all participants in the regional compact. Cooperation should be easiest to achieve with these types of services.

Besides differences in policy preferences, participants may also differ in their political power. The third critical characteristic that affects the likelihood of cooperation is the level of symmetry in this strength across the players. The power of each relative to the others is the result of three factors: need for the service (what will be the value of the alternative or status quo), their discount factor (how critical is it that the service be provided soon), and their level of risk aversion (willingness to trade-off a sure thing versus a chance at something better). If the asymmetry of the participants is too great, no cooperative outcome may be feasible. The power of some players may lead them to demand more than any joint gains possible from a cooperative agreement. Where an agreement can be reached, the stronger player will be able to command more of the division of the spoils for himself.
The issue of the discount factor as a source of participant strength brings in the issue of time. The fourth characteristic that can affect a cooperative outcome is stability of the players' positions over time. The cooperative agreement itself may alter the strength of the participants, as well as outside forces. If the agreement requires players to make investments in specific assets or other long-term commitments, it can alter the outcomes that would be available to them if the agreement broke down in the future. A compact to forego construction of infrastructure or to refuse to compete for new businesses in return for current tax-base shares may reduce the growth opportunities available to a city in the future. The higher the cost to the participant of these precluded options, the lower the discounted payoff to that participant from cooperation. Preferences of the participants may also diverge over time. Changes in the population of the city, political representatives, fiscal capacity, or other factors may lead participants' value of the cooperative outcome to change over time. The greater the differences in investments and the probability that preferences will drift apart over time, the less likely a cooperative agreement will be made, and any agreement will require additional bonding or sanctioning commitments to be made.

Any model of cooperation must incorporate these four characteristics, summarized in Table One. Let us now consider several of the models used to explain metropolitan interactions and determine how they incorporate these features with an eye to assessing when each might be a good model of regional cooperation.
Prisoner's Dilemma

The single-play Prisoners' Dilemma game has probably been the model most commonly used to study metropolitan relationships, especially in the area of economic development (Bowman, 1988; Grady, 1986; Green and Fleischmann, 1989, 1991; Peretz, 1986; Rubin and Rubin, 1987; Schneider, 1989; Wolman, 1988). A large part of its appeal is that the payoff structure does seem to capture the inherently competitive nature of relationships among cities. However, as discussed below, this game depends on several very strong assumptions which rarely hold among cities.

The standard payoff structure of the Prisoner's Dilemma game is shown in Figure One. Each city must choose between a Cooperate or Defect strategy, such as refusing to offer location incentives or offering them. Because B is greater than A and D is greater than C, when each city considers what to do it will always be better off with the returns from the defect strategy, regardless of what the other city does. Since each player has a dominant strategy of defecting, there is only one possible outcome of the game (D,D). This outcome is a Nash Equilibrium, meaning that no player has an incentive to unilaterally switch to a different strategy because his payoff with the new outcome would be less.

But this is not a Pareto-optimal outcome. If all cities choose Cooperate, each would be made better off compared to the (D,D) outcome. The (C,C) outcome is not a Nash Equilibrium, however, because if Player One chose to Cooperate, Player Two could make himself better off by defecting ((B>A) and vice versa. In the case of cities competing for development, any individual city could improve its position if it defected and offered some incentives while its competitors did not. It would then attract more investment than it could have in the competitive market (when all cities refused to offer concessions). It even could
reap these gains by offering a fairly low level of incentives because its competitors (who chose the Cooperate strategy) offered none. Since each city makes the same calculation, each defects to protect itself from the negative consequences of being the only one to cooperate. All cities would offer concessions and the cooperative 'no compete' agreement would collapse.

<table>
<thead>
<tr>
<th>CITY ONE</th>
<th>Cooperate</th>
<th>Defect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A,A</td>
<td>B,C</td>
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<table>
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<tr>
<th>CITY TWO</th>
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<tbody>
<tr>
<td>Cooperate</td>
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<tr>
<td>Defect</td>
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Figure One -- Standard Prisoner's Dilemma Game

Where A<D, D>C, B>A. Player One's payoff are first, Player Two's payoff second.

While initially plausible, the Prisoner's Dilemma game does not stand up to scrutiny even in the area of economic development. Considering the four characteristics defined in the first section, the Prisoners' Dilemma game is particularly limited in addressing divergence in preferences, asymmetry in player positions, and stability of the game over time. The model assumes all players are interchangeable -- they have the same preferences for development and the same political power. Neither is true. The existence of slow-growth and anti-growth movements in various parts of the country, plus strict zoning regulations that maintain wealthy, residential-only suburbs belies the first claim. Equal
positions imply that each city faces the same status quo without the cooperative
development policy, i.e. each would attract the same level and type of economic growth.
Cities differ significantly in the other features they can offer new businesses -- quality of the
workforce, wage rates, access to markets for inputs or the final product, and so forth. Cities
that would attract considerable growth even without the regional agreement will be able to
demand more of the benefits from an agreement, rather than accepting the symmetric
division of the joint gains that the Prisoners' Dilemma model dictates. Finally, the static
nature of the model does not allow for the impact of repeated play or any changes over time
that would either make cooperation more or less likely. As we will see later, repeated
interactions with the same players can significantly change the dynamics of the game,
providing implicit communication, permitting trade-offs of benefits in one interactions for
higher costs in another, and incorporating safeguards for changes in the player's positions or
preferences over time.

These limitations of the Prisoners' Dilemma have been addressed in three ways,
each of which leads to a new model. First the payoff structure was changed, leading to
an Assurance Game. Second, repeated play was introduced leading to the Iterated
Prisoner's Dilemma Game. Third, variation in player preferences and political power was
added in Bargaining Games.

**Assurance Game**

In the Assurance game, the payoff structure is changed so that Defect is no longer
a dominant strategy. This can be seen in Figure Two. Each player would prefer to
cooperate if the other player did as well (A>B, unlike in the Prisoners' Dilemma Game),
but prefer to defect if the other player did so (C>D, unchanged from the Prisoner's Dilemma). There is a clear Pareto-optimal outcome of both cooperate (A>D) which is also a Nash Equilibrium. All participants want to be at the (C,C) Nash equilibrium -- if Player One knows that Player Two will cooperate he has no incentive to defect, his payoff is highest if he also cooperates. Conversely if Player one knows that Player Two will defect, he also wants to defect. The payoff will be less than when both cooperate but greater than cooperating while the other player defects. (C,C) is a Nash equilibrium in this case, which it was not for the Prisoners' Dilemma.

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**Figure Two -- Standard Assurance Game**

Where A>D, D>C, B<A. Player One's payoff is given first, Player Two's payoff second. Nash Equilibrium outcomes are starred.

<table>
<thead>
<tr>
<th>CITY ONE</th>
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<th>Defect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperate</td>
<td>A,A *</td>
<td>C,B</td>
</tr>
<tr>
<td>Defect</td>
<td>B,C</td>
<td>D,D *</td>
</tr>
</tbody>
</table>

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The difficulty is that there are two Nash equilibrium in this game: (C,C) and (D,D). If both players must choose simultaneously and without communication it is not certain that each will play Cooperate. If one player is very risk averse and uses a Maximin decision criteria that focuses on maximizing the value of his lowest possible payoff (which would occur when the other player defects), he would play defect. If both use this strategy, there would be no incentive to change it in future play because (D,D) is a Nash Equilibrium. While one player may realize there is a better strategy available, he cannot be sure that the other player shares his realization. In the real world,
communication between the players can allow them to determine what strategy each
would play and to realized that matched strategies of (C,C) would be best.

In the case of metropolitan cooperation, since communication is possible, the
question of whether players will be able to reach a cooperative agreement is not of
particular interest. Of more importance is the likelihood that this payoff structure exists
or could be created, since it would then lead to cooperative outcomes. The Assurance
Game corresponds to the case where preferences are in complete convergence. All
players prefer the (C,C) outcome. The Prisoners' Dilemma structure in contrast
corresponds to the case where preferences are in complete conflict. The only way for
each player to get his own largest payoff is to take an action (defect) that will lower the
other player's payoff. In cases where preferences have both features -- convergence on
provision of the services but conflict over the division of it -- a nested model where the
final payoffs combine the results from both the Assurance Game (provide or not) and the
Prisoners' Dilemma Game (individual benefits greater than individual costs) is necessary.

Policy recommendations regarding the way out of a Prisoners' Dilemma game
have focused on recasting it as an Assurance Game by lowering the Defect payoff
through sanctions or increasing the Cooperate payoff through incentives. When the
players are individuals this may be done by appeal to solidarity incentives (Chong, 1991).
But for metropolitan politics, participants are political representatives (agents) whose
utility function is more limited to effects on constituents (principals). Appeals to
personal utility are less likely to be effective. Selective incentives for cooperation may
require linking payoffs across games or different service provisions. For example,
economic development policies have been linked to state infrastructure policies.
While the Assurance game does increase the chances of a cooperative outcome, it is still fails to capture several relevant characteristics of metropolitan politics. As a symmetric game, players are still interchangeable, with preferences and positions in convergence. The static nature of the game is not a concern if players are able to communicate because the preferred outcome is also a Nash outcome. Repeated play will not change the prediction in that case. However, a focus only on the static version again obscures the possibilities of changes in the symmetric positions and preferences of the players over time.

**Iterated Prisoners' Dilemma**

While the Assurance Game increases the chances of cooperation by linking the Prisoners' Dilemma payoffs to those in other areas, the Iterated Prisoner's Dilemma Game (IPD) relies on the impact of repeated interactions to change the payoffs available to participants. Players attempt to maximize their payoffs over the entire course of interactions with each other. A strategy of Always Defect will provide the highest payoffs only if the other player also plays Always Defect. If there is any probability that Player Two may play Cooperate, then Player One could improve his total payoff by using a different strategy that includes cooperation.

Several parameters affect the optimal choice of strategy and therefore level of cooperation in this case. Uncertainty over the ending point of the game, discount rate of the players, and the relative size of the payoffs can induce cooperation in early rounds because of the value of future payoffs. Credible sanctions either internally or externally
imposed also work to maintain the cooperate strategy. All are related to the possibility that future benefits from cooperation will be greater than current benefits from defection.

The relative size of the payoffs for defect and cooperate influence the possibility that sanctions that can be imposed against a player who defects. Sanctions in this game are generally imposed by the other players through their decision to also defect in later rounds following one initial defection by a player. The cost to the sanctioning player cannot be so high that he would be better off not imposing the cost, while still high enough to prevent the other player from consistently using the defect strategy.

Expectations about the number of rounds in the game affect the player decisions as well. The higher a player's expectation that the game is nearing the end the more weight he attaches to current payoffs. Risk aversion is closely tied to these estimates when there is no natural stopping point. Risk aversion is the willingness of a participant to accept a lower amount that is a certainty (a payoff today) than the same or even higher amount that is the result of a gamble (a payoff in the next round if the player is not certain there will be a next round). Greater risk aversion will lead to a greater probability of choosing to Defect in early rounds because the lower but certain payoff has greater value to the player than a higher but risky payoff in the future.

The same is true for a player's discount value. Even if future payoffs would occur with certainty, they are generally worth less because the benefits are not immediately available. The more impact that present conditions have on the player, the higher the discount rate, and again the more weight that is attached to getting the best possible payoff in the current round of play. The more important the current payoffs are to the player, the more likely he will choose Defect. He can reap the 'sucker' payoff in that
round if the other player uses a Cooperate strategy. Even with severe sanctions for playing Defection (such as the other player never cooperating again), if a player's discount rate is sufficiently high, the benefits of early defection can outweigh the losses in future rounds.

As an illustration of these relationships, if both players utilize a Tit for Tat strategy (where they play cooperate on the first round and then match the other participant's move from the preceding round), neither player will defect as long as the common discount value (the percentage of the future payoff that would equal getting that payoff today) is greater than the larger of either \((C-A)/(A-B)\) or \((C-A)/(C-D)\) from the payoff matrix in Figure One. Cooperation can be sustained if a specific set of relationships hold. Applying this model to metropolitan politics requires solving the game to determine the parameter values (payoffs and discount rates) that would sustain cooperation as done for the Tit for Tat strategy. These values establish 'regimes' -- ranges of values where the prediction from the model would be cooperate and ranges where the prediction would be defect. Assessing the range of values for these parameters in the real world then determines the probability of cooperation among cities.

One major difficulty with this approach is the multiplicity of solutions -- both in terms of the number of Nash Equilibrium that exist and mathematically the number of parameter estimates that must be solved for in the system. Both features require simplifying assumptions to reduce the possible outcomes and mathematically restrict some of the parameter values. The most common of these simplifying assumptions has been to maintain symmetry among the players. Maintaining that assumption can limit
the applicability of this approach to the metropolitan politics arena where diversity among the players appears to be a major factor driving interactions.

The value of the Iterated Prisoners' Dilemma in studying metropolitan cooperation also depends on the assumption that the payoff structure in the single play adequately captures the participants' preferences and positions. If we believe some level of competition among cities is more likely than the agreement that underlies the Assurance Game payoffs, the IPD framework is a more accurate approach.

While the Iterated Prisoners' Dilemma game can incorporate more of the four city and policy characteristics identified in the first section than the two previous models, doing so greatly complicates the model and will still require other simplifying assumptions to make the approach workable. The last model considered in this paper can address player diversity more readily than the IPD, but at the expense of a few other assumptions.

**Bargaining Models**

The final model considered here is that of a bargaining game. This approach most explicitly takes into account possible asymmetries on player preferences and positions, the impact of repeated play, and allows for change over time. The basic bargaining game is the Nash model, which is similar to models of "splitting a pie" between two players. The size of the pie is the joint gains available form working together. Each player wants more of the item, and the more that any one player gets the less that the other will receive. The preference structure is predominantly competitive and focuses explicitly on the division of the good rather than the decision to provide or not.
At any point either player could choose to walk away from the negotiations because he could get a better deal somewhere else, including the possibility of the status quo. The value of this 'outside option' determines the minimum payoff that a player will accept in the current negotiations and strongly affects the strength of his bargaining position. Each player can have a different outside option, which might result in one or both making such large demands in the current negotiations (because they could do that well in another deal) that there is no acceptable split and the negotiations break down. At that point, it is assumed each player would take the other deal and get the value of his outside option. Cooperation between these two players would dissolve.

The solution of the bargaining game is the outcome \((x_1, x_2)\) that maximizes the Nash product, given in Figure Three. Each player gets the most that he can given the characteristics of the other player. Besides their outside options, these relevant characteristics are each player's level of risk aversion and their levels of time preference -- both capturing the value of future payoffs compared to current payoffs.

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**Figure Three -- Bilateral Bargaining Game**

\[
\begin{align*}
\text{Max} & \quad (x_1 - \beta_1)^\alpha (x_2 - \beta_2)^{1-\alpha} \\
\text{Arg} & \quad (x_1 - \beta_1)^\alpha (x_2 - \beta_2)^{1-\alpha}
\end{align*}
\]

Where:

\(\beta_i\) = the breakdown point of player i
\n\(\alpha = \log \frac{\delta_1}{\delta_1 + \delta_2}\)
\n\(1-\alpha = \log \frac{\delta_2}{\delta_1 + \delta_2}\)
\n\(\delta_i = 1 - \theta_i\) = the discount factor of player i
\n\(1 + \rho_i\)
\[ \theta_i = \text{risk aversion of player } i = [0,1] \]
\[ \rho_i = \text{rate of time preference of player } i = [0,1] \]

The solution for this game is:
- Player one: \[ x_1 = \beta_1 + \alpha(M - \beta_1 - \beta_2) \]
- Player two: \[ x_2 = \beta_2 + (1-\alpha)(M - \beta_1 - \beta_2). \]

M is the total value of the item bargained for, in most cases it is normalized to equal one (conceptually 100% of the pie) in order to simplify the presentation. The Nash solution assigns a payoff \( (x_i) \) to each player of the value of his breakdown point or outside options \( (\beta_i) \) plus some proportion \( (\alpha \text{ or } 1-\alpha) \) of what remains from \( M \) after these values have been distributed. The size of this proportion is determined by the player's time preference and risk aversion.

From the model it is fairly easy to see the direct impact that the three parameters will have on the negotiated outcome. The higher the value of a player's outside option \( (\beta_i) \), the more he can command in any given deal.

The impacts of time preference and risk aversion are slightly more difficult to see since they are combined in the discount factors \( (\delta_i) \). The ratio of the log values of these discount factors determines the allocation of the remainder after each player has satisfied his outside option demands. The ratios in the two equations must sum to one, representing complete allocation of the remaining portion. Each player's payoff depends on the level of the discount factor for the other player. The higher the discount factor, the more impatient the player is, and the more willing he is to accept less in order to ratify the deal immediately. Breaking apart the allocation fraction \( (\log \delta_i/\log \delta_1 + \log \delta_2) \) illustrates the separate effects of time preference and risk aversion.
A player's time preference reflects how important it is to him that a deal be completed today rather than in the future. This is a standard present value discount rate, where higher rates mean the value of the item declines quickly. The impact of time preference on the negotiated outcome can be seen most clearly if the value of the other factor in the allocation fraction (risk aversion) is set to a constant value. Using zero for that constant simplifies the algebra by letting the factor drop out of the formula, but comparable results would be obtained with any constant.

Setting risk aversion \( (\gamma_i) \) equal to zero, \( \delta_i = 1/(1+\rho_i) \). As \( \rho_i \) (the discount rate) increases, \( \delta_i \) decreases. Because \( \delta_i \) is always less than one, its logged value is always negative, and as \( \delta_i \) decreases the log of \( \delta_i \) takes on a larger negative value. Negative values in both the numerator and denominator of the allocation fraction cancel, so as log \( \delta_i \) becomes a larger negative number the allocation fraction as a whole increases in value. The higher allocation fraction means the other player receives a larger percentage of the remaining good. The player with the higher discount rate does worse in the negotiations. Intuitively, whichever player sees the value of the deal dropping faster if it is delayed would be more eager to get a deal now, even if that means taking a smaller portion of the value.

Risk aversion measures the player's assessment that if the deal is not concluded now the negotiations might end for some reason, usually that the other player changes his mind and the opportunity to make any deal disappears. Very risk averse players place a high probability on not seeing chance to negotiate. At the extreme, they perceive their alternatives as the current offer or nothing. Again to see the effect of changes in risk aversion, the other factor \( (\rho_i) \) in \( \delta_i \) is set to any constant. Using zero simplifies the
algebra, making the denominator of $\delta_i$ equal to one so it can be ignored. As risk aversion ($\theta_i$) increases, $\delta_i$ gets smaller. The logged value becomes a larger negative number, and the allocation fraction as a whole increases. A player with a high level of risk aversion is willing to get less in the deal in order to guarantee that it will go through now.

The relationships of the cities on these three characteristics will determine the best choice of city negotiation strategy and how much of the benefits of any cooperative arrangement each player could win.

The value of the bargaining approach is the explicit relationship between the critical features needed to generate cooperation. The value of both players' outside options determine the possibility of joint gains. The model recognizes the possibility that joint gains could exist -- based strictly on the outside options values some deal that makes both players better off is available -- but that division of the good to both players' satisfaction may still not be possible. The two levels of diversity in preferences is more directly accommodated than in the previous models. Differences in players' positions or bargaining strengths are also directly incorporated, including the outside options, time preferences, and risk aversion levels. Asymmetry can be easily incorporated by permitting each of these three values to vary across players. Changes over time in asset specificity can be included by changing the value of each player's outside option -- given the new investments how well could that city now do in negotiations with other partners
or by itself? Preference drift could be captured by changes in the difference between the two players' outside options.

The primary limitation on the Nash bargaining model approach is its assumption of complete information. Eliminating uncertainty over player moves and the underlying parameter values reduces the number of Nash Equilibrium to one, avoiding the problems in using the Iterative Prisoners' Dilemma. It is easier to analyze the effects of asymmetric players in the bargaining model than in the IPD model, in large part we have gained greater precision over the parameters we do estimate at the expense of not addressing the effects of uncertainty over the other city's goals or preferences. The trade-off across these two approaches is primarily over which factors we want to model to capture because they are more significant to our understanding of this particular situation and which can be held constant through assumptions.

Since solutions to every model will depend on the assumptions that underlie them, knowing which are critical to the model predictions and which are critical to capturing the empirical reality are important in our determination of how to study specific problems. All too often models are applied to situations without adequate consideration of whether they are the best match available to the problem of interest. This paper has attempted to lay out several models that could be appropriate for studying the issues of regional cooperation and more clearly specifying the assumptions for each and their consequent limitations.

Work on metropolitan governance and regional cooperation have included many issues -- from establishing new general purposes governments to new single purpose special districts to new interlocal service contracts. These situations do vary in the
characteristics of the policies and the governments involved. Variations that suggest more attention to matching the model used to study the situation to the features of the case will be important in furthering our understanding of the prospects for metropolitan cooperation.
BIBLIOGRAPHY


*National Civic Review.* 83 (Summer/Fall): 290.
Table One -- City And Service Characteristics that Affect Cooperation

Joint Gains

Preference Diversity
- Conflict over level and division of the policy.
- Agreement over level, but conflict over division.
- Agreement over both level and division.

Asymmetry of Players' Positions/Strengths
- Alternative to the cooperative outcome
- Time preference/discount value
- Risk aversion

Stability of Game Structure/Parameters
- Preference drift
- Asset specificity/investment
Table Two -- Types of Models and Assumptions:

**Prisoners' Dilemma Limitations**
1. Static
2. No communication between players; no learning over repeated plays
3. Competition in the payoffs, so (D,D) is dominant and Nash Equilibrium
4. No credible sanctions or external enforcement
5. Symmetric players

**Assurance Game**
1. Static
2. Communication possible; permits coordination on one of the multiple Nash Equilibrium that are possible
3. Cooperation increases payoffs, if other person cooperates. (C,C) is Nash Equilibrium but so are other outcomes
4. No sanctions, but none needed
5. Symmetric players

**Iterated Prisoners' Dilemma**
1. Repeated play with same participants.
2. Possibility for implicit communication; learn other players' strategy or types.
3. Cooperation is a possible Nash Equilibrium, but there are many others.
4. Likelihood of (C,C) outcome depends on:
   - length of play (number of rounds)
   - risk aversion; affects believes about number of iterations
   - credible sanctions possible -- either internal (achieved by other player's strategic choice to defect) or external (achieved by outside enforcement agent)
   - discount values; value of future (C,C) payoffs high enough to give up the difference between (D,C) and (C,C) today
5. Symmetric players

**Bargaining Games**
1. Repeated play possible
2. Differences in players' preferences accomodated
   - size of joint gains determines if good provided or not (outside options)
   - strength of players determines division of the good (time preference and risk aversion)
3. Differences in players' strengths/positions accomodated
4. Cooperation is a possible Nash Equilibrium, dependent on parameter values

For clarity all games are presented as two person games, though each can be extended to N-person.