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Intermunicipal health care consortia in Brazil: Strategic behavior, incentives and sustainability

Luciana Teixeira[1], Mauricio Bugarin[2]* and Maria Cristina Dourado[3]
[1]*Brazilian Chamber of Deputies, Brasília-DF, Brazil*
[2]*Ibmec São Paulo, Vila Olímpia, São Paulo-SP, Brazil*
[3]*Brazilian Finance Ministry, Escola de Administração Fazendária, Estrada de Unaí, Brasília-DF, Brazil*

SUMMARY

This article studies strategic behavior in municipal health care consortia where neighboring municipalities form a partnership to supply high-complexity health care. Each municipality partially funds the organization. Depending on the partnership contract, a free rider problem may jeopardize the organization. A municipality will default its payments if it can still benefit from the services, especially when political pressures for competing expenditure arise. The main result is that the partnership sustainability depends on punishment mechanisms to a defaulting member, the gains from joint provision of services and the overall economic environment. Possible solutions to the incentive problem are discussed. Copyright © 2006 John Wiley & Sons, Ltd.

KEY WORDS: health economics; municipalities; partnership; incentives; games

INTRODUCTION

The Brazilian Unified Health System (SUS) is a new decentralized structure for managing public health care. The new system transferred responsibilities and resources from the central government to the states as well as the municipalities. On the one hand, this process enhanced the quality of health services, increased the participation of the population, resulting in a more transparent decision making process, and adapted the supply of services to local health conditions. On the other hand, decentralization also brought inefficiencies due to the loss of economies of scale and scope, the fragmentation of services and the coordination failures. Therefore, one of the main challenges faced by the new system appears to be the trade-off between decentralization and coordination.

The process of assigning responsibilities among different levels of government is well understood by the fiscal federalism literature, which includes the devolution of

* Correspondence to: M. Bugarin, Ibmec São Paulo, Rua Quatá 300, Vila Olímpia 04546-042, São Paulo-SP, Brazil. E-mail: bugarin@isp.edu.br

autonomy principle (Wagner, 1983; Oates, 1999). This principle establishes that public goods and services shall be provided by the level of government which more closely represents the beneficiaries: Decentralized decision making can increase social welfare by adjusting provision of goods and services to different preferences and local costs.

On the opposite side, supplying certain services by small municipalities can bring considerable diseconomies of scale. New technologies in the medical sciences increase the system complexity and costs so that disseminating supply among all municipalities, with its resulting atomization, generates inefficiencies. This happens because the production of specialized health services frequently requires scales of production which are not compatible with the small local population demand. Indeed, only a much reduced number of municipalities in Brazil have a population big enough to justify the supply of all levels of complexity required by an integral health care system.

In addition to the scale problem, it should also be stressed that different municipalities have also different levels of technical capability. Moreover the organization of functional health systems is not necessarily restricted to municipal territories. Thus, in addition to geographical issues, one should also consider network issues as well as technical and operational capabilities in order to properly define the functioning of decentralized health systems.

Therefore, the issues of articulation and integration of municipal systems come to play an important role if one wants to ensure access to health services of desired complexity levels. The consequent association of several municipalities in order to jointly offer public services seems to be an old and wide-spread procedure throughout the world. In Spain, local partnerships can be traced back to the year 1409, when the Mancomunidad de Enirio-Aralar, at the Basque country, joined 13 municipalities for handling forest resources. Presently, 5857 out of 8096 Spanish municipalities are associated into ''mancomunidades'' (Fonte *et al*., 1999). In the United States, Community Health Partnership (CHP) initiatives flourished as a result of voluntary collaborations of public and private actors. According to Mitchell and Shortell (2002), there is evidence that the CHP ''frequently fail to achieve measurable results'' and problems associated to their governance and management have been sited as the possible causes of that failure. In Finland, the decentralized health care system, formed by 450 autonomous municipalities responsible for most services, was partially integrated into large municipal associations—the so called Health Care Districts—and its output indicators compete well in international comparisons (Niskanen, 2002).

Collaboration and partnerships among municipalities also appeared in Brazil in the form of voluntary intermunicipal integration into health consortia (Mendes, 2001). There exist today more than 141 Intermunicipal Health Consortia (IHC) in Brazil, distributed among 13 states and providing services to more than 25 million people (Lima and Pastrana, 2000). Those institutions have been created since the 1980s, without clear definition about a regional organization in which they should be merged nor a clear public incentive for their constitution.

It is worth noting that collective action at the local level aimed to address common issues is not restricted to the health care sector. It can also be found in areas such as

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education (typically high schools), environment, sanitation and food supply, to mention just a few. Therefore, this article's results can be easily adapted to analyze broader partnership phenomena.

A consortium is a union of two or more organizations of the same legal status, as a tool for overcoming local challenges. The present article assumes that consortia enhance the efficiency and quality of services and, as a result, should be stimulated.

Despite the efficiency gains derived from the consortium, there may be cases in which a municipality would opt to withdraw from the partnership, even when such a decision contravenes the contractual terms of the consortium, due to political or financial fragilities within the municipality.

On the financial side, although municipalities were the primary beneficiaries of the 1988 Constitution, which increases revenue appropriations to local governments, they continue to face a vulnerable fiscal situation. Although, on the one hand, their sources of financing have expanded, on the other hand, the decentralization of government services, especially social services, had a profound fiscal impact on local finance. That late development could reduce a municipal mayor's incentive to honor her commitments to the consortium.

On the political side, if a mayor believes that the municipality could continue to partially use the services and benefits derived from the consortium without the municipality's financial participation (the free rider behavior), she may decide to become delinquent. This article posits that the principal objective of political leaders (the mayors) is to ensure her electoral survival. Therefore, she will take decisions in order to maximize the median voter's utility. Furthermore, the median voter's preference regarding investment in health—as opposed to other investments—will depend on a (stochastic) economic environment: in a *favorable* environment the median voter may support strong investment in health programs whereas in an *unfavorable* situation the voter may prefer other more urgent types of spending, such as unemployment insurance, for example.

The financial and political considerations set out above clearly demonstrate the vulnerability of the consortia. When a municipality joins the consortium and subsequently defaults, the remaining members may take two different actions: they may suspend access to the consortium's health services for the inhabitants of that municipality, or they may continue providing those services. Under the first scenario, the defaulting municipality has been punished. The purpose of the present study is to assess whether or not the existence of a punishment mechanism affects the outcome of this intricate political game as regards creation and sustainability of consortia.

For that purpose, the present study analyses two game theoretic models. The first model assumes that it is possible to block health services to the inhabitants of a defaulting municipality. The equilibrium outcome shows that, in general, this is an efficient mechanism for preventing default. Therefore, under a punishment mechanism the consortium is stable. Some consortia, such as the *Consórcio Intermunicipal de Saúde de Penápolis/SP* (CISA), have adopted that course of action (Ribeiro and Costa, 1999; Gontijo *et al.*, 1994).

Such approach, however, contravenes the SUS principle of universal service access with no barriers to citizens, a principle prescribed, moreover, in paragraph 196 of the Brazilian Federal Constitution. The second model assumes that blocking

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health services to citizens living is a defaulting municipality is not legally unfeasible. In this case, the equilibrium outcome shows that, if the consortium is formed, one municipality will default. In this case, the production of health services will be suboptimal. Moreover, if the gains from forming a consortium are not high enough, then the consortium will not be formed at all in the first place. This last result illustrates how an incentive problem coupled with an inappropriate legal system may lead to an inefficient equilibrium.

The article is organized as follows: Section ''The Basic Model'' sets out the basic model with a comprehensive explanation of the game. Section ''Model 1: The Punishment Case'' discusses the equilibrium outcome of the game in the cases where a punishment mechanism is applied to the municipality that withdraws from the consortium. Section ''Model 2: The No-Punishment Case'' presents the solution of the game for those cases in which no punishment is imposed on the defaulting municipality. Section ''The Role of Nature'' extends the original model to include an analysis of what happens when the electorate's preference for alternative (other than health) actions becomes predominant within the context of an unfavorable economic environment. Section ''Other Extensions'' offers other extensions to the basic model. Section ''A Brief Discussion on Possible Solutions to the Consortium Problem'' discusses possible solutions to the free rider problem in health care consortia. Finally, Section ''Conclusion'' concludes.

THE BASIC MODEL

Description of the game

In order to analyze the incentives for creation sustainability of Intermunicipal Health Consortia, we consider a two-periods ($t = 1,2$), two-player dynamic game of incomplete information between the mayors of two municipalities $j = 1,2$.

In each period, mayor j, $j = 1,2$, has a budget B_j to be allocated between two types of expenditure: those involving health actions (S) and those including all other actions (P). Health actions can be implemented by each municipality separately—the so-called *local health actions*—and/or within partnership with other municipalities, through the constitution of a consortium.[1] For simplicity, assume that the both municipalities have the same budget: $B_1 = B_2 = B$. This assumption can be easily relaxed as long as the budgets are not too different.

The strategic decisions involving the agents are the following.

In the first period, mayors decide whether to form or not to form an IHC.

If they decide not to form a consortium, the expenditures of each municipality will be executed locally in each of the two periods. In this case, there will be no interaction between their populations or intermunicipal externalities. Therefore, each mayor $j = 1,2$ decides independently how to spend his budget in local health

[1]Typically, the consortium does not implement all health actions and services necessary in order to reduce health risks and aggravations. Therefore, even with the creation of the health partnerships, in general, local actions will continue to exist.

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actions and other (local) actions in each of the periods, $t = 1,2$. Let L_{jt} denote the amount spent by municipality j in local health services at period t and let P_{jt} denote the amount spent by municipality j in other local actions at period t, where $j = 1,2$ and $t = 1,2$. Note that when consortium is not formed mayors face the following budget constraint:$L_{jt} + P_{jt} \leq B,\ j = 1,2,\ t = 1,2$.

If the mayors decide to form the IHC, each municipality will be required to transfer a fixed monetary amount S_a, which corresponds to an entry-fee that is used for the initial investments in the consortium. The investment S_a needs maturation so that its return takes place only at $t = 2$. After the resource is transferred to the consortium, each mayor j decides how to spend his remaining budget $(B - S_a)$ in local health actions (L_{j1}) and other actions (P_{j1}) at time $t = 1$. Note that when the IHC formed, mayors face the following budget constraint in period 1: $L_{j1} + P_{j1} \leq B - S_a$, $j = 1,2$.

In the second period, mayors decide whether they will remain in the consortium or abandon the institution. If they remain, they can benefit from the gains of the period 1's initial investment kS_a, $k > 1$. The parameter $k > 1$ reflects the part of the additional gains from forming a consortium. Moreover, they have to transfer a fixed amount S_q, which will be used to pay for the consortium's maintenance expenses. After the resource is transferred to the consortium, each mayor j decides how to spend his remaining budget $(B - S_q)$ in local health actions (L_{j2}) and other actions (P_{j2}) at time $t = 2$. Note that when there is no default, mayors face the following budget constraint in period 2: $L_{j2} + P_{j2} \leq B - S_q$, $j = 1,2$. The quotas yield higher returns when spent under the IHC structure, resulting in lS_q, $l > 1$ for each municipality. This is the other part of the additional gains due to the joint provision of health service.

The parameters $k > 1$ and $l > 1$ reflect the technological return of the IHC and models the fact that provision of health care services by the consortium generates a series of gains arising from economies of scale, implementation of a referral system, expansion and diversification of specialized service offerings, standardization of medical procedures, and availability of monetary incentives that stimulate an increase in productivity among health care professionals. The difference between the gains that stem from the initial investment and the maintenance expenditures is due to the fact that each one of these expenditures fulfills different purposes. The initial expenditures are typically expenditures on capital goods, as construction or renovation of facilities, acquisition of equipments, and others. On the other hand, the expenditures in the second period will cover the maintenance costs of the consortium like salaries, supplies, etc.

When municipality j defaults, not paying the maintenance quota S_q, mayor j decides how to spend his entire budget (B) in local health actions (L_{j2}) and other actions (P_{j2}) at time $t = 2$. Note that when mayor j defaults, its budget constraint in period 2 is: $L_{j2} + P_{j2} \leq B$. Moreover, in this case, the technological gains due to the other municipality's investment will be reduced to $(l/2)S_q$.

The goal of the present modeling is to assess the role of incentives in the decision of a mayor with respect to abandoning the consortium after its constitution and the effect of those incentives in the creation of that institution. For simplicity, the analysis is concentrated in one of the two players, the mayor $j = 2$, assuming that the mayor $j = 1$ will never abandon the consortium in the second period.

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There are two arguments for that simplification, one technical and the other one empirical. From a technical point of view, it simplifies the description and the resolution of the game and, at the same time, makes the partnership more attractive and secure to the other mayor. Therefore, under this hypothesis, if one obtains negative results about the sustainability of the partnership, these results will be even more significant. From an empiric point of view, the asymmetry between the two municipalities reflects the fact that one of them is considered the hosting municipality. Therefore, all the initial investment is done in that municipality, which will preserve the physical structure of the consortium if the other municipality decides to abandon it. In practice, everything occurs as if the hosting municipality does not have the option of abandoning the consortium. Section ''Symmetric Utility Functions'' describes the effects of relaxing that hypothesis on the game equilibria.

After mayor $j = 2$ decides whether or not to remain in the consortium, each player $j = 1,2$ decides how to spend its remaining budget (net of possible expenditures with the consortium) between local health action and others: L_{j2} (health), P_{j2} (others).

Finally, the mayors derive utility from the investment decisions in the two periods, as described in the next section.

The utility of politicians

The underlying assumption of the present study is that the primary motivation of every politician is to remain in power (Ferejohn, 1986; Persson and Tabellini, 2000; Bugarin, 2003). Therefore, the mayor will channel budget resources to expenditures that maximize his reelection probability.

The impact of the mayor's expenditure choices on her reelection prospects will depend on the value voters attach to investments on health actions compared to investments on other actions. This article assumes that the preferences of voters in municipality 2 in period $t = 1,2$ can be described by the following Cobb–Douglas function:

$$U_{2t}(S_{2t}, P_{2t}, \alpha) = S_{2t}^{\alpha} P_{2t}^{(1-\alpha)}$$

The parameter $\alpha \in [0,1]$ in the equation above, which is discussed in greater detail in Section The Role of Nature, can change from one period to the other revealing the extent to which the economic environment affects preference of voters of a municipality. Observe that the term S_{2t} refers to the total investment in health actions, which involves the local health expenditures L_{2t} as well as the expenditures in the consortium, S_a and S_q.

As discussed before, for simplicity reasons we assume that voters of municipality 1 are interested exclusively in investments in health care actions. In addition to simplify the analysis, this hypothesis has the advantage of increasing the incentive to the formation of the consortium because of the technological gains discussed previously. Therefore, the instability results that will be shown in this article become even stronger in the case where municipality 1 can also spend resources on other actions.[2] On the basis of this assumption, it is possible to express the preferences of

[2]Section ''Other Extensions'' presents a discussion about the results obtained when this hypothesis is relaxed.

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these voters, in each period $t = 1,2$, through the linear utility presented below:

$$U_{1t}(S_{1t}) = S_{1t}$$

In the above equation, the term S_{1t} refers to total health expenditure, involving local expenditure L_{1t} as well as consortium expenditure S_a and S_q. Note that, when the consortium is not formed, mayor 1's budget constraint at period t becomes simply $L_{1t} \leq B$, $t = 1,2$. Similarly, when the consortium is formed, mayor 1's budget constraint is $L_{11} \leq B - S_a$ in period 1 and $L_{12} \leq B - S_q$ in period 2.

Finally, politician $j = 1,2$ maximizes her reelection probability by also maximizing the sum $U_{j1} + U_{j2}$ of utilities in the two periods. Note that no discount factor is used. Section ''Discount Factor'' presents a discussion on the effects of such a discounting.

The states of nature

This paper's models incorporate uncertainty about the economic environment. The relative importance voters attach to health care actions in relation to other actions is modeled by the parameter α in the objective function of municipality 2. The parameter is contingent on a favorable ($\alpha = f$) or unfavorable ($\alpha = d$) economic environment, where $f, d \in [0,1]$ and $f > d$. A favorable environment may indicate, for example, a period in which the general population's financial conditions improve, a circumstance that enables that population to direct its aspirations toward medium and long-term government actions, which usually generate greater social returns (under the model, these are restricted to actions in the area of health care). By contrast, when the economic environment is unfavorable, voters tend to adopt a short-term view, to the extent that they turn their attention to actions that will bring them immediate benefits, like employment insurance during an economic crisis, for example.

A value of α_t is realized at each period $t = 1,2$ and observed by the mayor of municipality 2 at the moment she makes a decision in the correspondent period. For simplicity, we assume that, in the first period, $\alpha_1 = f$. This hypothesis makes the consortium more attractive during this period, which reinforces the negative results of this article.

The extensive form game

As we consider a dynamic game of two periods, we will present an extensive form for the game in $t = 1$ and two extensive forms for the game in $t = 2$, corresponding to two possible continuation games.

Figure 1 presents the game in $t = 1$. It begins in node t_{11} where municipality 1 decides whether or not to propose to municipality 2 to form a consortium. If the proposal is made, municipality 2 decides whether it will accept it (node t_{12}). If 1 does not make a proposal or if 2 does not accept it, the consortium is not formed and the players decide in isolation how much to invest on health and other actions (nodes t_{13}, t_{14}, t_{16}, t_{17}). Finally, if 2 accepts the proposal made by 1, the consortium is formed, the mayors pay the initial investments (S_a) and decide how to spend locally the rest of

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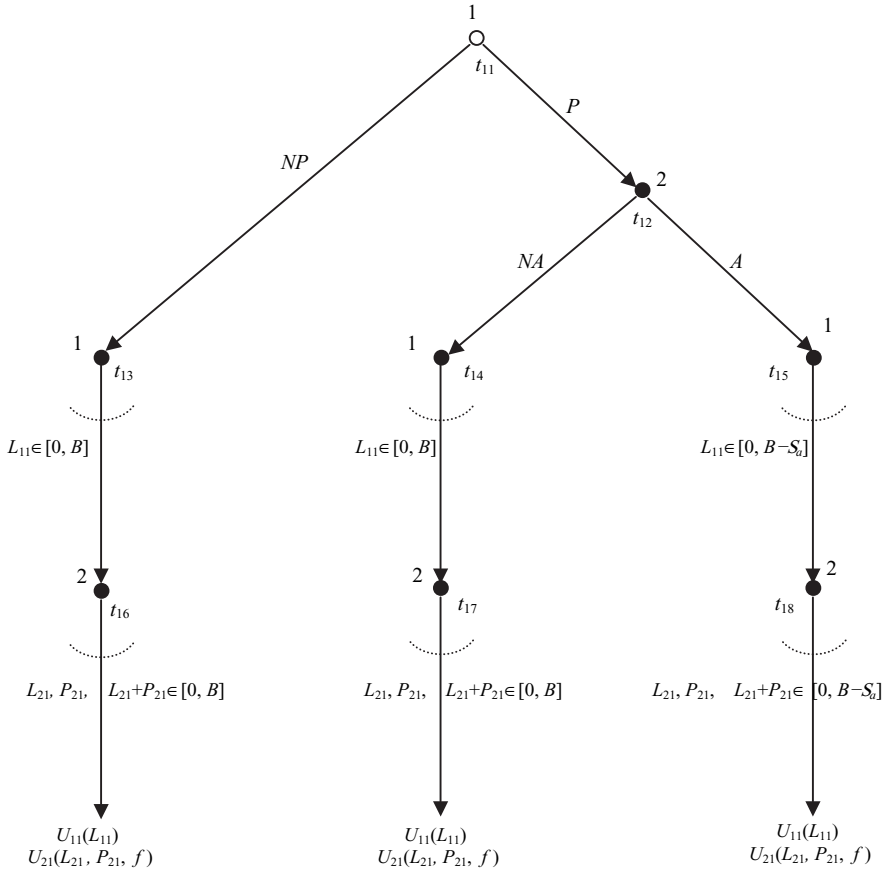

Figure 1. The extensive form representation of the game in period 1

their resources (nodes t_{15} and t_{18}). The dotted curves indicate that municipalities have an infinite number of possible actions in the corresponding decision node but only one generic choice is presented. In node t_{13}, for example, mayor 1 can choose any value for L_{11} between 0 and B.

Figure 2 represents the game in $t = 2$, when the consortium is not formed in the first period. In that case, each municipality decides locally and independently how to invest the entire budget B in health care actions and other actions. In this article, uncertainty with respect to the economic environment is formalized by the introduction of a third player: nature (N), as it is usually done in game theory. The probability of a favorable state of nature (f) in the second period is ρ, while the probability of it being unfavorable (d) is $(1-\rho)$. Player 2 observes the state of nature before making her investment decision in the second period. Due to the fact that the state of nature only affects the preferences of voters at municipality 2, this information is irrelevant to player 1. For that reason, player 1's decision-node comes

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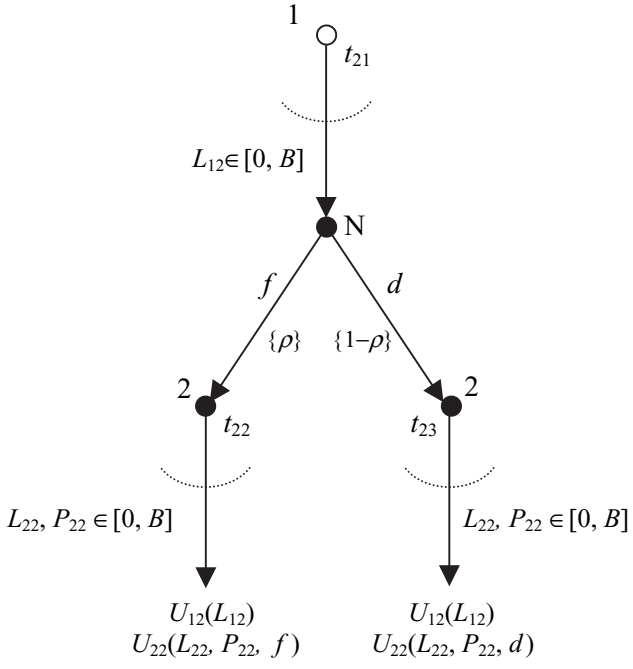

Figure 2. The Game in the second period without consortium creation

before Nature's. Finally, observe that we model player 1's decision as preceding player 2's decision (nodes t_{14} to t_{18}). To the extent that the decision of 1 about local expenditure does not affect player 2, there is no loss of generality in this modeling approach, which is made merely for the sake of simplifying the solution of the game. The same sequential approach is taken, again without loss of generality, in the continuation game in period 2.

Figure 3 presents the continuation of the game when an IHC is formed in t = 1. In that case the mayor of municipality 2 decides whether she honors its commitment with the partnership (node t_{32})–paying the quota S_q–or default, after observing the state of nature (node t_{31}), that is, after verifying the relative preference of the voters between health care actions and other actions (α). In order to simplify the extensive form game, only one edge from the initial node was included, labeled α, which represents the two possible choices of the state of nature: $\alpha = f, d$. The probability of the occurrence of these events is described generically by $p\alpha = \rho$ if $\alpha = f$ and $p\alpha = 1-\rho$, if $\alpha = d$. Once that decision is taken, each municipality decides independently how to spend locally its reminiscent budget.

The extensive form presented above applies to the two models that will be studied in this article depending on the parameter δ, which can assume the values 0 and 1. When $\delta = 0$ one has model 1, in which case default yields discontinuation of services to the inhabitants of the defaulting municipality. In that case municipality 2 will not

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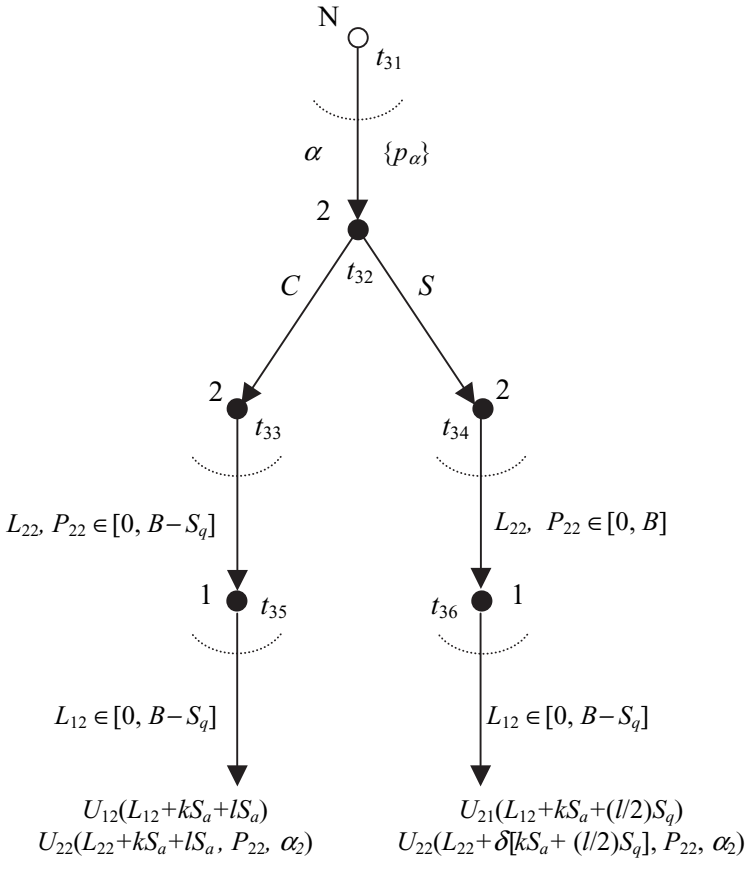

Figure 3. The Game in the second period with the consortium creation

benefit from the technological return associated to the consortium. In contrast, model 2 corresponds to the situation in which $\delta = 1$. In that case, residents of the defaulting municipality can still have access to the consortium facilities. Nevertheless, due to the fact that only one municipality contributes to maintaining the consortium, the volume of available resources decreases, which reduces the technological return of the institution.

In this article, a reduction in the technological factor from l to $l/2$ models the effect of withdrawing from the consortium. Observe that if $l < 2$, then resources invested in the consortium by municipality 1 in $t = 2$ will generate less return than if the resources were invested locally. This phenomenon is due to the fact that the consortium serves a greater population—consisting of the residents of both municipalities—than local health facilities do. Furthermore, observe that the technological gain associated with the initial investment will not be modified. Indeed, it consists of an investment that was earlier executed.

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MODEL 1: THE PUNISHMENT CASE

The first model assumes that punishment can be imposed on a defaulting municipality by means of discontinuing access to the consortium's health services, to the population of the defaulting municipality. This is the case for the Penápolis Consortium, for example (Ribeiro and Costa, 1999). This corresponds to setting $\delta = 0$ in the utility of the defaulting mayor in the right corner of Figure 3, that is, the utility of a defaulting mayor $j = 2$ is:

$$U_{22}(L_{22} + 0.[kS_a + (l/2)S_q], P_{22}, \alpha_2) = U_{22}(L_{22}, P_{22}, \alpha_2)$$

We look for the subgame perfect equilibrium outcome of the game. Therefore we solve the game by backward induction. Let us first determines the incentives for municipality 2 to remain in the consortium by solving the game in Figure 3, when the consortium is formed (F) in the first period.

In the second period mayor 1 chooses $L_{12} = B - S_q$, regardless of the choice of mayor 2 (nodes t_{35} and t_{36}). The corresponding utilities for mayor 1 are: $U_{12}(C) = U_{12}(L_{12} + kS_a + lS_q) = B + kS_a + (l-1)S_q$, when 2 decides to remain in the consortium and, $U_{12}(S) = U_{12}(L_{12} + kS_a + (l/2)S_q) = B + kS_a + ((l/2) - 1)S_q$, when 2 decides to abandon it.

In node t_{33}, where municipality 2 decides to remain in the consortium, the maximization problem of the mayor 2 is, for $\alpha = f, d$,

$$\begin{cases} \underset{L_{22}, P_{22}}{Max} (L_{22} + kS_a + lS_q)^a P_{22}^{(1-\alpha)} \\ \text{st} \quad L_{22} + S_q + P_{22} \leq B \end{cases}$$

Since utility is strictly increasing in L_{22} and P_{22}, the budget constraint is binding. Therefore, from the first order condition, we find, for $\alpha = f, d$,

$$L_{22} = \alpha B - (1 - \alpha)k\, S_a - [\alpha + (1 - \alpha)l]S_q \tag{1}$$

It is noteworthy that the above equation will indeed correspond to the solution of the problem of mayor 2 only if the technological gains k and l and the preferences of voters (α) satisfy the condition:

$$B \geq \frac{1 - \alpha}{\alpha} kS_a + \left(1 + \frac{1 - \alpha}{\alpha} l\right) S_q \tag{HIH}$$

That condition, which is called here ''Health Investment Desirability Hypothesis,'' can be interpreted in two ways. On the one hand, the entry-fee S_a and the maintenance-quota S_q cannot be too high compared to the total municipal budget.[3] This section assumes that (HIH) condition holds. Section ''The Role of Nature'' presents a discussion of the results of the game when that condition is not satisfied.

[3]This seems to meet the data; for example, the 26 municipalities of the State of Minas Gerais that form the Consortium ''Alto do São Francisco'' apply 2% of the Municipality Participation Fund (FPM) to the maintenance of the consortium's administrative structure (Paulics, 2000). On the other hand, the importance voters assign to health care actions compared to that attached to other actions cannot be too small.

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Substituting Equation (1) into the utility function of mayor 2 yields:

$$U_{22}(C,\alpha) = \alpha^{\alpha}(1-\alpha)^{(1-\alpha)}[B + kS_a + (l-1)S_q] \tag{2}$$

At node t_{34}, in which municipality 2 decides to abandon the consortium (S), the maximization problem is, for $\alpha = f, d$,

$$\begin{cases} \underset{L_{22},P_{22}}{Max}\,(L_{22})^{\alpha}P_{22}^{(1-\alpha)} \\ \text{st} \quad L_{22} + P_{22} \leq B \end{cases}$$

The solution of the problem is $L_{22} = \alpha B$ and the corresponding indirect utility function of the mayor is:

$$U_{22}(S,\alpha) = (L_{22})^{\alpha}(B - L_{22})^{(1-\alpha)} = \alpha^{\alpha}(1-\alpha)^{(1-\alpha)}B \tag{3}$$

Comparing the utility of mayors when the municipality remains in the consortium (2) with the utility resulting from its withdrawal from the consortium (3), one concludes that the potential for punishment is sufficient to assure the maintenance of the consortium once it has been formed, for: $k,\ l > 1 \Rightarrow B + kS_a + (l-1)S_q > B$. Therefore, regardless of the state of nature, municipality 2 will choose to remain (C) in node t_{32}.

The solution of the game in Figure 2 is immediate. In this case, the consortium is not formed (NF) in the first period. Municipality 1 will choose $L_{12} = B$ and its resulting utility will be $U_{12}(NF) = B$. On the other hand, in the state of nature α, municipality 2 will obtain utility $U_{22}(NF, \alpha) = \alpha^{\alpha}\ (1-\alpha)^{(1-\alpha)}B$, $\alpha = f, d$.

Next we determine the incentives to form a consortium (F) by solving the game in Figure 1. If the consortium is formed, utilities of municipalities 1 and 2 in the first period will be, respectively:

$$U_{11}(F) = B - S_a \quad \text{and} \quad U_{21}(F) = f^{f}(1-f)^{(1-f)}(B - S_a)$$

When municipality 2 decides not to accept joining a partnership, or municipality 1 decides not to make the proposal, the utilities of municipalities 1 and 2 in the first period are, respectively:

$$U_{11}(NF) = B \quad \text{and} \quad U_{21}(NF) = f^{f}(1-f)^{(1-f)}B$$

Backward induction implies that, in the case where the consortium is formed, municipality 2 will remain in the partnership in the second period.

The payoffs resulting from utility maximization of mayor 1 in the first and second periods, when the IHC is formed is:

$$\begin{aligned} U_1(F) &= U_{11}(F) + U_{12}(C) = B - S_a + B + kS_a + (l-1)S_q \\ &= 2B + (k-1)S_a + (l-1)S_q \end{aligned} \tag{4}$$

When the consortium is not formed, the resulting utility of mayor 1 in the two periods is:

$$U_1(NF) = U_{11}(NF) + U_{12}(NF) = B + B = 2B \tag{5}$$

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Comparing utilities (4) and (5), one concludes that the sequentially rational strategy of mayor 1 is to propose the association.

Turning now to municipality 2 in the first period, if the mayor receives an offer to form the consortium and refuses it, her expected utility in the second period will be ΘB, where $\Theta = \rho f^{f}(1-f)^{(1-f)} + (1-\rho)\ d^{d}(1-d)^{(1-d)}$. Note that this mayor calculates his expected utility because when deciding whether or not to accept the offer she does not know voter's realized preferences in $t = 2$, that is, she is unaware of the state of nature (α_2) in the second period.

Therefore, when she decides to join the partnership but to later abandon it, her expected utility in the two periods will be:

$$\begin{aligned} U_2(NF) &= f^{f}(1-f)^{(1-f)}B + \Theta B \\ &= [(1+\rho)f^{f}(1-f)^{(1-f)} + (1-\rho)d^{d}(1-d)^{(1-d)}]B \end{aligned} \tag{6}$$

On the other hand, if she accepts the proposal, her expected utility in the second period will be $\Theta[B + (l-1)S_q + kS_a]$. Therefore, if she accepts the proposal, her expected utility on both periods will be:

$$U_2(F) = f^{f}(1-f)^{(1-f)}(B - S_a) + \Theta(B + (l-1)S_q + kS_a) \tag{7}$$

Comparing Equations (6) and (7), one concludes that mayor 2 will accept the proposal if and only if:

$$\Theta(l-1)S_q + [k(1-\rho)d^{d}(1-d)^{(1-d)} + (k\rho - 1)f^{f}(1-f)^{(1-f)}]S_a \geq 0 \tag{8}$$

Condition in Equation (8) will hold if at least one of the following conditions is satisfied:

(i) The technological gain from the initial investment, k, is sufficiently high.
(ii) The probability of a favorable state of nature, ρ, is sufficiently high.
(iii) The technological gain (l) from the maintenance quota is sufficiently high.
(iv) The maintenance quota S_q is sufficiently high compared to the initial investment S_a.

Condition (i) and (ii) ensure that $k\rho - 1 > 0$ and, as a result, all the terms in the left-hand side of Equation (8) are positive. Conditions (iii) and (iv) ensure that even if this does not occur, the first term on the left-hand side of Equation (8), which is positive, will dominate the second term. In this article we assume that some of the above conditions will hold and, therefore, there will be a unique solution by backward induction to the game: the IHC is formed and maintained.

Proposition 1 summarizes the main result in the punishment model.

Proposition 1: *Consider the consortium formation game in which it is possible to block access to the consortium health services to inhabitants of a defaulting municipality. Suppose, moreover, that the parameters of the game are such that the conditions below are satisfied.*

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$$B \geq \frac{1-\alpha}{\alpha} kS_a + \left(1 + \frac{1-\alpha}{\alpha} l\right) S_q \qquad \text{((HIH))}$$

$$\Theta(l-1)S_q + [k(1-\rho)d^d(1-d)^{(1-d)} + (k\rho - 1)f^f(1-f)^{(1-f)}]S_a \geq 0 \qquad (8)$$

Then, there exists a unique subgame perfect Nash equilibrium outcome in which municipality 1 proposes to form a consortium to municipality 2, municipality 2 accepts 1's proposal in the first period and does not default on its quota payments in the second period.

Therefore, the IHC if formed and is sustainable. ■

MODEL 2: THE NO-PUNISHMENT CASE

This model assumes that it is not possible to punish the municipality that withdraws from the consortium, in light of the Brazilian Constitutional prohibition on any form of discrimination against citizens in the provision of health care services financed by the SUS. According to that principle, no consortium facility can deny health treatment to a citizen in need of medical assistance, even if the municipality in which that citizen resides does not contribute financially to the institution's maintenance. Therefore, model 2 corresponds to setting $\delta = 1$ in the utility of the defaulting mayor in the right corner of Figure 3, that is, the utility of a defaulting mayor $j = 2$ is:

$$U_{22}(L_{22} + 1.[kS_a + (l/2)S_q], P_{22}, \alpha_2) = U_{22}(L_{22} + 1.[kS_a + (l/2)S_q], P_{22}, \alpha_2)$$

The other figures remain unchanged. As in the preceding model, we look for the subgame perfect equilibria of the game. Therefore, we solve the game by backward induction. Note that there is no change in the resolution of the subgame presented in Figure 2.

Consider now the game in Figure 3. If mayor 2 defaults, she will not make the payment of the maintenance fee (S_q). However, the population of that municipality will still have access to the consortium facilities. Therefore, the politician will be able to allocate a larger share of the municipal budget to other activities.

The difference between this model and the model with punishment centers on the fact that the utility function of the defaulting loses only a portion of the return lS_q. When municipality 2 defaults on the maintenance-fee it is still able to benefit from the expenditures made by the other municipality because of the absence of punishment.

Let us now analyze 2's decision regarding permanence or not in the consortium. When municipality 2 decides to remain, the maximization problem is identical to that in model 1, so that the utility function of the politician is:

$$U_{22}(C, \alpha) = \alpha^{\alpha}(1-\alpha)^{(1-\alpha)}[B + kS_a + (l-1)S_q] \qquad (9)$$

On the other hand, if 2 defaults, the utility function of the politician is different than the one presented in the first model. The corresponding maximization problem

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is, for $\alpha = f, d$:

$$\begin{cases} \underset{L22,P22}{Max} \left(L_{22} + kS_a + \frac{1}{2}S_q\right)^{\alpha} P_{22}^{(1-\alpha)} \\ L_{22} + P_{22} \leq B \end{cases}$$

The term ½Sq, which appears in the utility function of the mayor of municipality 2, refers to the expenditures municipality 1 commits to the maintenance of the consortium. Since the utility is strictly increasing in L_{22} and P_{22}, the first order condition yields,

$$L_{22} = \alpha B - (1-\alpha)kS_a - (1-\alpha)\frac{l}{2}S_q \tag{10}$$

Substituting Equation (10) into the utility function of mayor 2, for $\alpha = f, d$, yields,

$$U_{22}(S,\alpha) = \alpha^{\alpha}(1-\alpha)^{(1-\alpha)}\left(B + kS_a + \frac{l}{2}S_q\right) \tag{11}$$

The model considers that the technological gain produced by the investment made in the consortium's maintenance falls within the range $1 < l < 2$ so that the marginal benefit l has an upper bound of 2. Comparing the utilities of municipality 2 when it remains in the consortium (10) and when it withdraws from the partnership (11), we can conclude that the municipality will default.

Consider now the incentives for consortium creation. According to Figure 1, if municipality 2 rejects the offer to enter into partnership with municipality 1 (*NF*), its expected utility function in the second is ΘB where, as before, $\Theta = \rho f^f(1-f)^{(1-f)} + (1-\rho)d^d(1-d)^{(1-d)}$. Similarly, the expected utility in the two periods is:

$$\begin{aligned} U_2(NF) &= f^f(1-f)^{(1-f)}B + \Theta B \\ &= [(1+\rho)f^f(1-f)^{(1-f)} + (1-\rho)d^d(1-d)^{(1-d)}]B \end{aligned} \tag{12}$$

When municipality 2 decides to participate in the partnership, but defaults in the second period, its expected utility function is $\Theta(B + kS_a + (l/2)S_q)$ and its expected utility function in both periods is:

$$U_2(S) = f^f(1-f)^{(1-f)}(B - S_a) + \Theta(B + kS_a + (l/2)S_q) \tag{13}$$

Comparing Equations (12) and (13), one concludes that mayor 2 will accept the proposal of mayor 1 if and only if:

$$\Theta(l/2)S_q + [k(1-\rho)d^d(1-d)^{(1-d)} + (k\rho - 1)f^f(1-f)^{(1-f)}]S_a \geq 0 \tag{14}$$

The above equation is similar to condition (8) of the preceding model and is assumed to be satisfied by the same reasons discussed earlier. Therefore, it is sequentially rational for municipality 2 to accept the offer of municipality 1, form the consortium in the first period, and default in the second period.

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We proceed now to municipality 1's decision with respect to proposing association (node t_{11}). If the mayor does not make the proposal for the formation of the consortium, her utility, considering both periods, is:

$$U_1(NF) = B + B = 2B$$

On the other hand, by backward induction, municipality 1 recognizes that if she makes the proposal (F), mayor 2 will accept it and will default in the second period. Therefore, the utility of mayor 1 when she makes the proposal to municipality 2 is:

$$U_1(F) = B - S_a + B + kS_a - S_q + (l/2)S_q = 2B + (k-1)S_a - (1-(l/2))S_q$$

Hence, municipality 1 will propose consortium creation if:

$$(k-1)S_a - \left(1 - \frac{l}{2}\right)S_q \geq 0 \tag{15}$$

If condition (15) is satisfied, municipality 1 will make the proposal, municipality 2 will accept it and will default in the second period. There will be formation but not sustainability of the institution. On the other hand, if (15) is not satisfied, the IHC will not be created.

Proposition 2 summarizes the main result in the non-punishment model.

Proposition 2: *Consider the consortium formation game in which it is not possible to block access to the consortium health services to inhabitants of a defaulting municipality.*

1. *Suppose, first, that the parameters of the game are such that the condition below are satisfied.*

$$1 < l < 2$$

$$\Theta(l/2)S_q + [k(1-\rho)d^d(1-d)^{(1-d)} + (k\rho - 1)f^f(1-f)^{(1-f)}]S_a \geq 0 \tag{14}$$

$$(k-1)S_a - \left(1 - \frac{l}{2}\right)S_q \geq 0 \tag{15}$$

Then, there exists a unique subgame perfect Nash equilibrium outcome in which municipality 1 *proposes to form a consortium to municipality* 2, *municipality* 2 *accepts* 1's *proposal in the first period but defaults on its quota payments in the second period.*

Therefore, the IHC if formed but it is unsustainable.

(ii) *Suppose now that condition (15) is not satisfied. Then, there exists a unique subgame perfect Nash equilibrium outcome in which municipality 1 will not propose to form a consortium.*

Therefore, the IHC is not formed. ■

Note that, when the IHC is formed, municipality 2 defaults on its obligations in period 2. Therefore, the resources available to the consortium are reduced, thereby

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leading to a decline in efficiency and quality of the services, which, at the same time, triggers a proportional drop in the technological gains accrued. This inefficiency is a common result in the partnership literature, as can be seem in the seminal article by Holmström (1982) or the more recent article by Bugarin (1999), Cramton *et al.* (1987), or Dutta and Radner (1994).

Therefore, the second model highlights an important fragility of the IHC. The fact that IHC started to be formed in Brazil only in the 1980s (Lima and Pastrana, 2000), suggests that the technological returns to the partnership, the parameters k and l, were not high enough before, so that condition (15) was not met. Only recently, with the advent of more costly high-complexity procedures on one hand, and the decentralization discussed earlier on the other hand, have the technological returns become high enough.

Mitchell and Shortell (2002) ague that the Community Health Partnerships (CHP) in the USA do not show evidence of measurable results. One of the main characteristics of these institutions is their voluntary property. The present model may explain why such voluntary collaboration without a punishment rule may lead to suboptimal results.

On the other hand, Finland's Health Care Districts ''get the majority of their money by selling the specialized health services to the member municipalities'' (Niskanen, 2002); therefore, the free-rider problem is solved at it is not surprising that Finland health care output indicators compete well in international comparisons.

THE ROLE OF NATURE

So far, the models assumed that the entry-fee S_a and the maintenance-quota S_q do not represent a significant portion of the total municipal budget and that the importance voters attach to health actions (α) is not excessively small when compared to the significance attributed to other public activities. These restrictions assure that condition (HIH) is satisfied. That assumption is relaxed in this section.

Consider condition (HIH), which can be recast in the manner set forth below, wherein $\varphi(\alpha) = \frac{1-\alpha}{\alpha}$.

$$B \geq \varphi(\alpha)kS_a + [1 + \varphi(\alpha)l]S_q \qquad \text{(HIH}')$$

When α approaches zero, the value of $\varphi(\alpha)$ becomes very large ($\lim_{\alpha \to 0} \varphi(\alpha) = +\infty$), so that above condition will probably not be satisfied. If we consider that α represents the relative value voters attach to health actions and that in the unfavorable state of nature ($\alpha = \mathrm{d}$) the value of the parameter is small, it is reasonable to assume that condition (HIH′) will not be satisfied in that state. In that case, municipality 2 will decide not to spend any resources on local health care actions, given that in order to assure her reelection, the mayor will choose to direct those resources to other types of activities.

On the other hand, when α approaches one, the value of $\varphi(\alpha)$ converges to zero ($\lim_{\alpha \to 1} \varphi(\alpha) = 0$). Therefore, in the favorable state of nature ($\alpha = f$), the value of the right-hand side of (HIH′) converges to S_q. In that case the previous condition will be

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easily satisfied, so it is assumed here that condition (HIH′) still holds, so that municipality 2 will have an incentive to direct resources to health services.

Note that now mayor 2 will act differently depending on the state of nature in model 1. When the state of nature is favorable, she will not default. However, when the state is unfavorable she may find it optimal to default (for certain values of the parameters), in spite of the treat of punishment. As the initial investment is not recovered, municipality 2 may prefer not to accept the proposal to form the consortium in model 1, if the probability of an unfavorable state of nature is two high.

In the no-punishment model, mayor 2 will continue to have an incentive to join the consortium, which is therefore created, but then default. The decision of municipality 1 is identical to the one discussed before.

To conclude, when nature plays a more effective role in defining the electorate's preferences, consortia become even more vulnerable with respect to creation and sustainability.

OTHER EXTENSIONS

This section discusses five other alternative extensions to the basic models presented in Sections ''The Basic Model'' and ''Model 1: the Punishment Case''.

The game in the first period: Simultaneous proposals

The basic model assumes that municipality 1 decides first whether or not to make a proposal and, if so, municipality 2 decides whether or not to accept it. This asymmetry in the behavior of players can be easily corrected by letting both municipalities decide simultaneously whether or not to propose a partnership. In that case, the IHC would only be formed if both municipalities decide simultaneously to make the proposal or, in a more natural way, if the two municipalities agree simultaneously to the creation of the partnership.

Clearly such a modification does not change any of the results, so that the equilibria found earlier remain the same. However, there is, in this case, one additional equilibrium in which both municipalities do not make the proposal. Since the consortium is created only when both municipalities make the proposal, that is indeed a somewhat trivial subgame perfect equilibrium that results in non-formation of IHC. That equilibrium could be excluded in the case of Model 1 if one adds a Pareto criterion for equilibrium selection. Indeed, due to the efficiency gains of consortium provision of health services, the equilibrium that results in consortium formation and stability Pareto dominates the other equilibrium.[4]

Symmetry in the possibility of default

Suppose now both players are allowed to default. If, by defaulting, a municipality gives up all initial investments, the results of model 1 remain unchanged. Indeed, the

[4]We are grateful to an anonymous referee for pointing out this equilibrium.

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threat of exclusion is a powerful tool for inducing municipality 1 to remain in the consortium, since it values exclusively health care expenditures.

There can be different equilibria in model 2. Under this new assumption, municipality 1 can benefit from free riding as well, if municipality 2 does not default. There are now two possible equilibria with consortium formation: in the first one, 2 will default and 1 will keep the consortium structure whereas in the second one, municipality 1 suspends payment and 2 stays. In any of the two equilibria, there will be formation of the consortium, but it will not be sustainable. In the case where the technological return does not compensate the free rider effect, the consortium will not be formed, similarly to the original model.

Symmetric utility functions

Assume now that both mayors value health care actions as well as other actions. If one holds the hypothesis that municipality 1 cannot withdraw from the consortium and assumes that a condition to equivalent (HIH) is valid for that municipality, the same results of model 1 are obtained.

However, in model 2, the losses due to the free rider behavior increase for player 1, since health care actions become less important to her. Therefore, the incentives for mayor 1 not to be interested in the partnership increase, so that the consortium will more likely not be created.

Infinitely repeated game

Assume now that, if the consortium is formed in period $t = 1$, then player 2 decides in each period $t > 1$ whether to remain in the institution, paying that period maintenance fee S_q or withdraw from the IHC. Once the decision of abandoning the consortium is made, municipality 2 will not return to the institution. In this case there is no modification in model 1: the threat of denying the population access to the consortium facilities is sufficient to sustain the partnership. In fact the incentive becomes even stronger when municipality 2 is aware that the gains from the association can be repeated infinitely. In this context, there is no need for a Folk Theorem argument.

In model 2, the free rider effect is repeated in each period so that 2 has a greater incentive to accept the formation of the IHC and then, to default. However, the additional gain from the initial investment, which was the main incentive for 1 to make the proposal is now reduced due to the losses that 1 will have to face in all the infinite remaining periods. In that case, 1 will not propose creation of the consortium.

The above result for model 2 will change if municipality 1 has the possibility of dissolving the partnership, when municipality 2 does default. If the resulting dissolution is irreversible, then the threat of ending the partnership is used to discipline the behavior of 2. In that case, a Folk Theorem result ensures the existence of a Nash equilibrium in the repeated game, in which municipality 1 abandons the partnership if 2 defaults (a trigger strategy). In this situation, the stability of the consortium is maintained. However, this equilibrium may not be subgame perfect. In fact, if the IHC dissolution implies in the total loss of the initial investment, the threat

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may not be credible. Therefore it becomes relevant to study the mechanisms that will be used in the moment the partnership breaks out, since they may play a fundamental role in the credibility of the trigger strategy (Cramton *et al*., 1987).

Discount factor

Suppose now players discount time $t = 2$ payoffs at discount-rate $\mu \in (0,1)$. Then, the opportunity cost of giving up the resources allocated to the entry-fee in the first period increases so that waiting for the investment to mature becomes more costly. Despite the fact that nothing changes in the resolution of the games presented in Figures 2 and 3, which occur in the second period, the probability that players will not constitute the IHC in the first period increases.

A BRIEF DISCUSSION ON POSSIBLE SOLUTIONS TO THE CONSORTIUM PROBLEM

The analysis of different generalizations of the models studied earlier confirms the difficulties in forming and sustaining intermunicipal health consortia as the negative results obtained seem rather robust. However, both the theoretical literature and the Brazilian government have been engaged in pointing out possible solutions to the consortium problem.

On the theoretical side, a companion paper (Teixeira *et al*., 2006) presents a contract theoretic analysis of the consortium problem. The main conclusions of the paper are the following. First, the Federal government can align municipalities' incentives by offering additional monetary transfers to the municipality that does not default. Due to the efficiency loss in case of default, the required transfers may be much smaller than the quota S_q. Second, if transfers from higher levels of government are not an option, the Federal government can still play the role of the regulator of the federalism, as suggested in Oates (1999). The main mechanism here is that the municipalities sign a contract allowing the Federal government to deposit the quota directly into the consortium accounts in case of default. In that case, the Federal government will also deduce that amount from the mandatory transfers it is constitutionally required to make to the defaulting partnership. Such a mechanism solves the commitment problem with no cost for the Federal government, so that a municipality will never be able to default in the second period. Finally, the second mechanism has the drawback of reducing the incentives for consortia formation. Indeed, since the municipality knows that it will not be able withdraw from the partnership in the future, its mayor may prefer not to make such an irreversible commitment that he will regret if the realized state of nature is unfavorable in period 2. In that case, the Federal government may offer additional transfer incentives when the consortium is formed, in order to make this step more attractive and align the municipalities' incentives, by affecting the technological gains (the parameter l) from IHC formation. We refer to the paper for modeling details.

On the government's side, the issue of consortium regulation has been widely discussed over the last 10 years and, on April 6, 2005 Congress passed a new

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legislation (Law 11107) aimed at regulating consortia. The new law establishes the rules for intermunicipal consortia formation and management and requires specific contracts for these institutions. It allows for exclusion of defaulting municipalities, but it does not deal with the issue of blocking access to inhabitants from these defaulting municipalities. In that case, due to the constitutional requirement of non-exclusion of public health services, being excluded from the consortium may become in fact a reward, rather than a punishment, since the exclude municipality's inhabitants will not be blocked from consortium health services and the mayor does not have to pay the consortium maintenance quota. Thus, the new legislation, although it makes it clearer that a defaulting municipality may be punished, does not set the proper legal framework for that punishment to have a real effect on the municipality's decision about defaulting. Therefore, one is forced to believe that a nontrivial effort is yet to be made in order to solve the consortium problem.

CONCLUSION

The present article has analyzed the sustainability of intermunicipal health care consortia in the light of game theory.

Although there are potential gains of scale, scope and coordination associated to such partnerships, the study shows that there are free rider incentives to be dealt with in order to ensure stability to the consortium. The free rider problem arises from the fact that one of the members of the partnership may benefit from the gains of joint provision of health services without participating in its financing. This problem is aggravated in Brazil by a Constitutional clause that states that health care funded by public institutions cannot segregate, so that every citizen should have access to any public health care establishment when needed.

Under such conditions health care consortia are unstable and the gains from association may be unachievable. The result is shown to be robust to the inclusion of a variety of frictions in the basic model.

Therefore, in order to cope with the instability of intermunicipal consortia, one needs to look for new forms of incentives that could counter the free rider effect. Those could involve transfers from higher-level governments to stable consortia, some type of commitment-contract between the partnership members or a mix of both types of incentives. Given the potential efficiency gains associated to the partnership, the analysis of stabilizing mechanisms is left as a suggestion for future research.

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