Political Economy of Intermunicipal Health Consortia Formation: Effects of Income and Preference Heterogeneity among Municipalities*

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Abstract

This article presents models of electoral competition in municipalities in which candidates for mayor announce platforms consisting of the amount of health services to be provided and the corresponding tax schedules. Health services can be provided in an autarkic way or by means of a consortium of two municipalities. The paper studies the effects of income and preference heterogeneity among municipalities. Only when municipalities are totally homogeneous may one assert that the consortium brings about an increase in the provision of health services. Moreover, homogeneous consortia tend to be formed whereas heterogeneous municipalities tend to remain separated.

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1. Introduction

A large number of reforms aimed at improving the delivery of public health services were adopted in the 1970s in response to the welfare state crisis in industrialized countries. These reforms were implemented at different moments in nearly all industrialized and developing countries, being more comprehensive in the United Kingdom and in New Zealand, less comprehensive in Germany and in the Netherlands, and relatively restricted in the USA.

Mendes (2001) mentions three waves of reforms. The first one, which extended from the 1970s to the first half of the 1980s, consisted of cost reduction measures that resulted in the stabilization of expenditures incurred by national health systems in almost every European country. The second one, from the second half of the 1980s to the first half of the 1990s, is characterized by measures that aimed to increase the microeconomic efficiency of the health systems, at the lowest possible cost, mainly by means of organizational innovations. Finally, the third wave of reform was implemented in the late 1990s and is characterized by the search for equity, improvement of public health services, acknowledgment of the importance of primary care and increased participation in decision-making processes in the health sector. In general, these reforms redefined the role of the state and market, extended patient rights, established new public health functions and promoted the decentralization of actions and services.

The reform of the Brazilian health system, implemented in the late 1980s, was based on the principles established by the Brazilian Constitution of 1988, article 198, such as universal provision of health care, integrity of health care and decentralization of actions and services. As for decentralization, the Organic Health Law[1] and the Basic Operational Rule of 1993 (NOB-SUS 01/93) transferred the management of health actions to state and city governments. The 1996 NOB-SUS 01/96 legislation deepened the decentralization process. City governments were designated to be responsible for health management, in addition to being responsible for the control, assessment and audit of health care providers within their territories.

The decentralization promoted by the reform of the Brazilian health system, as occurred in several other countries, increased the allocative efficiency, quality and transparency of health services, due to the proximity between users and the authorities in charge of the decision-making process. On the other hand, that process also brought about difficulties concerning the management of policies and actions, and inefficiency due to losses of scope and scale, which resulted from the fragmentation of health services.[2]

This is a classical dichotomy associated with the provision of a public good. On the one hand, the "benefit principle" requires that the decision about the

[1] Consisting of Law 8.080, September 19,1990, and Law 8.142, December 28, 1990.
[2] Ribeiro and Costa (1999).

provision be taken by the level of government that more closely represents the beneficiaries; on the other hand, the cost of such provision substantially increases as decentralization advances.[3]

Mendes (2001) mentions the microregion of Baturité, which comprises eight towns in the state of Ceará, as an example of fragmentation of health services. According to the State Department of Health of Ceará, "there are eight hospitals with an average occupation of 22%; seven ultrasounds (two would be enough); and ten laboratories of clinical pathology operating in a diseconomy of scale and at low quality." "This scenario observed in the microregion of Baturité is rather the rule than the exception in the Unified Health System (SUS)," says Mendes.

In the 1980s, the first intermunicipal health consortia (IHC) were created, in response to the excessive fragmentation of municipal health systems, which generate diseconomies of scale, and the increasing health expenditures as a result of technological innovations[4] and of the aging of the population. In the 1990s, the regionalization of health services was a matter for intense debate. The Basic Operational Rule of 2001 (NOAS-SUS 01/01) finally implemented the regionalization of health services.

It should be underscored that establishing local partnerships is an age-old practice. In 1409 a.C, in the Basque Country, *Mancomunidad de Enirio-Aralar*, gathered 13 municipalities for the management of forest resources. Spanish *mancomunidades*, similarly to Brazilian consortia, are a typical case of horizontal partnership between municipalities. In Spain, out of 8,096 municipalities, 5,857 are joined together in *mancomunidades*. In general, they are municipalities with less than 5,000 inhabitants, which gather together in order to cope with municipal fragmentation and to reestablish more efficient scales of production.[5]

In Brazil, this type of municipal association was studied by Teixeira et al. (2003), as far as the free-rider behavior is concerned. This behavior consists of the incentive a municipality receives to form a consortium so as to take good advantage of productivity gains from the joint provision of health services, and to default, passing the burden of consortium financing on to the other municipalities. The main result obtained by these authors was that the free rider behavior tends to prevent the formation of consortia or tends to dissolve them quickly.[6]

Given this instability, Teixeira et al. (2002) analyze incentive mechanisms that are able to neutralize the destabilizing free rider effect on the IHC, so as to guarantee that the association will not be dissolved.

[3]See Oates (1999) or Boadway and Wildasin (1984).

[4]Okunada and Murthy (2002) assert that technological innovations, on the supply side, are the major cause for the increase in health expenditures.

[5]Fonte et al. (1999).

[6]The free rider effect is extremely common in collective decision-making processes and permeates a significant part of the social choice theory. For a careful analysis of the free rider problem, see the seminal work by Olson (1965), which originated a voluminous literature on this issue.

Therefore, the studies mentioned above show the difficulty in forming and maintaining an IHC, due to the free rider effect, and then show how these difficulties can be overcome. Since these papers focus on the free rider behavior, they present some simplifications. Among these simplifications, the fact that municipalities are essentially identical and that the mayor of a municipality can decide, on his own, about the allocation of resources to the health sector should be highlighted. Taking for granted that the free rider problem is already solved, the present paper seeks to analyze another potential cause of instability for the consortium that was not considered in previous studies: the heterogeneity between municipalities. This study models the political decision-making process in terms of health expenditures, and evaluates the effect of income and preference heterogeneity among voters on the formation of consortia and on the provision of health services.

Thus, this study develops pre-electoral political competition models at the local level. The political platforms to be implemented by elected candidates concern the provision of health services and the tax schedules. These services may be rendered autarkically by the municipality or by an intermunicipal health consortium. In equilibrium, the proposed platform will be that which maximizes a median voter's utility, as discussed further ahead.

Besides the introduction, the paper is organized into four sections. Section 2 presents the model of autarkic provision of health services, in which voters derive utility from private consumption and from the consumption of health services. The solution regarding the optimal provision of health services and a median voter's utility are calculated in subsection 2.3. Section 3 presents a model in which municipalities have the option to provide health services through an intermunicipal consortium. The effects of the heterogeneity of municipalities on the provision of health care are assessed as to the average incomes and preferences of these municipalities and as to the bargaining power of their respective mayors. Section 4 analyzes social welfare. Three different situations are analyzed considering the average incomes and preferences of municipalities so as to define in which of them consortia will be formed. In other words, the answer to the following question is provided: what types of municipalities have a larger propensity to form health consortia? Section 5 concludes and provides some suggestions for further investigation.

2. Autarkic Provision of Health Services

2.1 Pre-electoral competition

This study develops models of pre-electoral political competition at the municipal level.

The time structure of the game is the following. First, candidates present their political platforms; after that, elections take place and voters choose the candidate whose platform best represents their interests. The candidate who receives more

votes is elected mayor; if there is a tie, one of the candidates with the largest number of votes is randomly chosen. Finally, the elected candidate implements the policies announced during the election campaign.

The modeling employed herein dates back to the seminal work by Hotelling (1929), later applied to political science, with a wealth of details, by Downs (1957). It should be highlighted that this methodology postulates that the candidate, after being elected, will implement the announced platform, regardless of any post-electoral incentives. This hypothesis supposes that the candidate derives utility exclusively from the fact that he holds a government job, not having any preference over which policies should be implemented. A more sophisticated justification for the politician's behavior lies in the fact that, since elections take place at a determined frequency, in the subsequent elections, voters may punish the candidate who does not implement the announced platform by not re-electing him. Irrespective of the justification for this behavior, the present paper follows Downs' tradition by positing that the politician will implement his election platform.[7]

2.2 Municipalities and their voters

Municipality i has a population of N_i voters. Voter j of this municipality has income y_{ij} and derives utility from private consumption c_{ij} and from the consumption of public health services (F_i), which is provided by the municipality government.[8]

Let s_i be the total amount of resources spent by the municipality on health. The health production of the municipality is given by the function $f_i(s_i, N_i)$ and the utility of agent j has the following form:

$$U_{ij}(F_i, c_j) = F_i^{\alpha_i} c_{ij}^{(1-\alpha_i)} = (f_i(s_i, N_i))^{\alpha_i} c_{ij}^{(1-\alpha_i)}, \text{where } \alpha_i \in [0,1] \qquad (1)$$

For tractability reasons, the model assumes that local expenditures in one municipality have no effects on decisions about the health expenses of other municipalities, that is, the spillover effects of health expenses (externalities) are disregarded. The coefficient $\alpha_i \in (0.1)$ reflects the importance that the inhabitants of municipality i give to the consumption of health services relatively to the consumption of the private good, being therefore a characteristic of that municipality.[9] Thus, if α_i is too large (small), then agent gives the consumption of health services a lot of (little) importance.

[7]For a detailed discussion, see Persson (2000, chapter 2).

[8]Actually, health is a semipublic or merit good. According to Giambiagi (2000, p. 33), although these goods may be submitted to the exclusion principle, they produce a large number of social benefits and positive externalities that justify their partial or total production by the public sector.

[9]Note that the proposed model assumes that the relative preferences of the inhabitants of a municipality over health/private consumption are homogeneous: voters of municipality i have the same preference parameter α_ii. A more general alternative is to suppose that each inhabitant j has his own parameter α_{ij}.

The health production function of municipalities, $f_i(s_i, N_i)$, is an increasing function of per capita expenditures on health (s_i) and of the corresponding population (N_i). Therefore, keeping the population constant, if the per capita expenditure increases, so does the provision of health services. On the other hand, if the total population increases and the same per capita expenditure is maintained, health production will increase.

The hypothesis above reflects the gains of scale and scope associated with the provision of health services. Economies of scale are observed when the curve for the average long-term cost of a certain health care provider decreases as the product increases. Economies of scope occur when two or more different goods can be jointly produced at lower costs than if they were produced separately.[10] Health goods and services often are produced by multiproduct firms – which offer numerous medical procedures – that are subject to such efficiency gains.

Of note, the health economics literature emphasizes that health production may vary with the amount used (extensive changes) and the rate at which tests and procedures are performed (intensive changes), while keeping the population constant: it increases when utilization and frequency levels are low, decreases when more resources are used and can even be negative due to iatrogenic diseases.[11] However, this study supposes that health expenditure, when medical treatment is added, improves the health conditions of the population and thus exerts a positive effect on the voter's utility. In Brazil, as well as in other developing countries, this simplification of the production curve – with only positive marginal returns – is justified because population coverage and the frequency of several complex procedures and exams do not measure up to international standards. This is the case of prenatal visits. The Ministry of Health, based on international standards, established that the ideal number of prenatal visits should be 6 per expectant mother. In 2001, the average number of visits was of only 4.2. This suggests that the increment in the total number of appointments and in their frequency per expectant mother, and consequently, the additional expenditure on this procedure, would greatly improve women's health. This piece of evidence is even more significant when one considers that, according to the Outpatient Information System of SUS (SIA/SUS), from January to October 2002, only 6% of expectant mothers who participated in the Program for Humanization of Prenatal Care and Childbirth attended all scheduled visits.[12] By generalizing this result, we may conclude that the region of the production function in which the resources are being applied corresponds to the ascending part of the curve, especially for the services produced by the consortium (more complex services).

[10] Folland et al. (1997).

[11] See Phelps (1992).

[12] Prenatal care is considered to be complete when expectant mothers have had six prenatal visits, done all mandatory exams, been vaccinated against tetanus, given birth, and visited their physician during the puerperium.

In order to generate explicit expressions for the solution of the problems to be analyzed, the particular form $f_i(s_i, N_i) = s_i g(N_i)$ will be used for the health production function. Therefore, this function is assumed to be multiplicatively separable in its two arguments and function g is strictly increasing and strictly concave.[13]

Every voter j pays taxes to municipality i at $\tau_i \in (0,1)$, and his net income available for consumption is given by $(1 - \tau_i) y_{ij}$. Therefore, the private consumption decision of voter i is contingent on his budget constraint:

$$c_{ij} \leq (1 - \tau_i) y_{ij}$$

Health expenditures made by the municipal government are financed in either of the following ways: by transfers made by higher levels of government or by the tax collected from taxpayers. The transfers correspond to SUS funds, allocated by the Ministry of Health and the State Department of Health, and to other resources (e.g.: constitutional transfers).[14]

Let t_i be the per capita value of government transfers received by municipality i and let $y_i = \frac{\sum_{j=1}^{N_i} y_{ij}}{N_i}$ be the average income of this municipality. Then, the per capita budget constraint of municipality i is:

$$s_i \leq t_i + \tau_i y_i$$

In the present model, the sole functions of municipal government are tax collection and provision of health services. In particular, concurrent public expenses are not taken into consideration as occurs in other recent studies.[15] This simplification allows for an accurate analysis of the trade-off between taxes and the provision of the public good, as well as the analysis of the effects of heterogeneity between municipalities on the formation of consortia, as will be discussed in the subsequent sections.

[13]Note that *a priori* there may be some difference between population N_i of the municipality and the number of patients who have been cared for, n_i, the latter of which should be considered for the health production function. For simplicity, both values are identified, which does not influence the qualitative results obtained in the study. The authors thank André Rossi Oliveira for making such a distinction.

[14]Differently from this study, to check the allocation of health resources, determined by Constitutional Amendment # 29, subnational resources are considered to be those which derive from local taxes, added to constitutional transfers.

[15]See Teixeira et al. (2003, 2002), who make a distinction between health expenditures and other expenditures. Besides the concurrent expenses unrelated to the health sector, we should observe that different municipalities may also have different priorities regarding the provision of several types of health services, which, for instance, may be correlated with their epidemiological profile. Such distinction has not been included in the present study. We thank an anonymous referee for drawing our attention to this issue.

2.3 Electoral equilibrium

During the electoral campaign, a candidate for mayor k of municipality i proposes a platform (s_i, τ_i) corresponding to the provision of public good s_i and tax rate τ_i necessary for its provision. A voter j will vote for candidate k, if his political platform (s_i, t_i) provides better utility than the platforms presented by the other candidates.

If candidate k presents the best proposal for voter j, k will solve the following program:

$$\begin{cases} \underset{(s_i,\tau_i)}{Max}\ U_{ij}\left(f_i\left(s_i, N_i\right), c_{ij}\right) \\ \quad r.a\ c_{ij} \leq \left(1-\tau_i\right) y_{ij} \\ \qquad s_i \leq t_i + \tau_i y_i \end{cases} \tag{2}$$

The restrictions of the previous problem are binding and, therefore, the implicit solution is given by:

$$\begin{cases} s_i = t_i + y_i \frac{1-\alpha_i}{\alpha_i} \frac{f_i(s_i,N_i)}{f_{i,s}(s_i,N_i)} \\ \tau_i = 1 - \frac{1}{y_i} \frac{1-\alpha_i}{\alpha_i} \frac{f_i(s_i,N_i)}{f_{i,s}(s_i,N_i)} \end{cases} \tag{3}$$

In the expression above, $f_{i,s}\left(s_i, N_i\right) = \frac{\partial}{\partial s} f_i\left(s_i, N_i\right)$ is the partial derivative of f_i with respect to its first variable s. Plugging in the explicit form $f_i\left(s_i, N_i\right) = s_i g\left(N_i\right)$ yields the following explicit solution:

$$\begin{cases} s_i = \alpha_i\left(t_i + y_i\right) \\ \tau_i = \alpha_i - \left(1-\alpha_i\right) \frac{t_i}{y_i} \end{cases} \tag{4}$$

Note that the platform that maximizes the utility of agent i is not dependent on income y_{i_j} but only on the preference parameter a_i, on transfers t_i and on the average income of municipality y_i. In particular, every candidate will present that same platform (4) in equilibrium; which the elected mayor will then implement.

That result is a special case of the "Median Voter Theorem." This theorem established that under certain regularity conditions, the political platforms presented by different candidates in a pre-electoral campaign converge to the same value: the policy preferred by the median voter. Since the preferences of voters of municipality j totally coincide concerning the optimal platform (4), due to the form of utility functions[16] U_{ij}, this platform is the same as that of the median voter. Indeed, in the present model, every voter of the same municipality is a median voter of this municipality.

The fact that the inhabitants of the same municipality preferred the same political platform is a peculiar result, which occurred because the voters' utilities

[16] In this paper, it is supposed that $\frac{\alpha_i}{1-\alpha_i} > \frac{t_i}{y_i}$, so as to avoid corner solutions such as $\tau_i = 0$. Therefore, the per capita transfers should not be too large compared to the average income of the municipality.

were of the Cobb-Douglas type. Consider now a more general utility function U_{ij}, strictly increasing in its arguments. Then, the restrictions in (2) remain active, in such a way that the original problem is reduced to a one-dimensional maximization problem whose solution s_{ij} represents the political platform preferred by voter j. Therefore, voters with a different income may have different preferences over the optimal provision of health services. Nevertheless, as voters are still ranked according to their preferred political platforms, the median voter's preferred policy will be a Condorcet winner, provided that utility function $U_{ij}(s_i)$ – now regarded as an exclusive function of policy s_i – is single-peaked. In summary, it is possible to prove the median voter theorem for more general forms of the voter's utility, provided that it is strictly concave in s_i.[17]

Also, it is worth discussing the convergence of the platforms proposed by all candidates. This is a typical result of Downs' models, also known in political theory as Duverger's law, which is a consequence of the existence of a Condorcet winner. However, this type of equilibrium is often questioned as in practice there usually are significant differences in the platforms of political parties running for the elections. This fact is a major object of study in political sciences and is typically attributed to the existence of an ideological component in the utility functions of voters and candidates, which is not discussed in the present study.[18]

From solution (4) note that for each real transferred to municipality j, there will be a reduction equal to $1-\alpha_i$ cents in the value of the municipality's own resources originally destined to the health sector. Thus, in real terms, the total amount of resources allocated to the health sector is of only a_i cents. In fact, the remaining $1-\alpha_i$ cents are used to reduce the tax burden ($\tau_i y_i$). This is the adverse effect of governmental transfers on the tax effort of municipalities, a result known in the fiscal federalism theory and widely tested empirically.[19] In the specific case of health expenditures, this result concurs with the empirical evidence analyzed by Ferreira (2002), which show that an increase of R$ 100,00 per inhabitant in SUS transfers causes an average increase of R$ 67,00 per inhabitant in the municipality's expenses on health and sanitation.

The utility of voter i in the electoral equilibrium is:

$$W_{ij}^{A}\left(y_{ij}\right)=\Theta\left(\alpha_i,\alpha_i\right)g\left(N_i\right)^{\alpha_i}\left(\frac{y_{ij}}{y_i}\right)^{(1-\alpha_i)}\left(t_i+y_i\right) \tag{5}$$

The function Θ is given by $\Theta\left(\alpha,\beta\right)=\alpha^{\beta}\left(1-\alpha\right)^{1-\beta)}$. Index A indicates that W_{ij}^{A} is the utility obtained by agent j of municipality i when this municipality *autarkically* provides the public good. The next section analyzes how this utility

[17] We thank an anonymous referee for drawing our attention to this issue.

[18] For an analysis of the effects of the ideological component on political equilibria, see Persson and Tabellini (2000), Drazen (2000) or Bugarin (1999).

[19] See Minassian (1997) and Ribeiro (1998).

is affected when two municipalities form a consortium for the joint provision of health services.

3. Consortium for Provision of Health Services

3.1 Intermunicipal health consortium

Suppose now there are two municipalities, $i = 1, 2$, respectively characterized by their population (N_i), their preferences (α_i) and by the incomes of their inhabitants (y_{ij}).

These municipalities may opt to form an intermunicipal consortium for the joint provision of health services. If the consortium is formed, the municipalities will have the same per capita expenditure on health, $s = s_1 = s_2$, since, presumably, all health services will be provided by means of the consortium. Health expenditures will now be financed by governmental transfers received by the two municipalities, t_1 and t_2, respectively, as well as by tax collected by the municipalities, $\tau_1 y_1$ and $\tau_2 y_2$.

The present analysis presupposes that when the consortium is formed the municipalities equalize their tax burdens. In the model, there is only one public good that is provided and only one source of tax collection. Thus, in any population equilibrium, the two municipalities, which now offer the same amount of health services, are expected to collect the same tax amount, $\tau_1 = \tau_2 = \tau$. This simplifying hypothesis is used in the fiscal federalism literature, according to which voters "vote with their feet".[20] Each citizen will choose to live in the municipality that offers him the best ratio between tax burden and the provision of public goods.

Finally, we suppose that both municipalities receive the same per capita transfers from higher levels of government: $t_1 = t_2 = t$. This is a simplifying hypothesis, which is however partially corroborated by the data shown in the subsequent table. Note that the per capita value of SUS transfers tends to be proportional to the size of the municipality.[21] As for constitutional transfers, we have an inverse relationship, that is, the smaller the municipality, the higher the per capita value transferred. With these two forms of transfer to municipalities, one can verify that, except for the category of municipalities with less than 10,000 inhabitants, the total amount of per capita transfers to smaller municipalities is virtually the same as that received by richer municipalities ($t_1 = t_2$).

[20] Tiebout (1956) reaches that result under the following basic assumptions (among others): voters enjoy perfect mobility to choose the municipality where their preference patterns are better satisfied; the public services provided do not present external economies or diseconomies between municipalities; and there are no restrictions imposed by job opportunities.

[21] This happens because the transfers for intermediate and highly complex procedures tend to parallel the available supply, which concentrates on larger municipalities. Therefore, the volume of these transfers exceeds the volume of transfers based on the per capita criterion (such as the fixed part of primary care), which explains the trend observed in Table 1. We thank an anonymous referee for drawing our attention to this issue.

Table 1
SUS and Constitutional per capita transfers according to municipality size – year 2000

Municipality population (in thousands)	SUS per capita transfers (in reais) (a)	Constitutional per capita transfers (in reais) (b)	Total per capita transfers (in reais) (a) + (b)
Below 10	16.86	515.54	532.40
From 10 to 50	17.38	295.42	312.80
From 50 to 100	27.77	248.16	275.93
From 100 to 300	36.00	270.36	306.36
From 300 to 500	46.37	240.03	286.40
Above 500	54.83	245.81	300.64

Source: FINBRA, 2000 in Ferreira (2000).

3.2 Health production function

As previously mentioned, the recent literature on intermunicipal health consortia suggests the existence of efficiency gains associated with the provision of health services by the consortium.[22] These gains result from economies of scale with greater administrative flexibility to hire personnel and standardize medical procedures, among others. This study models the possibility of obtaining such gains, supposing the existence of a new health production function $f(s, N)$ that is increasing in its two variables: s, *per capita* health expenditure by means of a consortium, and $N = N_1 + N_2$, total population of the two consortium member municipalities. To explicitly solve the optimization problems, again we will use the multiplicatively separable form: $f(s, N) = sG(N)$ in which function G is strictly increasing and strictly concave. In this case, we suppose that $G(N) \geq g(N)$, that is, health production by means of a consortium is at least as efficient as it would be if a municipality with the same population as that of the consortium produced it autarkically.

With the hypothesis above, the utility that an inhabitant i, of the consortium member municipality j, derives from his consumption basket is then given by:

$$U_{ij}^{C}\left(f\left(s,N\right)_{i},c_{j}\right)=\left(f\left(s,N\right)\right)^{\alpha_{i}}c_{ij}^{(1-\alpha_{i})}=G(N)^{\alpha_{i}}s^{\alpha_{i}}c_{ij}^{(1-\alpha_{i})} \tag{6}$$

3.3 Negotiation

The determination of health expenditure (s), with the consequent definition of tax burden (t), depends on the political negotiation between the mayors of the municipalities involved. In particular, the greater the negotiation power of a mayor, the closer to optimal the provision by means of the consortium will be for his municipality. Therefore, different results may be obtained, depending on the bargaining power of each mayor. However, regardless of the result of this process, it should be Pareto-optimal.[23]

[22] Mendes (2001), Lima and Pastrana (2000) and Ribeiro and Costa (1999).

[23] This hypothesis is associated with the fact that mechanisms that deal with the free rider effect have already been discussed in previous studies. Thus, this study takes for granted that

Thus, to predict which will be the decision about the municipality's health expenditure, when services are provided by means of a consortium, it is necessary to solve a Pareto problem. Supposing that the mayor of a municipality assigns the same weight to each of his voters, the maximization problem of the consortium can be written as:

$$(P)\begin{cases} \underset{q,\tau}{Max}^{1} \left[\prod_{j=1}^{N_1} U_{ij}^{C}\left(f\left(s,N\right),c_{2j}\right)\right]^{\lambda_1}\left[\prod_{j=1}^{N_2} U_{2j}^{C}\left(f\left(s,N\right),c_{2j}\right)\right]^{\lambda_2} \\ r.a.\ c_{1j} \leq \left(1-\tau\right) y_{1j} \\ \qquad c_{2j} \leq \left(1-\tau\right) y_{2j} \\ \qquad s \leq t+\tau y \end{cases}$$

Coefficients $\lambda 1, \lambda 2 \in [0,1], \lambda 1 + \lambda 2 = 1$ are Pareto weights of the maximization problem and reflect the possible differences in the mayors' negotiation power. Thus, the greater the $\lambda 1$, the more the preferences of inhabitants of municipality 1 will influence the choice of q and τ, regarding the preferences of voters of municipality 2.[24]

A possible specification for $\lambda_i, i = 1,2$, is $\lambda_i = \frac{N_i}{N_1+N_2} = n_i$, that is, a mayor's negotiation power is a direct function of the population size with respect to the total population of the consortium.[25] However, this is not the only natural specification. Another specification would be: $\lambda_i = \frac{N_i y_i}{N_1 y_1 + N_2 y_2}$, that is, a mayor's negotiation power would be proportional to the income of the population of his municipality relatively to the total income of the consortium.

Variable y corresponds to the average income in the consortium: $y = n_1 y_1 + n_2 y_2$.

Pareto problem (P) can be solved similarly to the problem of autarkic provision of health services. The restrictions are active and the solution is:

$$\begin{cases} s = t + y - \frac{1-\mu}{\mu}\frac{f(s,N)}{f_s(s,N)} \\ \tau = 1 - \frac{1}{y}\frac{1-\mu}{\mu}\frac{f(s,N)}{f_s(s,N)} \end{cases}$$

Where, $\mu = \lambda_1\alpha_1 + \lambda_2\alpha_2$. When the production function takes the form $f\left(s,N\right) = sG(N)$ the following explicit solution is obtained:

such mechanisms have already been implemented.

[24]The objective function presented above can be replaced by an equivalent one, which is perhaps more common, if the logarithm function is applied, resulting in the following expression:

$$\lambda_1 \sum_{i=1}^{N_1} u_{1j}\left(f\left(s,N\right),c_{1j}\right) + \lambda_2 \sum_{i=1}^{N_2} u_{2j}\left(f\left(s,N\right),c_{2j}\right)$$

in which $u_{ij} = \log \circ U_{ij}$.

[25]In the Greater Bilbao Water Partnership, Spain, the number of voters of each municipality at the general assembly of the consortium is proportional to the size of its population.

$$\begin{cases} s = \mu(t + Y) \\ \tau = \mu - (1 - \mu)\frac{t}{y} \end{cases} \tag{7}$$

It is important to analyze the effect of population size, negotiation power and other problem parameters on the consortium equilibrium.

First, the relative size of each population affects the equilibrium exclusively by means of the new average reference income: $y = n_1 y_1 + n_2 y_2$, where $n_i = \frac{N_i}{N_1 + N_2}, i = 1, 2$. Thus, the larger the population of municipality i, the larger n_i will be and, consequently, the heavier the weight of the average income of the municipality in determining the consortium equilibrium.

Secondly, the negotiation power of each municipality will define a new "preference pattern": $\mu = \lambda_1 \alpha_1 + \lambda_2 \alpha_2$. Thus, the more influential the mayor of municipality i, the larger λ_i will be and the more strongly parameter μ will reflect the preferences of that municipality. This is the only effect of the negotiation power of the municipality on the determination of the consortium equilibrium. In particular, if both municipalities have the same preference $\alpha_1 = \alpha_2 = \alpha$, then $\mu = \alpha$ and the negotiation power of municipalities no longer affects the consortium equilibrium.

3.4 Effects on health expenditure

It is interesting to compare the solution to the problem of autarkic provision (3) with the consortium solution (7), in order to determine, for each municipality $i = 1, 2$, if there will be an increase or reduction in health expenditure. The two expressions corresponding to the respective health expenditures are presented below.

Autarkic provision: $s_i = \alpha_i (t + y_i)$

Consortium provision: $s_i = \mu(t + y) = (\lambda_1 \alpha_1 + \lambda_2 \alpha_2)(t + n_1 y_1 + n_2 y_2)$

Consider the following four cases, classified according to the level of homogeneity of municipalities.

Case 1: Homogeneous preferences and incomes

If municipalities have homogeneous preferences ($\alpha_1 = \alpha_2 = \mu$) and the same average income ($y_1 = y_2 = y$), then the consortium will not cause any change in the per capita health expenditure. However, it should be underscored that there will be an increase in the provision of the public good, due to gains of scale and scope associated with the joint provision of health services.

Case 2: Homogeneous preferences and different average incomes

If municipalities have homogeneous preferences ($\alpha_1 = \alpha_2 = \mu$), but different average incomes ($y_1 < y < y_2$), then the consortium will increase health expenditures in the poorest municipality and reduce the expenditures in the richest municipality.

Case 3: Different preferences and homogeneous incomes

If municipalities have different preferences ($\alpha_1 < \mu < \alpha_2$), but identical average incomes ($y_1 = y_2 = y$), then the consortium will increase health expenditures in the municipality that gives less importance to the provision of health services and reduce expenditures in the municipality that attaches highest importance to the provision of health services.

Case 4: Different preferences and different average incomes

Finally, if municipalities have different preferences, i.e. $\alpha_1 < \mu < \alpha_2$, and different average incomes ($y_1 \neq y_2$), then two situations should be taken into consideration.

If $y_1 < y < y_2$, that is, the municipality that gives less importance to the provision of health services is also the poorest municipality, then health expenditure will be higher in that municipality ($i = 1$) and lower in the richest municipality, which attaches highest importance to health. This situation is similar to the one analyzed in case 3.

On the other hand, if $y_1 > y > y_2$, that is, the richest municipality is the one that gives less importance to health provision, then, there may be an increase or reduction in health expenditure in each municipality depending on the specific values assumed by variables α_1, α_2, y_1 and y_2. Thus, one cannot guarantee the effect of the consortium on health expenditures.

The previous comparisons show a potential source of tension in the formation of consortia. On the one hand, in case 2, there will be an increase in the per capita health expenditure, and consequently, an increase in taxes, in the poorest municipality. On the other hand, in cases 3 and 4 (first situation) there will be an increase in health expenditures and in taxes as well, in the municipalities that give less importance to health services.

Therefore, in order for a municipality to enter a consortium - taking for granted that the free rider problem has been solved -, the median voter should carefully consider the effect of these variations on health expenditures that result from the consortium. The next section deals with that issue, in an attempt to predict what consortia will be formed.

4. Welfare Analysis: What Consortia Will Be Formed?

4.1 Pre-electoral competition: political economy of consortion formation

The possibility for municipalities to form a consortium introduces a new focus on the electoral campaign analyzed in section 2. As a matter of fact, the candidate for mayor should include the decision to form or not a partnership in his political platform, since such association implies a change in the provision of the public

good and consequently in the amount of tax collected.

If candidates decide not to propose a consortium, the public good will be produced autarkically, and therefore, according to the result obtained in the previous game, in equilibrium, a voter j of municipality i derives utility:

$$W_{ij}^{A}\left(y_{ij}\right)=\Theta\left(\alpha_i,\alpha_i\right)g\left(N_i\right)^{\alpha_i}\left(\frac{y_{ij}}{y_i}\right)^{(1-\alpha_i)}\left(t_i+y_i\right)$$

On the other hand, the best proposal that can be made to voter j of municipality i involving the formation of a consortium will result in the utility shown below, where index C indicates the utility of i when municipality j forms a consortium.

$$W_{ij}^{C}\left(y_{ij}\right)=\Theta\left(\mu,\alpha_i\right)G(N)^{\alpha_i}\left(\frac{y_{ij}}{y}\right)^{(1-\alpha_i)}\left(t+y\right)$$

Thus, the proposal that involves the formation of a consortium will be preferred by voter j, if and only if:

$$W_{ij}^{C}\left(y_{ij}\right)\geq W_{ij}^{A}\left(y_{ij}\right)$$

Equivalently,

$$\left[\frac{G(N)}{g\left(N_i\right)}\right]^{\alpha_i}\geq\left[\frac{\Theta\left(\alpha_i,\alpha_i\right)}{\Theta\left(\mu,\alpha_i\right)}\right]\left[\frac{\frac{t+y_i}{y_i^{(1-\alpha_i)}}}{\frac{t+y}{y^{(i-\alpha_i)}}}\right] \tag{8}$$

Note that the expression above does not depend on the particular income of voter j. Therefore, either all voters in the same municipality prefer the autarkic provision of health services or all of them prefer the consortium.[26]

The term on the left hand side $B\left(N_i,N\right)=\left[\frac{G(N)}{g(N_i)}\right]^{\alpha_i}$ represents the gain for municipality i from the health consortium. Given the hypothesis of gains of scale and scope associated with the consortium, this term is always greater than 1.

On the other hand, the two terms on the right hand side correspond to the loss caused by the decision to form a consortium for the provision of health services.

The first of these terms, $P\left(\alpha_i,\mu\right)\left[\frac{\Theta(\alpha_i,\alpha_i)}{\Theta(\mu,\alpha_i)}\right]$, corresponds to the loss caused by preference aggregation when preferences differ with respect to the importance of health services in relation to private consumption. Note that if $\alpha_1=\alpha_2$, then $\mu=\alpha_i$ and $P\left(\alpha_i,\mu\right)=1$, which has no effect on the right hand side. On the other hand, if $\alpha_1\neq\alpha_2$, then $\mu\neq\alpha_i$, and $P\left(\alpha_i,\mu\right)>1$, which might jeopardize the inequality.[27]

[26]Except, of course, in the special case in which equality is observed in (8). Assume, in that extreme case, that all voters will prefer the consortium.

[27]The function $\phi(\mu)=\Theta(\mu,\alpha_i)$ reaches its maximum value at $\mu=\alpha_i$.

The second of these two terms, $R(y_i, y) = \frac{t+y_i}{y_i^{(1-\alpha_i)}} \left[\frac{t+y}{y^{(1-\alpha_i)}}\right]^{-1}$, corresponds to the loss caused by the fact that consortium decisions are based on the average income of the two municipalities, and not only on the income of municipality i. Again, note that expression R takes value 1, when the municipalities have the same income ($y_1 = y_2 = y$), which does not affect inequality (8).

It is now necessary to determine when condition (8) will be satisfied for both municipalities $i = 1, 2$, such that they decide to form a health consortium. For that purpose, consider four different cases.

4.2 Consortium of homogeneous municipalities

First, suppose that the inhabitants of both municipalities have the same preferences over private consumption, $\alpha_1 = \alpha_2 = \mu$, and that the average incomes of these municipalities are identical, $y_1 = y_2 = y$. In this case, the expression to the right of the inequality (8) becomes 1, as previously observed, such that (8) will always be satisfied.

Therefore, when there is complete homogeneity between municipalities, the gains due to joint production will induce both municipalities to form a consortium, provided that the free rider problem, studied in Teixeira et al. (2002, 2003), is solved.

4.3 Consortium of municipalities with homogeneous preferences and different incomes

Let us now suppose that municipalities give the same relative value to the consumption of the public good ($\alpha_1 = \alpha_2 = \mu$) but have different average incomes ($y_1 < y < y_2$). Then, inequality (8) is reduced to:

$$\left[\frac{G(N)}{g(N_i)}\right]^{\alpha_i} \geq \left[\frac{\frac{t+y_i}{y_i^{(1-\alpha_i)}}}{\frac{t+y}{y^{(1-\alpha_i)}}}\right]$$

In this case, there are different incentives for both municipalities.

For municipality 2, it is easy to check that, as $y_2 > y$, $R(y_2, y) < 1$. As $B(N_2, N) > 1$, municipality 2 will wish to join the consortium regardless of the value of α_2.

As for municipality 1, define functions $\gamma(\alpha_1) = \left[\frac{G(N)}{g(N_i)}\right]^{\alpha_i}$ and $\rho(\alpha_1) = \frac{t+y_1}{y_i^{(1-\alpha_1)}} \left[\frac{t+y}{y^{(i-\alpha_1)}}\right]^{-1} = \frac{t+y_1}{t+y} \left(\frac{y}{y_1}\right)^{(1-\alpha_1)}$. It follows that:

(i) $\gamma(\alpha_1)$ is strictly increasing with $\gamma(0) = 1$ and $\gamma(1) = \frac{G(N)}{g(N_1)} > 1$ and

(ii) $\rho(\alpha_1)$ is strictly decreasing with $\rho(0) = \frac{t+y_1}{t+y} \left(\frac{y}{y_1}\right) > 1$ and $\rho(1) = \frac{t+y_1}{t+y} < 1$.

Comparing functions γ and ρ it becomes clear that there is a value $\overline{\alpha}_1 \in (0,1)$, such that:

(i) if $\alpha_1 < \overline{\alpha}_1$, then (8) will not hold and municipality 1 will not join the consortium.

(ii) if $\alpha_1 > \overline{\alpha}_1$, then (8) will hold and municipality 1 will wish to join the consortium.

In summary, in the case in which both municipalities have the same preferences and different average incomes, the richest municipality will always show interest in forming the consortium. However, the consortium will only be formed if the interest of inhabitants of both municipalities in health services is sufficiently high.

When the consortium is formed, we may predict an increase in health production in the poorest municipality. However, there will be a reduction in health expenditure in the richest municipality, as observed previously. Therefore, the effect on the provision of health services in the municipality with a higher income depends on the production gains associated with the consortium, which may result in an increase or reduction in health production.

4.4 Consortium of municipalities with homogeneous incomes and different preferences

Consider now a situation in which the municipalities have the same average incomes, $y_1 = y_2 = y$, but different preferences in terms of the importance of health services versus private consumption: $\alpha_1 < \mu < \alpha_2$. In this case, inequality (8) is reduced to:

$$\left[\frac{G(N)}{g(N_i)}\right]^{\alpha_i} \geq \left[\frac{\Theta(\alpha_i, \alpha_i)}{\Theta(\mu, \alpha_i)}\right]$$

The term to the left corresponds to the production gains (of scale and scope) associated with consortium production, and is greater than 1 by assumption. On the other hand, the term to the right is also always greater than 1, and increases its value as α_i moves away from μ, since $\alpha_1 \neq \alpha_2$. If the values of α_1 and α_2 are sufficiently close, then the condition will be satisfied. However, as these values move away from each other, the term on the right becomes too large. For instance, if $i = 1$, $\alpha_1 = 0.4$, $\alpha_2 = 0.99$, $\lambda_1 = 0.01$ and $\lambda_2 = 0.99$, then the term on the right exceeds 5, which means that $G(N)$ has to be at least 125 times $g(N_1)$ for municipality 1 to be interested in forming the consortium. That value reaches 390625, if $\alpha_1 = 0.1$.

Thus, if incomes are the same and preferences are different, the production gains from the consortium should be extremely high in order to induce the municipalities to agree on forming a consortium. Therefore, preference heterogeneity

between consortium member municipalities may become a hindrance to the partnership.

4.5 Consortium of municipalities with different incomes and different preferences

In this case, the two "costs" associated with the formation of the consortium, $P(\alpha_i, \mu) = \left[\frac{\Theta(\alpha_i,\alpha_i)}{\Theta(\mu,\alpha_i)}\right]$ and $R(y_i, y) = \frac{t+y_i}{y_i^{(1-\alpha_i)}}\left[\frac{t+y}{y^{(i-\alpha_i)}}\right]^{-1}$ are greater than 1, which makes formation of the consortium less feasible than in the last two cases analyzed. Therefore, when municipalities have different incomes and different preferences, the consortium is not expected to be formed in equilibrium.

4.6 What consortia will be formed?

This section summarizes the determining role of homogeneous incomes and preferences in the constitution of intermunicipal health consortia. When consortia are totally homogeneous, gains of scale are sufficient to guarantee their formation. Heterogeneity, however, imposes some restrictions upon it.

When only the average incomes of municipalities are heterogeneous, there will be formation of consortia as long as the relative preference of inhabitants of these municipalities over the public good is not extremely low. It is noteworthy that, in this case, the richest municipality will not be interested in increasing health expenditure, but rather in sharing the health production costs with the other municipality, reducing its per capita health expenditure. As a consequence, that municipality will be able to reallocate its resources between private and public consumption, due to the health production gains associated with the consortium. On the other hand, the poorest municipality regards the consortium as an opportunity to increase its health production.

Conversely, when only the preferences of inhabitants over the public good are heterogeneous, the consortium will only be formed when this heterogeneity is quite low. Even in that case, the consortium will be formed only when the gains of the joint health production are very high.

Finally, when both incomes and preferences over the public good are heterogeneous, there will usually be no consortium.

The reduced empirical evidence available seems to support the results obtained with income homogeneity. The analysis of per capita income of the existing consortia in the Brazilian state of Minas Gerais suggests that incomes are homogeneous between the consortium member municipalities. In 31 of 64 consortia in 2003, which include 754 municipalities, 70% to 100% of the member municipalities are separated only by one income decile. Moreover, in the same Regional Health Board, 59.1% of consortium member municipalities have more homogeneous incomes than the municipalities that did not form partnerships.[28]

[28]The percentage of municipalities separated by one income decile was regarded as proxy for

With respect to the role of similar preferences in the formation of consortia, the attempt to use the mayor's political party, as well as the political composition of the City Council, as proxies for the preferences of inhabitants of a municipality did not lead to significant conclusions. An alternative analysis is to use a measure of income inequality in municipalities as a proxy for the preferences of their inhabitants over health services. The rationale behind this approach is that municipalities with less inequality have different preferences over health services from municipalities with larger income inequality.[29] This approach, and further studies on the best parameters that should be used to assess the preferences of the inhabitants of a municipality over health services are left as suggestions for future investigation.

5. Conclusion

Based on a model with political microfundamentals, the present study assessed the effects of heterogeneity between municipalities regarding politicians' decision about the inclusion of the consortium proposal in their political platforms *vis-à-vis* the possibility of autarkic provision of health services.

The major result of the study concerns the strong relationship between the characteristics of municipalities and the formation of consortia. When the incomes of municipalities and the preferences over the provision of public goods are homogeneous, the consortium will be formed. When the average incomes of municipalities are different, but their preferences are identical, there may be formation of a partnership, provided that both municipalities give enough importance to the provision of the public good. Finally, consortium formation is less probable when municipalities give different importance to the provision of health services. In addition, consortia will hardly be formed when municipalities have different preferences and different average incomes.

Therefore, this study answers the initial question about which consortia will be formed, predicting the formation of two different kinds of association: homogeneous consortia, in which the average incomes and preferences of municipalities are very similar; and consortia in which the municipalities have heterogeneous incomes but homogeneous preferences, provided that these preferences give due importance to the provision of the public good. However, the latter organizational structure suggests a curious alignment of interests in consortia. Whereas consortia will lead to a higher health production in the poorest municipality, the richest municipality joins the consortium not because of its interest in increasing public good production, but because of the possibility to reduce its average health expenditures.

considerations about income homogeneity. This percent value was calculated using the number of municipalities in the modal income decile as reference and adding the municipalities with the second highest frequency. Details of this study may be obtained from the authors.

[29]We thank an anonymous referee for drawing our attention to this alternative approach.

This study is the first attempt to elucidate the political economy behind the formation of intermunicipal health consortia. However, many aspects still need to be analyzed, especially regarding the mayors' negotiation power. In fact, the current model supposes that the result of the negotiation between municipalities when the consortium is formed is efficient and solves a Pareto problem, providing health services by means of a consortium. The development of an explicit negotiation model is a natural extension of this hypothesis.

A negotiation mechanism could be one similar to Rubinstein's, with complete information, as developed in Bugarin (1999). In that case, one expects to reach an efficient result in which the bargaining power of each municipality is made explicit. Another extension would be a bargaining model with incomplete information about the types of the mayors, which may bring about inefficiency and involve signaling and/or reputation building issues (Pires and Bugarin (2002)). In addition, the political economy model could be extended so as to allow preference heterogeneity as well as income heterogeneity within the same municipality.

In addition to the suggested developments, a more in-depth empirical investigation should be conducted in order to elucidate the factors that lead to the formation of heterogeneous consortia. That extension should include an analysis of the free rider effect, which is already present before the formation of the consortia, in a model containing any number of contiguous municipalities.

In the present study, the consortium effect on health production was modeled by means of an exogenous and increasing function of per capita health expenditure and of the attended population. It would be interesting to consider more general production functions (even if exogenous) in order to check the consistency of the current results.

It is also important to clarify the mechanisms that produce gains, and especially, losses from the consortium provision of health goods and services. As far as disincentives are concerned, some costs related to the consortium provision of health goods and services should be analyzed. This analysis should include transportation costs – since patients need to commute between the consortium member municipality and the host municipality – and political costs – as voters are less likely to associate the health services provided by another municipality with their mayor's actions, which may not result in votes for this mayor.

Although the hypotheses regarding the variables that affect health production (*per capita* expenditure and covered population) are natural, the explanation for the chosen format is basically technological, with recourse to gains of scale and scope from the consortium. Nevertheless, the production gains from the consortium may be explored via arguments that more closely relate to the theory of comparative advantage and to information economy.

Indeed, different municipalities may have different capacities for the provision of health services. This capacity may be the result of a wider experience in the management of large medical businesses (administrative advantage), existence of

human capital (preference for working in certain municipalities for any personal reasons, for instance), or municipal courts of audit that have better control over health expenditures, among others. Given these different capacities, consortia would generate production gains by simply exploring the comparative advantages of each municipality.

Another exogenous explanation for the production gains from consortia is related to the introduction of new incentives based on the dedication of health professionals hired by the consortium. Since consortia are privately owned, they have greater flexibility to hire and lay off employees. Therefore, better wage contracts (high powered incentives) than those currently established by the public administration may be negotiated. A performance-based wage system may result in a higher level of dedication by health professionals, generating a higher health production.

Finally, the analyses developed herein can be adapted to several other sectors rather than health care services. The consortium between municipalities for the solution of common problems has become a reality in different areas, such as environment, sanitation, supply, among others. Thus, the results obtained here may be useful not only for the health sector, but also for a broader analysis of consortium formation in Brazil.

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