Too Many Municipalities?*

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Contents: 1. Introduction; 2. The Provision of a Public Service in a Single Municipality; 3. The Decision to Divide a Municipality; 4. The Optimal Number of Municipalities; 5. Conclusion.

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Does democracy lead to the creation of too many municipalities? We analyze this issue within the context of the Alesina e Spolaore (1997) model where the quality of municipal services deteriorates with the distance from the center of a municipality. Individuals can vote in a referendum to split an existing municipality. We show that social welfare will decline when municipalities are split if the level of the public service, as chosen by the median voter, is lower in the new smaller municipalities. In general, the model indicates that there may be a democratic bias in favour of creating too many municipalities.

Democracia leva à criação de muitos municípios? Este assunto é analisado com base no modelo Alesina e Spolaore (1997) onde a qualidade dos serviços municipais pioram devido à distância do centro municipal. Sendo assim, habitantes são levados a decidir, através de voto, pela divisão de um município existente em outros novos municípios. Quando um município é dividido, o bem-estar social também irá deteriorar se o nível do serviço público escolhido pelos eleitores para os novos municípios é ruim. Em geral, o modelo indica que a tendência democrática pode favorecer à criação de muitos municípios.

1. INTRODUCTION

Between 1982 and 2007, the number of municipalities in Brazil increased by 41 percent.[1] The increase in the number of municipalities has been attributed to the incentives created by the intergovernmental transfer system because per capita transfers are inversely related to the population of a municipality. Consequently, if a municipality is divided in two, total grants to the two new municipalities

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[1] Mendes (2008, p. 37).

can exceed the transfer that the old municipality received. In this way, the Brazilian intergovernmental transfer system favours the division of existing municipalities into smaller units. Whether the creation of new, smaller municipalities is a good or bad policy depends upon whether the number of existing municipalities is "optimal".

Relatively little has been written by economists on re-drawing the boundaries of municipal governments. Epple e Romer (1989) found that "detachments", where boundaries are redrawn to exclude some land, were quite rare in the United States in the 1970s, representing less than two percent of the total number of changes in municipal boundaries. They noted that in the United States the institution rules permitting detachments vary from state to state, but most states have stringent regulations, such that "only undeveloped land at the boundary of a municipality is potentially eligible for detachment, and some form of collective approval is required in most states" (p. 318). The states with the highest rates of detachments were those where only a petition to a court or municipality was required.

Carey et alii (1996) analyzed the consolidation of municipalities in Alleghany County Pennsylvania based on economies of scale in the production of public services. They noted that "electors are much less likely to support a consolidation plan if it may substantially change (for the worse) their existing local government tax levels or services" (p. 117), and in their model they imposed "socio-economic" constraints on potential consolidations to reflect these political realities.

More recently, a large literature has developed that addresses the question of the break-up and separation of nations. Bolton e Roland (1997) have analyzed the incentives for separation for regions where individuals' have different incomes. Nations provide a private good, income redistribution, which can lead to the break-up of a country because some voters would like to have a level of redistribution that is closer to their preferred policy. While the Bolton and Roland model has features that are also present in the model developed in this paper, their model applies to nation states and is concerned with issues, such as the free flow of capital, that are not central to the question municipal fragmentation.

Our model is most closely related to Alesina e Spolaore (1997), who developed a model of the optimal number of governments when there is a trade-off between reductions in the per capita costs of providing a public good to a larger population and the increase in preference heterogeneity that occurs as the population of a jurisdiction increases. They showed that the efficient number of governments is less than the "stable" number of governments, indicating that there is a tendency for democratic institutions to produce "too many governments".

As in Alesina e Spolaore (1997), we assume that the quality of a municipal service deteriorates with distance from the center of a municipality where the facility producing the service is located. Individuals living in outlying regions of a municipality may seek improvements in the quality of the public service they receive by voting in a referendum to form a new municipality which will reduce their distance from the facility. We use a utilitarian social welfare function to evaluate whether this democratic process will produce too many or too few municipalities.

Our model differs from the Alesina and Spolaore model in one important respect. They assumed that the level of services, and therefore the expenditure by each government, is not affected by the number of governments. In our model, the amount that the municipal government spends on the public service is determined by the median voter, and the preferred level of service will, in general, change as the number of municipalities increases, the population of each municipality decreases, and the marginal tax price for the public service increases, but the perceived quality of the public service increases. Haimanko et alii (2004), Goyal e Staal (2004), Staal (2006), and Bogomolnaia et alii (2008) also analyzed the efficient and stable number of governments when there are economies of scale in the provision of a public service and preference heterogeneity increases with the size of the population, but they also maintained Alesina and Spolaore's assumption that the per government expenditure on the public service is not affected by the number of governments.

Our main results can be summarized as follows.

- The cost of service deterioration with distance from a facility has to exceed the total cost of producing the public service for it to be socially desirable to split a municipality in two equal parts.
- A sufficient condition for social welfare to decline when the M^{th} municipality is added to a region is that the ratio of service deterioration costs to production costs is less than or equal to $M(M-1)$.
- Equivalently, adding a municipality to a region reduces social welfare if the level of public service provided by each municipality declines.
- An expression for the upper-bound on the optimal number of municipalities in a region can be derived based on the ratio of service deterioration costs to production costs.
- A set of conditions exists whereby a majority of the population will favour dividing a municipality even though social welfare is reduced.
- In general, the model suggests that there may be an electoral bias in favour of creating too many municipalities. Transfers to municipalities that are inversely related to population would only increase the incentive to create more municipalities, resulting in potentially greater social welfare losses.

2. THE PROVISION OF A PUBLIC SERVICE IN A SINGLE MUNICIPALITY

Initially, we assume that one municipality covers the geographic area that is shown in Figure 1. The population of the entire region is 2 units and has a uniform unit density. Individuals have a fixed point of residence in the region, and their location will be denoted by variable d, where $-1 \leq d \leq 1$. (We will refer to $0 < d \leq 1$ as the R region and $-1 \leq d < 0$ as the L region.) The municipal government provides a public good from a facility that is located at the center of the geographic area. The public service is non-congestible, but the quality of the public service deteriorates as the distance from the facility increases. We use the following utility function to describe preferences:

$$U = C + \Gamma g - \frac{1}{2}\gamma g^2 - \delta g|d - f| \tag{1}$$

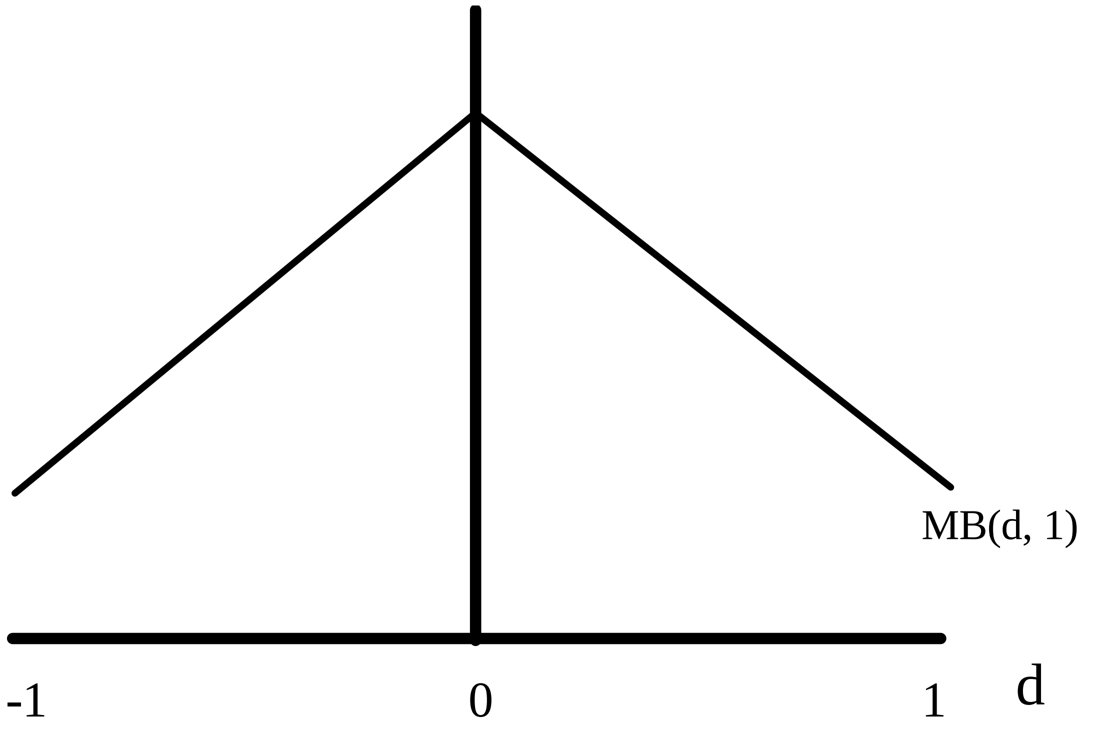
where C is consumption of private goods, g is the level of the public service, and f is location of the facility. Γ and γ are positive parameters representing preferences for the public service. The δ parameter represents that rate at which the quality of the service deteriorates as the distance from the facility increases. The marginal benefit curve, for a given level of g, is shown in Figure 1. In particular, it is assumed that the marginal benefit from the public service, $MB = \partial U/\partial g$, deteriorates as the distance from the facility $|d - f|$ increases. Examples of such services where the marginal benefit deteriorates with distance from the facility are police and firefighting services.

The level of the public service has a constant marginal cost of c, and there maybe a fixed cost $F \geq 0$ associated with the facility as well. The total cost of providing any given level of service, $F + cg$, is shared among all of the residents of the municipality. An individual's budget constraint is therefore equal to $Y = C + (F + cg)/2$ where Y is the individual's income, which is assumed to be the same for all residents. The marginal "tax price" of a unit of the public service is $0.5c$ for all of the residents.

It is assumed that the level of service is determined by majority voting and that median level of service demanded will be the level provided by the municipal government. Since all residents pay the same marginal tax price and the marginal benefit from the public service declines as distance from the facility increases, the median demand for the public service will be the amount that maximizes the utility function of the individuals at the points -0.5 and 0.5, or:

$$g(1) = \frac{\Gamma}{\gamma} - \frac{1}{\gamma}\left[\frac{c + \delta}{2}\right] \tag{2}$$

Figure 1:



where $g(1)$ indicates the median demand for the service when there is one municipality in the region. The utility level that individuals achieve when one municipality provides the service is:

$$U(d,1) = Y - 0.5\left[F + cg(1)\right] + \Gamma g(1) - \frac{1}{2}\gamma\left(g(1)\right)^2 - \delta g(1)|d| \tag{3}$$

The individuals located at the center of the region have the highest utility and those located at the region's boundaries will have the lowest utility because they receive the lowest quality of service.

3. THE DECISION TO DIVIDE A MUNICIPALITY

Now consider a proposal to split the region into two municipalities. We assume that the new municipalities will be created only if a majority of the population in each of the proposed municipalities votes in favour of it in a referendum. It is assumed that the boundary between the two new municipalities will be at 0 and the two new municipalities will locate their facilities at -0.5 and 0.5, i.e. at the centers of the new municipalities. The public service levels provided by the new municipalities will also change because the median demands for public service will be those by individuals located at $d = -0.75$ and $d = -0.25$ in the L region and by individuals at $d = 0.25$ and $d = 0.75$ in the R region.

While the median voter's distance from the facility will reduced from 0.5 to 0.25, the marginal tax price for the public service will increase from $0.5c$ to c because the population of each new municipality is one unit. The public service levels in the new municipalities will be equal to:

$$g(2) = \frac{\Gamma}{\gamma} - \frac{1}{\gamma}\left[c + \frac{\delta}{4}\right] \tag{4}$$

Therefore the level of service provided in the new municipalities will be higher than in the original municipality if and only if $\delta/c > 2$. That is, public service provision will be higher if and only if the rate at which services deteriorate with distance from the facility exceeds the twice marginal cost of providing a higher level of service. The utility level that an individual can now achieve in R region with the new municipality is given below:

$$U(d{,}2) = Y - [F + cg(2)] + \Gamma g(2) - \frac{1}{2}\gamma\left(g(2)\right)^2 - \delta g(2)|d - 0.5| \qquad 0 \leq d \leq 1 \tag{5}$$

(Given the symmetry of the regions, a similar expression will describe the well-being of individuals in the L region. We will focus our discussion on the incentive to create the new municipality in the R region.) First, note that everyone in the new municipality will have to pay higher taxes unless service levels decline by more than 50 percent. In other words, per capita taxes will be higher if:

$$g(2) > 0.5\left(g(1) - \frac{F}{c}\right) \tag{6}$$

Figure 2 illustrates shows the utility levels of individuals in the R region with the new municipality, $U(d,2)$, and with one municipality $U(d,1)$. The diagram illustrates the case where individuals located between d1 and d2 will be better off if the old municipality is split into two parts, where $0 < d_1 < 0.5$ and $0.5 < d_2 \leq 1$. If $d_2 - d_1 > 0.5$, a majority of the residents of R region are better off with the new municipality, and a referendum to create the new municipality would be approved. Note that a necessary condition for referendum to pass is $U(0.5,2) > U(0.5,1)$. In other words, for the majority to be better off with the new municipality, the individuals located at the center of the new municipality must be better off.

Figure 3 shows a specific a case in which the referendum to split the municipality would be supported by the majority of the population in region R. In this case $\delta/c = 1.5$ and $F = 0$, and the other parameter values were chosen such that in the initial situation one unit of the public service would be demanded and the tax price elasticity of demand is -0.50.[2] The solid line represents the utility levels attained when the entire region falls under one municipal government whereas the dashed line represents the utility levels of individuals in the R region with the creation of the new municipality. All individuals from $d_1 = 0.425$ to $d_2 = 1$ are better off with the new municipality and therefore a majority of the population, 57.5 percent, would vote in favour of establishing the new municipality. Note, however, 42.5 percent of the population would be worse off with the creation of the new municipality. The parameter values adopted in this case are favourable for the creation of a new municipality. With other parameter values, such as $\delta/c = 0.5$ and $F = 0$, no one would be in favour of creating the new municipality.

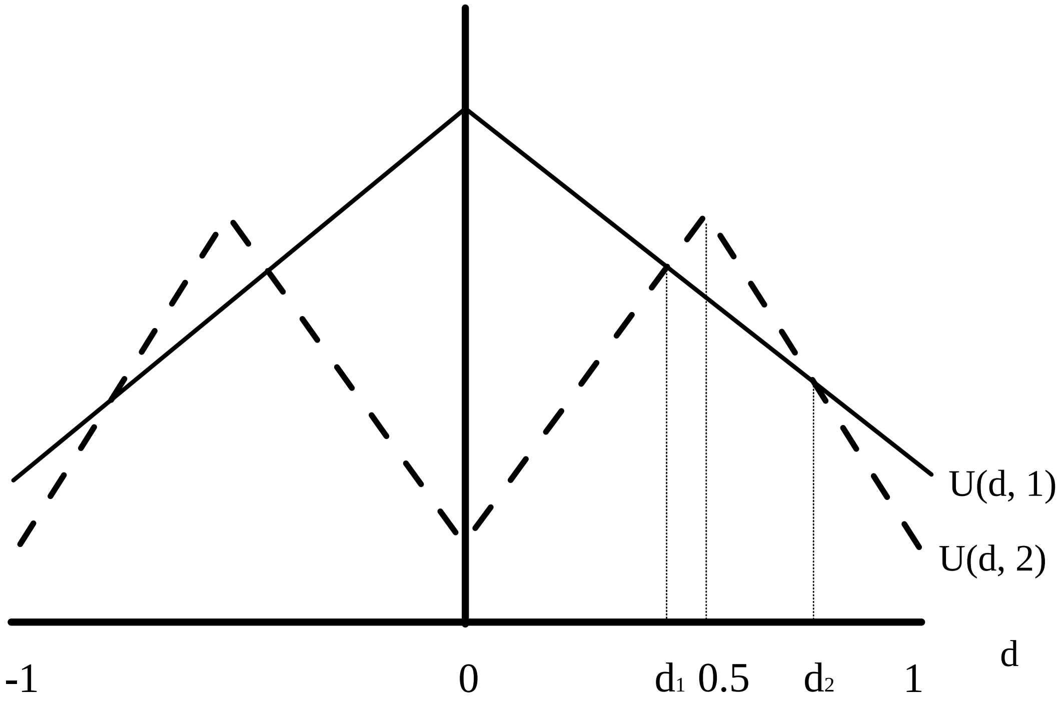
Figure 3 illustrates a case where a majority of residents would favour the creation of a new municipality, even though their individual taxes would almost double, in order to receive a better quality of service. The question arises whether the creation of the new municipality is "optimal" from a social perspective. This is the topic that we turn to in the next section.

4. THE OPTIMAL NUMBER OF MUNICIPALITIES

To discuss the question of whether majority voting in referenda would produce the optimal number municipalities, we need to generalize the model to allow for M identical municipalities in the entire

[2]The other parameter values are $c = 1, \gamma = 1, \Gamma = 2.25$.

Figure 2:



region. We will focus our attention on the "right-most" municipality. The population of a municipality is $2/M$ and its facility will be located at the point $f(M) = (M-1)/M$. The maximum distance that any individual is from the facility will be $d_{max}(M) = 1/M$. The median voter (for public service provision) will be located at $\theta(M) = (2M-1)/2M$ and his distance from the facility will be $v(M) = 1/(2M)$. The median voter's demand for the public service will be:

$$g(M) = \frac{\Gamma}{\gamma} - \frac{1}{2\gamma}\left[cM + \frac{\delta}{M}\right] \tag{7}$$

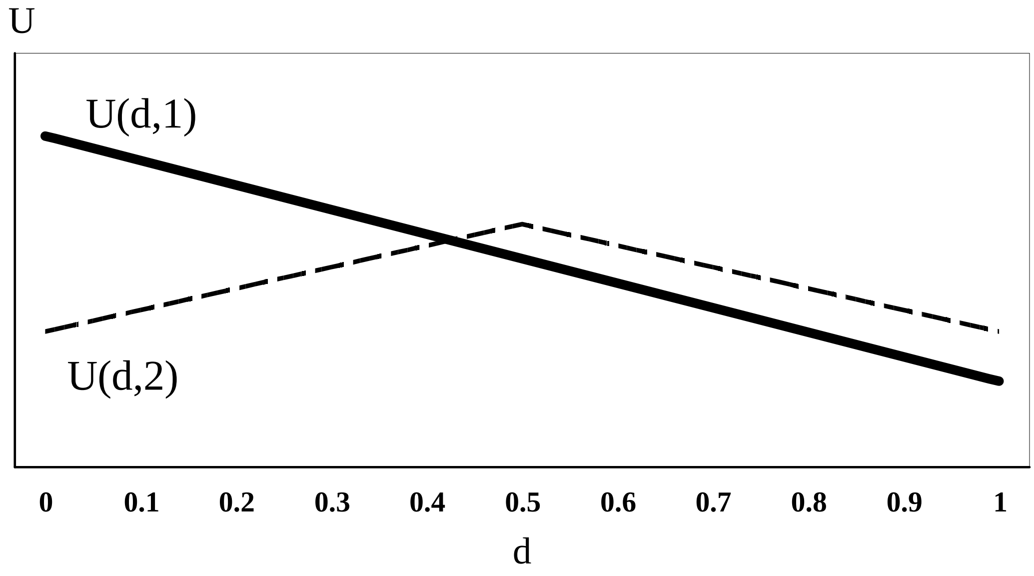
Therefore the change in the level of public services when we add an additional municipality to the region will be:

$$g(M) - g(M-1) = \frac{1}{2\gamma}\left[\frac{\delta}{M(M-1)} - c\right] \qquad M \geq 2 \tag{8}$$

If $\delta/c > M(M-1)$, adding a municipality to the region will lead to an increase in the level of public services provided. However, as we add more municipalities and divide the region into smaller and smaller units, the public service level will eventually decrease because the gain from improved quality of service (distance from the facility) will have a smaller impact on demand than the increased tax price for services due to the decline in the population of the municipality.

The utility level of an individual at point d (in the right-most municipality) will be equal to:

Figure 3:



$$U(d,M) = Y - \frac{F + cg(M)}{2/M} + \Gamma g(M) - \frac{1}{2}\gamma\,(g(M))^2 - \delta g(M)|d - f(M)|$$
$$2f(M) - 1 \leq d \leq 1 \qquad (9)$$

In order to discuss the "socially optimal number of municipalities" we need to specify the society's goal or objective function. There may be a variety of views about what the criteria should be adopted for evaluating the provision of public services, including concerns about equality of access to public services. In this paper, we will adopt a rather simple criterion – a utilitarian social welfare function – to evaluate the alternative levels of public services provided with different numbers of municipal governments, although we acknowledge that other criteria might be applied. We adopt a utilitarian social welfare function because it seems appropriate in the context of the current model where it is assumed that everyone has the same income. Thus the social welfare function is the following:

$$W(M) = \int_{-1}^{1} U(x,M)dx = 2.\bar{U}(M) = 2Y - M\,[F + cg(M)] + 2\Gamma g(M) - \gamma\,[g(M)]^2 - \frac{\delta g(M)}{M} \qquad (10)$$

where $\bar{U}(M)$ is the average utility achieved by a resident of the region. The social gain or loss from adding the M^{th} municipality can be written as follows:

$$W(M) - W(M-1) = \frac{\delta}{M[M-1]}g(M) - [F + cg(M-1)] \qquad (11)$$
$$+ \left[2\left[\Gamma - \frac{g(M) + g(M-1)}{2}\gamma\right] - cM - \frac{\delta}{M-1}\right][g(M) - g(M-1)]$$

where the first term on the right-hand side is the gain from reducing the average distance to the facility by adding the M^{th} municipality, the second term is the cost of the services provided by the additional municipality, and the third term is the net social gain from the change in the level of services induced by adding an additional municipality, evaluated at the average service level with M and $M-1$ municipalities. Recall that the change in the level of service is given by (8) and that services will increase (decrease) if δ/c is greater than (less than) $M(M-1)$.

The analysis of the optimal number of municipalities is made more complex by the net social gain or loss from changes in the level of services provided as the number of municipalities increases. Some insights into the issue can be gleaned if we assume $g(M) = g(M-1) = g$, then M is the optimal number of municipalities if following conditions hold:

$$W(M+1) - W(M) < 0 < W(M) - W(M-1) \qquad \text{or:}$$

$$M(M-1) < \frac{\delta g}{F+cg} < M(M+1) \tag{12}$$

The integer that satisfies the above condition represents the optimal number of municipalities, assuming the level of the public service is fixed. In particular, note that if $\delta g/(F+cg) < 1$, then it is optimal to have one municipality provide the service. The model therefore indicates that the cost of service deterioration with distance from the facility has to exceed the total cost of producing the public good for it to be social optimal to split a municipality in two equal parts.

Table 1 indicates optimal number of municipalities for different ranges of service deterioration costs relative to production costs, assuming a constant level of public service.

Table 1: The ratio of service deterioration costs to production costs and the optimal number of municipalities

Ratio of service deterioration cost to production cost $x = \frac{\delta g}{F+cg}$	Approximate optimal number of municipalities
$0 \leq x \leq 2$	1
$2 < x \leq 6$	2
$6 < x \leq 12$	3
$12 < x \leq 20$	4

It is also useful to note that the optimal number of municipalities (assuming constant service levels) will be given by the condition:[3]

$$\sqrt{\frac{\delta g}{F+cg}} - 0.5 < M < \sqrt{\frac{\delta g}{F+cg}} + 0.5 \quad \text{for} \quad \delta g/(F+cg) > 0.25, \text{ otherwise } M = 1 \tag{13}$$

The above approximations for the optimal number of municipalities are based on the assumption that the level of service remains constant as the number of municipalities increases. However, this is a very dubious assumption because the marginal tax price that voters face will increase substantially when an additional municipality is added.

[3]This is equivalent to the number of efficient governments per unit of distance that was derived by Alesina e Spolaore (1997). Since the total length of the region in our model is twice as large as in the Alesina and Spolaore model, the optimal number of governments is twice as large as in their model.

Substituting (8) into (11) and using the median voters' utility maximization conditions, the following equation can be derived with measures the net welfare gain from adding a municipality, taking into account the change in the level of service.

$$W(M) - W(M-1) = -F + \left(\frac{\delta}{M(M-1)} - c\right)\left[\frac{\Gamma}{\gamma} - \frac{1}{2\gamma}\left(\frac{\delta}{M} - c(M-1)\right)\right] \tag{14}$$

Since the expression in square brackets is positive, a sufficient condition for social welfare to decline when an additional municipality is added is $(\delta/c) \leq M(M-1)$. This implies that social welfare will decline if adding an additional municipality will reduce the level of service provided by each of the municipalities. It also implies the following upper-bound on the optimal number of municipalities, M_{opt}:

$$M_{opt} \leq \frac{1}{2} + \frac{1}{2}\sqrt{1 + 4\frac{\delta}{c}} \tag{15}$$

Since the upper bound on the optimal number of municipalities in (15) exceeds the upper bound in (13), we conclude that allowing the provision of the service to vary can potentially increase the optimal number of municipalities. The restriction in (15) also implies that if $\delta/c = 1.5$, as in the numerical example shown in Figure 3, the optimal number of municipalities is less than 1.823. In other words, the creation of two municipalities would reduce social welfare (as measured by the utilitarian social welfare function) even though it would be supported by a majority of the population. The social welfare loss occurs in the case shown in Figure 3 because the area between the solid line and the dashed line to the left of $d = 0.425$ is greater than the area between the two curves to the right of that point.

In general, the incentive to create a new municipality is strong because three quarters of the population of the new municipality will be closer to the facility. This gain in the "quality of service" for these residents has to be balanced against their (likely) increase in taxes and the change in the level of services. Note that the potential gains achieved by up to three quarters of the population come at the expense of one quarter of the population who will get a lower quality of service and (most likely) higher taxes.

Thus situations arise where the majority of the population may receive a relatively small per capita net benefit from creating a new municipality, even though it imposes a larger total loss on a minority of residents. Indeed, it can be shown that a majority of the population will favour the creation of the two new municipalities, even though it results in a social welfare loss, if the following condition holds:

$$\frac{\Gamma}{\gamma}\left(\frac{\delta}{2} - c\right) < F + \frac{1}{2\gamma}\left(\frac{\delta}{2} - c\right)^2 < \frac{\Gamma}{\gamma}(\delta - c) - \frac{1}{8\gamma c^2}\left[3\left(\frac{\delta}{c}\right)^2 + 2\frac{\delta}{c} - 4\right] \tag{16}$$

In the situation portrayed in Figure 3, the above set of inequalities holds because the left-hand side is -0.562, the middle term is 0.031, and the right-hand side is 0.406. It seems unlikely that the above inequality could be reversed, i.e. where two municipalities are socially optimally, but a referendum on creating the new municipalities would be defeated. Reversing the left-hand side inequality requires a high value for Γ, but this would increase the increase the right-hand side of the inequality by an even larger amount. Thus, although we do not have a rigorous proof, it seems likely that there is a electoral bias in favour of creating too many municipalities even in the absence of population based transfers. Transfers to municipalities that are inversely related to population would only increase the incentive to create more municipalities, resulting in potentially greater social welfare losses.

5. CONCLUSION

The main contribution of this paper has been to extend the Alesina e Spolaore (1997) model to allow the level of public services to change when municipalities split up. Making the level of public services depend on the number of municipalities is realistic because voters in the new, smaller municipalities will see changes in the "quality" and the "tax price" of public services, and there is no reason to think that they would continue to favour the same level of service. Also, the identity of the median voter in the new municipality will change. Allowing the level of the public service to vary in the Alesina-Spolare model is important because our analysis shows that a reduction in the level of public service, following a democratic decision to divide a municipality, implies a reduction in social welfare.

While this framework provides a basis for evaluating proposals to create more municipalities, it has a number of limitations. For example, it ignores many important issues that arise in redrawing municipal boundaries, such as cross-boundary spillovers of municipal services and incentives to redraw boundaries based on geographic variations in municipal tax bases. An interesting future direction for research would be to extend the model to incorporate these elements.

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