A Spatial Model of the State
by
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Economists generally assume that political institutions are inefficient.\(^1\) Recently, however, it has been proposed that under competition, political markets are as efficient as economic markets.\(^2\) According to this hypothesis, in a democratic state, political competition will tend to eliminate rents, leading to an efficient allocation of public resources. It should be noted that this theory has several important corollaries that may be tested empirically. First, it predicts that voters in democratic states will be indifferent to political boundaries: competition should tend to make resource allocation independent of political institutions. Second, the theory predicts that residents of democratic states will be insensitive to the level of political decentralization: whether a service is supplied by local employees of a central government or by a lower level of jurisdiction, competition should assure that provision is efficient. Third, in democratic states, voter dissatisfaction should be distributed randomly over time and space: in the long run, inter-party competition combined with voter mobility should eliminate rents.

Each of these predictions is contradicted by observed political behavior. As the debate in the U.S. over the 1978 Panama Canal Treaty, in Switzerland over association with the European Community, and in France over autonomy for Corsica shows, voters do have strong preferences concerning the borders of their states. Nor are they indifferent to the extent of federalism, as the opposition to centralization from residents of Flanders, Quebec, and Bavaria demonstrates. Finally, long-standing complaints from regional blocks of voters in the southern U.S., western Canada, and northern England and Scotland suggest that other areas may have been systematically collecting political rents at these regions’ expense.

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\(^1\) See, for example Tullock [1965] and Brennan and Buchanan [1987], [1980].

\(^2\) Tiebout [1956] showed that voter mobility would lead to efficient decentralized provision of public goods. Becker [1983] and Cairns [1989] have demonstrated that competition among pressure groups leads to political outcomes that tend to minimize deadweight losses. Wittman [1989] has exposed weaknesses in many arguments for the failure of political markets.
These facts are, however, compatible with a strikingly different view of the political process. In a model proposed by David Friedman [1977], states are portrayed as rent-seeking organizations that attempt to maximize their total tax receipts by extending their boundaries until falling marginal tax revenues make further expansion undesirable. However, Friedman neglected the cost of territorial control. He also failed to consider the degree to which small regions are partially consolidated into larger federal states. Most important, he neglected to show the relevance of the spatial approach to present-day democratic states. The empirical evidence that he offered, based on incomplete information concerning linguistic zones and medieval trade routes was inconclusive.

The object of this paper is to add supply considerations and federalism to the spatial model of public choice and to extend it to democratic states. In the theoretical section, we propose a model of the determination of total public expenditures and military spending that focuses on spatial competition among states. Beginning with a unitary state, we show how boundaries and public spending are determined; we then extend our model to federalism. The efficient political market model and D. Friedman’s model of the size of states are special cases of this spatial model.

In the empirical section, we test this spatial public choice model against the traditional approach to collective decision-making, using annual time-series data for the principal German state from the Franco-Prussian War to the most recent period (1872–1986). Although German public finances have been examined in detail, previous studies have neglected spatial aspects. Yet during this period, Germany experienced two major changes in its territorial boundaries, and three modifications in its internal structure. Our findings show that for both military expenditures and total public spending, the spatial model has considerably greater explanatory power than the conventional public choice specification. They also suggest that German reunification was in the long-run interest of voters in the German Federal Republic.

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3 Margaret Levi [1988] and Blum and Dudley [1989] also portray the state as a revenue-maximizing body.

4 Friedman argued that over a period in which the importance of trade taxes as a revenue source increases, the number of competing states along a given trade route should decline, so that total tax revenues could be increased. While his data for Northern Italian trade routes confirmed this prediction, they also showed a similar tendency along dummy routes over which there was no trade (Friedman [1977, 71, Table 2, lines 1,2]). Friedman also argued that over a period in which the importance of taxes on labor income rises, state boundaries should be modified to increase the average percentage of speakers of a person’s language who live within the same fiscal jurisdiction. Yet when he controlled for size of country, he found little change in his index of linguistic homogeneity between 1648 and 1914, despite the great increase in income levels and the numerous boundary changes that occurred over this period (Friedman [1977, 75, Table 3, line 4]).

5 See Andic and Veverka [1964].
1. A Model of a Unitary State

Models of spatial competition were first developed to study price competition among firms. They have also been found appropriate for the study of competition among political parties in the preparation of electoral platforms. Consider how this approach might be applied to territorial competition among sovereign states. In order to derive propositions that may be tested empirically, we will attempt to keep the assumptions of our model as simple as possible.

1.1 Assumptions

Let the total population of an isolated area be distributed uniformly along a line bounded by the points 0 and 1. Assume that people are divided into two types: followers and leaders. Assume further that leaders, \( A, B, \ldots, m \) are less numerous than followers and that they are mobile. They set up states in an attempt to maximize their discretionary tax receipts; that is, total tax receipts less the cost of territorial control. Their states are established sequentially in time, with capitals at points \( z_A, z_B, \ldots, z_n \) respectively, where \( n \leq m \). If \( n < m \), then \( m-n \) potential leaders withdraw from the game temporarily. In controlling their territory, rulers will at the same time provide a public good to their citizens, namely, the guarantee of property rights.

Followers are assumed to be numerous and immobile. Each makes a discrete choice, deciding whether to consume his time in leisure or to produce. If he produces, the result is a differentiated product whose value is one when self-consumed. The individual’s net income before taxes is equal to this value plus an additional amount of hedonic income, \( h \), that measures the benefits he receives from belonging to the state. The individual will profit from having the right to exchange his production for the production of others within the state’s territory. In addition, he will gain from being allowed to interact socially with those who have a similar language and culture.

Consider the demand side of the state. Let \( z_{ij} \) be the position of member \( i \) of state \( j \) and \( z_j \) be the position of the center of that state. Because of transaction costs, the farther the individual is from the center of the state, the smaller will be his gains from trading with other members of the state. In addition, the

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6 See Launhardt [1982], Hotelling [1929], Lösch [1939], Hurter and Lederer [1985].

7 The Hotelling [1929] model was extended to party competition in the political sphere by Downs [1957], Kramer [1977] and others. Although the conclusions that Hotelling himself drew from his model have recently been challenged, the spatial approach continues to be one of the basic tools for modeling political behavior; for example, McKelvey and Schofield [1987] derive necessary and sufficient conditions for a point to be in the core under arbitrary (i.e., not necessarily majoritarian) voting rules.

8 For an analysis of the view that the essential role of the state is to guarantee individual rights, see Scully [1988].
greater this distance, the more his culture and language are likely to differ from those of the majority. Accordingly, let individual i's benefit from membership in state j, $h_{ij}$, equal a technologically determined amount, $X$, less an amount that is proportional to the individual's distance from the center of the state to which he belongs,

$$h_{ij} = X - a|z_j - z_{ij}|, \quad 0 < \mu < X \leq 1, \quad 0 < a, \quad (1.1)$$

where $X$ is always greater than the positive lower limit, $\mu$. Note that if rights of property and association could be guaranteed, the welfare-maximizing situation would be one of anarchy – with each individual at the center of his own individual state.

The willingness to pay taxes will depend on the gains, $h_{ij}$, received from belonging to the collectivity. If the tax level is set higher than this amount, the individual produces zero; otherwise he produces one unit. Let $z^*_j$ be the position of the most distant taxpayer belonging to state $j$. Then the radius, $r_j$, of state $j$ is

$$r_j = |z_j - z^*_j| \quad (1.2)$$

Assume that all taxpayers pay the same tax. Then the tax level can be no higher than the maximum amount that the most distant taxpayer is willing to pay. From (1.1) and (1.2), the tax, $t$, will be set at the level

$$t = X - ar. \quad (1.3)$$

Despite the social optimality of anarchy, once a state has been formed, each of its subjects has an interest in expanding the state's borders, since their tax rate will fall as more distant residents are brought under the ruler's control. In Figure 1, distance is measured along the horizontal axis, while output is measured on the vertical axis. Consider an initial state whose capital is at point A. Equation (1.2) defines the average revenue curves, QR and QS.

Turn now to the supply side of the state. The average cost per unit distance of controlling state $j$'s territory is equal to a technologically determined amount $Y$, plus an additional amount that is proportional to the distance between the most distant taxpayer, at position $z^*_j$, and the center of the state $j$ to which he belongs. This second component will also depend on geographical conditions.

$$c_j = Y + b|z_j - z^*_j|, \quad 0 \leq Y \leq \mu, \quad 0 < b,$$

or, from (1.2),

$$c = Y + br, \quad (1.4)$$

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9 This condition could be relaxed without changing the model's results, provided that intra-marginal taxpayers retain a part of their hedonic income.
where $Y$ is a variable with an upper limit of $\mu$.\footnote{The limiting case, $X = \mu = Y$, is that of anarchy, each individual forming his own state.} For the state with capital at point A in Figure 1, equation (1.4) defines the average cost curves, NU and NT.

At first glance, the above model seems incompatible with much of the recent theory of political processes in democratic states. Yet a closer look reveals that the essential features of the modern state are present, even though they may not be described explicitly. For example, although the model makes no mention of political parties, the political entrepreneur could easily be considered to be a dominant party within the political system.\footnote{LIPFORD and YANDLE [1987], [1990] have shown that under imperfect competition, a dominant political party can restrict output and raise prices for government services.} Similarly, although the demand side of the model does not include interest groups formally, the decrease in the willingness to pay taxes with increasing distance from the center could easily occur in discrete steps, so as to reflect the effect of regional pressure groups. Non-spatial effects of interest groups are captured by the height of the demand curve. Finally there is no specific reference to public bureaucracies in the model. However, the presence of supply-side influences on the model will be reflected in the height and slope of the average cost curves. The equilibrium tax rate is
then that which equalizes demand and supply at the territorial margin. Federalism, as we shall see, is essentially a device for pushing out this margin.

1.2 Equilibrium With Arbitrary Location

Assume that each leader attempts to maximize his total discretionary revenues net of costs of territorial control. He does so by setting a tax level, \( t \), the amount of income that each citizen in his state must pay in taxes. The ruler must also decide what radius, \( r \), around his capital he will attempt to control. The outcome then depends on whether or not there is enough room for a state with optimal borders.

(a) The Full-sized State

Assume that leader A establishes the capital of the first state at position \( z'_{\text{A}} \) (point A in Figure 1). What will his tax level be? And where will he establish his boundaries; that is, what will be the radius, \( r \), of his territory? If a uniform tax level is set, the boundary will be determined by the willingness to pay of the individual most distant from the capital. The population of the state will be \( 2r \). Therefore, from (1.3), total tax receipts, \( T \), are:

\[
T = 2r(X - ar). \tag{1.5}
\]

With population \( 2r \), from (1.4), total enforcement costs are:

\[
C = 2r(Y + br). \tag{1.6}
\]

Subtract (1.6) from (1.5) and differentiate with respect to \( r \):

\[
X - 2ar* = Y + 2br*. \tag{1.7}
\]

In other words, total net tax receipts are maximized with radius \( r^* = (X - Y)/[2(a + b)] \), at which marginal revenue equals marginal cost (provided \( r^* < 1/2 \).

Definition: A full-sized state is a state at the borders of which condition (1.7) is satisfied.

Substitution from (1.7) into (1.3) yields the optimal per-capita tax in a full-sized state:

\[
t^* = [(a + 2b)X + aY]/[2(a + b)].
\]

In Figure 1, for the state with capital at \( A \), the left side of equation (1.7) is represented by the marginal revenue curves, QC and QD; the right side of this equation is represented by the marginal cost curves, NC and ND. The optimal boundaries are then at points F and G, where the marginal cost of controlling additional territory is equal to the marginal revenues which that territory would
bring to the state. The equilibrium average tax level is FR and the average cost of territorial control FU. Total political rents, or discretionary tax revenues, are then equal to the rectangle RSTU.

(b) The Buffer State

Consider now the situation of the second state. Where will leader B establish his borders once A has chosen? Assume that military technology is such that in case of war between a full-sized and a smaller buffer state, the larger state is favored.

If there is enough room left on the line between 0 and 1, leader B too will set up a full-sized state. Otherwise, he will have to be satisfied with a somewhat smaller state, in which

\[ X - 2ar > Y + 2br. \] (1.8)

Definition: A buffer state is a state at the borders of which condition (1.8) is satisfied; that is, revenue from additional territory exceeds the marginal cost of controlling it.

This process is then repeated for leaders C, D, etc., until the line segment is fully occupied.

The state with capital at B in Figure 1 clearly satisfies condition (1.8): at borders G and 1, marginal revenue exceeds marginal cost. With average tax level GH, and average control cost GK, total political rents in this case are equal to HIJK.

1.3 Equilibrium With Optimal Location

In the previous subsection, \( r^* \) was defined as the optimal radius of the full-sized state for given technology. Consider now how the optimal location of states will depend on the size of \( r^* \).

(a) \[ 1/2 \leq r^*. \]

In this case, leader A will establish his capital at the mid-point on the line. There will be only one state. If \( 1/2 < r^* \), it will be of less than optimal size.

(b) \[ 1/6 < r^* < 1/2. \]

Leader A will continue to set up his capital in the mid-point of the line. However, there will be two other buffer states, one at each end of the line.\(^{12}\)

\(^{12}\) Suppose that \( r^* = 1/4 \). Why would there not be two full-sized states, one at 1/4 and the other at 3/4? If the first leader chooses either 1/4 or 3/4 for his capital, any subsequent increase in \( r^* \) will bring him into conflict with a state of the same military capacity as his own. By locating at 1/2, he is sure that his neighbors will be smaller buffer states he can defeat in case of conflict.
There will now be three or more full-sized states and generally buffer states filling the gaps between the former. Thus, in equilibrium the number of full-sized and buffer states will increase with the technological parameters, a and b, that determine the radius, \( r^* \), of the full-sized state.

2. A Model of a Federal State

The previous section assumed that each state had a single level of government. How are a state's borders affected by the possibility of multiple levels of authority? There are two sharply differing views of the effect of federalism on the share of public expenditures in total income. On the one hand, Brennan and Buchanan [1977], [1980] offer a 'bottom-up' view of federalism, suggesting that it is a means by which the citizens may constrain the taxing power of the leviathan state. If so, federal states should tend to have smaller public sectors. However, it is difficult to reconcile this view with the evidence that most federal constitutions have been drawn up by unrepresentative bodies or imposed by a central level of government. Oates [1972], [1985] suggested a 'top-down' view. Federalism, he argued, is a means by which the state's welfare-maximizing central decision-maker might allow certain public services to be tailored to satisfy differences in preferences that exist at the local level. Oates's [1985] own recent empirical work failed to find any systematic relation between the public share and degree of decentralization, but evidence offered by Bell [1988] is favorable to the 'bottom up' view.

Is it possible for federalism to reduce the overall tax share of income and yet still be in the interest of a dominant individual or group seeking to maximize its political rents? Consider once again the spatial model of the state presented in the previous section. It was argued that in a given state, a dominant individual or group attempts to maximize its discretionary tax revenues. The amount of such revenues depends on both the willingness to pay of taxpayers and the cost of territorial control. Suppose that the addition of a junior level of government lowers the willingness to pay of taxpayers by less than it reduces the cost of territorial control. Then not only will federalism reduce the tax share of income, but also will be in the interests of the dominant individual.

More formally, let \( a \), the frictional or spatial parameter in equation (1.3) that captures the effect of distance on the willingness to pay of taxpayers, be an increasing function of the number of regional subunits, \( s \), at the lower or state level of government.

\[
a = a(s), \quad a'(s) > 0. \tag{2.1}
\]

Bell [1989] extends the Brennan-Buchanan analysis to take account of the loss of externalities in the provision of public goods that results from federalism.
Note that this willingness to pay includes all taxes, and not just those paid to the federal level. Why might this friction parameter increase (i.e., willingness to pay taxes decline) with the introduction of federalism? A possible reason is increased competition between levels of government. Voters will tend to play one level of government against the other in an attempt to minimize the cost of the services they receive.

Similarly, let $b$, the spatial parameter determining the cost of territorial control in equation (1.4), be a decreasing function of the number of regional subunits, $s$,

$$b = b(s), \quad b'(s) < 0. \quad (2.2)$$

The explanation in this case would focus on the willingness to resist the power of the central authority. If those functions most sensitive to interregional differences in culture and language are devolved to a lower level of government, there will be limited support for local leaders attempting to gain regional autonomy. Accordingly, the willingness to resist the central authority will tend to decline with decentralization.

For any given set of boundaries, $r$, for the country as a whole, the level of discretionary tax receipts may be obtained by substitution of equations (2.1) and (2.2) into (1.5) and (1.6) respectively. By subtracting (1.6) from (1.5), and differentiating with respect to $s$, one obtains:

$$a'(s) = -b'(s).$$

Decentralization should continue until the marginal revenue loss from an additional subunit is just equal to the marginal saving in the cost of control. The second order condition for an internal maximum is that

$$a''(s) + b''(s) < 0.$$

Any further decentralization would reduce revenues by more than costs. From the point of view of the ruler, federalism is thus an efficient way of organizing space.

This result is illustrated for a buffer state in Figure 2. Decentralization shifts the average revenue curves from $QR$ and $QS$ down to $QR'$ and $QS'$. At the same time, it shifts the average cost curves downward from $NU$ and $NT$ to $NU'$ and

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14 More generally, in addition to military expenditures considered here, there will be other categories of public spending such as highways whose cost decline with decentralization because they can be provided more efficiently at the state or local rather than the federal level. See Lipford and Yandle [1990].
NT'. Provided that the former shift is less than the latter, total political rents will increase in passing from RSTU to R'S'T'U'.

Thus federalism may be seen as a way of maximizing the decision-maker's total rents – a strategy of "divide and rule". In a full sized state, the optimal dimensions of the state will increase with the creation of a federation. Up to the optimal degree of decentralization, the willingness to pay decreases by less than the cost of controlling territory, making it desirable for the ruler to extend his state's borders.

3. From the Model to Actual States

The model presented in the two preceding sections assumed that states are formed by mobile political entrepreneurs who attempt to maximize the net rents they can extract from supplying public goods to immobile taxpayers. Spatial competition then determines state boundaries, tax levels and degrees of administrative decentralization. There are several problems in applying this simple formulation to actual states. In particular, the assumptions of rent-maximization, spatial competition, and entrepreneurial federalism may be questioned.
One difficulty is that while the hypothesis of rent-maximizing rulers might apply to the Middle Ages and to the early modern period, it would seem to be less relevant for Western states in the late nineteenth and twentieth centuries. Here competition among political parties has tended to reduce such rents. Yet provided that the underlying factors determining the degree of political competition are exogenous, they can readily be incorporated into the spatial model. The greater the degree of voter mobility, and the more spatially homogeneous are preferences, the more elastic will be the willingness-to-pay and cost of control schedules, (1.1) and (1.4). In the limiting case of efficient political markets, these two schedules are perfectly elastic and coincident, and political boundaries are indeterminate. More generally, however, voter immobility and heterogeneity are probably sufficient to justify the revenue-maximizing assumption for many modern democracies: for example, Kau and Rubin [1981] have used this approach to explain long-term variations in U.S. public spending.

A second possible objection to the model is that state boundaries may not always be determined by competition for population and territory. Consider, for example, the world's longest undefended border, that between the United States and Canada. Is there any evidence that it may be explained by spatial competition? In answer to this question, a case can be made for the position that Canada is a buffer state on territory that the United States found too expensive to be worth conquering. 15 By the mid-nineteenth century in North America, the United States had emerged as a full-sized state between two buffer states, as the model predicts.

Whether states are governed as autocracies or as multi-party democracies, the history of the twentieth century suggests that they will tend to behave in accord with the predictions of the model of spatial competition. If a marginal territory is too expensive to control relative to its contribution to public revenues – as the Philippines were for the U.S., the southern half of Lebanon for Israel and Afghanistan for the U.S.S.R. – it will be abandoned. However, if it can be controlled at a cost less than its addition to the state offers – as in the case of Puerto Rico for the U.S., the West Bank for Israel, and Azerbaijan for the U.S.S.R. – then military occupation will be pursued.

Another possible problem with the model is its assumption that federations are put together by entrepreneurs wishing to balance loss of tax revenues

15 The eastern part of the U.S.-Canadian border, from the Great Lakes to the Atlantic Ocean was determined by the U.S. inability to capture the St. Lawrence valley in the 1775/76 campaign of Benedict Arnold. The forty-ninth parallel from the Great Lakes headwaters west to the Rockies was agreed upon in 1818, after unsuccessful attempts by American armies to capture territory north of the Great Lake during the War of 1812. Finally, in 1846, anxious to free its hands for expansion into promising Mexican territory in the south-west, the U.S. administration abandoned its claim to the Pacific coast north of the forty-ninth parallel.
against lower control costs. The model would seem to fit Imperial Germany. But can it explain confederations of independent states such as the U.S., Yugoslavia and the German Federal Republic or multi-ethnic federations such as Canada, Switzerland and Belgium? If one replaces the term entrepreneur by dominant group, the spatial competition approach does seem to have a considerable degree of explanatory power in each of these cases. Most federations have resulted from all-or-nothing propositions submitted to potential members by a dominant group favorable to centralization.

The question that must now be answered is whether this spatial approach to collective decision-making has greater explanatory power than conventional models of public choice.

4. An Empirical Test for Germany, 1872–1986

Consider the principal German states over the period from 1872 to 1986; namely, the Second Reich, the Weimar Republic, the Third Reich, and the Federal Republic. Was Germany a full-sized state or a buffer state during this period? Was it degree of administrative decentralization exogenously or endogenously determined? The answers to these questions have important implications for empirical modeling.

In a full-sized state, the spatial model predicts that total public spending and military spending will be determined simultaneously, whereas in a buffer state, the two levels of spending are independent. During the long interval from the Franco-Prussian War until the end of the first World War, and again for a brief period in the late 1930's prior to its attack on Poland, Germany's borders

16 The relatively centralized U.S. constitution of 1787 was prepared by a Federalist-dominated convention that was boycotted by advocates of states' rights. The latter failed to foresee that state conventions could be used to circumvent their opposition (RIKER [1987, 17]). In the case of Yugoslavia, Serbian leaders had played the key entrepreneurial role in the formation of a unitary state in 1918. The reduction of Serbia's influence under the federal constitution of 1946 was deliberately designed by Tito to conciliate the smaller ethnic groups to single-party rule under the Communist Party. As for West Germany, the Länder were set up by the three Western allies for administrative reasons in 1945–1946. Their partial unification into the Federal Republic in 1949 was favored by the Western occupying powers as a means of reducing the cost of defending this territory against Soviet expansion. The Canadian federation of 1867 was precipitated by the American refusal to renew the 1854 Reciprocity Treaty. Representatives of commercial interests in Ontario and Quebec, with the backing of the British cabinet, were gradually able to persuade the other provinces that east-west union was an acceptable second-best solution. As for Switzerland, the present-day federation replaced the loose confederation of 1815 only after the defeat of the conservative Catholic league, the Sonderbund in a brief civil war in 1847. In the case of Belgium, the pro-to-federal institutions of the 1971 constitution and its 1980 revisions represented concessions from the previously dominant French-speaking Walloons to the dissatisfied Flemish (WITTE and CRAEYBECKX [1987, 431–457]).
corresponded approximately to the maximum that it could control under the existing technology. However, the changes in frontiers that occurred following each of the two world wars were imposed by outside powers after her defeat. The model of the buffer state with exogenous frontiers is therefore appropriate, and simultaneous modeling of military and total expenditures is unnecessary.

With regard to the degree of administrative decentralization, under the imperial constitution of 1871, there were 24 separate political subunits in Germany. The Weimar constitution of 1919 reduced the number of states to 17, while under the Third Reich, Germany became in effect a unitary state, administered from Berlin. Prior to October 1990 the Federal Republic consisted of 10 states and West Berlin. For the purposes of our model, the only change that can be considered endogenous is that of 1933. The 1919 changes resulted in part from loss of territory, while those of 1949 were determined by the occupying powers.\(^{17}\) Accordingly, we will consider the number of political subunits to be exogenous.

### 4.1 The Empirical Model

Public spending as a share of income rose steadily in Germany for most of the century after unification (see Figure 3). From the mid-1970's on, however, public spending has tended to keep pace with income.\(^{18}\) As for the military-spending share, except for a fall in the Weimar period and a sharp rise during the Third Reich, the series is approximately stationary (see Figure 4). In the theoretical model, total government spending as a share of income in a buffer state is determined by equation (1.3), while military spending as a share of income is determined independently by equation (1.4). The first of these equations implies a negative effect of distance on the government share, while the second implies a positive effect of distance on the military share of income. However, the theoretical model assumes that population density remained constant, an assumption that is obviously unrealistic for the period studied.

To separate the effect of area from that of population and other variables, multiple regression techniques are appropriate. The variables used to test these hypotheses were defined as follows:

- **GS** = general government expenditures as a percentage of G.N.P.
- **MS** = military expenditures as a percentage of G.N.P.
- **PEOPLE** = logarithm of population
- **AREA** = logarithm of area of the state in thousands of square kilometers
- **STATES** = logarithm of number of states in federation

\(^{17}\) See footnote 16 above.

\(^{18}\) German public expenditure data are not available for the periods 1914--1925 and 1938--1949.
Figure 3
German government expenditures (% of G.N.P.)

Figure 4
German military expenditures (% of G.N.P.)
PAPERS = logarithm of number of newspapers with seven or more editions per week per capita
RADIOS = logarithm of radio receiving licenses per capita
TVS = logarithm of television receiving licenses per capita
RAIL = logarithm of railway line open in kilometers per-capita
PHONES = logarithm of telephone calls per capita
VEHICLES = logarithm of motor vehicles per capita
INCOME = logarithm of per-capita G.N.P. in marks at 1900 prices
PRICE = inverse of population
REPDUM = dummy variable declining linearly from one in 1872 to zero in 1876, zero thereafter
WARDUM = dummy variable set at one in year before war, otherwise zero
WEIDUM = dummy variable set at one for years 1925 to 1932, otherwise zero

The empirical model of the government share of income (GS) and the military share of income (MS) in a buffer state is presented in the following equations:

\[
\text{GS} = \alpha_0 + \alpha_1 \text{PEOPLE} + \alpha_2 \text{AREA} + \alpha_3 \text{STATES} + \alpha_4 \text{PAPERS} + \alpha_5 \text{RADIOS} + \alpha_6 \text{TVS} + \alpha_7 \text{INCOME} + \alpha_8 \text{REPDUM} + \alpha_9 \text{WARDUM} + \alpha_{10} \text{WEIDUM} + u,
\]

(3.1)

\[
\text{MS} = \beta_0 + \beta_1 \text{PEOPLE} + \beta_2 \text{AREA} + \beta_3 \text{STATES} + \beta_4 \text{PHONES} + \beta_5 \text{RAIL} + \beta_6 \text{VEHICLES} + \beta_7 \text{INCOME} + \beta_8 \text{REPDUM} + \beta_9 \text{WARDUM} + \beta_{10} \text{WEIDUM} + v,
\]

(3.2)

where \(u\) and \(v\) are random variables. The distance variable has been broken into two separate components, population (PEOPLE) and area (AREA). In the case of military expenditures, the sign predicted by the theoretical model is positive, distance and numbers tending to raise control costs. In the case of the total government share, the expected sign of the area variable is negative, since distance tends to reduce the gains from state membership. However, the expect-
ed effect of population is positive, since as density increases, the benefits of interaction with those who share one’s language and culture tend to rise.

The Brennan-Buchanan hypothesis discussed in the preceding section suggested that an increase in the number of states (STATES) should reduce the total government share, due to its effect of stimulating the degree of political competition. At the same time, by reducing the gains from opposition to the central regime, such a change should lower the cost of military control of territory. Accordingly, the expected signs of these two effects are negative.

The variables X and Y of equations (1.2) and (1.4) capture the non-spatial components of total public spending and military spending respectively. They were assumed to depend on the technologies of information processing and military control. Technologies that increase the degree of specificity of the education and experience acquired by those belonging to a national cultural group should raise the proportion of income that the state can extract in taxes from each citizen.

In the case of newspapers, the information transmitted can be understood only by those who have been trained to decode symbols written in a national language. Printed information is thus completely specific to a given national culture. Accordingly, the expected effect of increases in per-capita levels of large newspapers (PAPERS) on the willingness to pay taxes to national states is positive. Because radio transmits the spoken language, it may be understood with less culturally-specific prior training than a printed page of newspaper. Television, because of its visual content, is even less specific to a given national culture than radio. Accordingly, penetration of television may actually break down national identities, reducing the willingness of citizens to pay taxes to national states. If this hypothesis is correct, the effect of the number of radios (RADIOS) is uncertain, while the impact of television sets (TVS) per capita on the total government share may be negative.

In the military domain, technological change that reduces the expense of transporting or coordinating large numbers of soldiers should reduce the cost of territorial control. However, in the case of Germany, the rail and telegraph networks were essentially complete from a military standpoint by 1870. Indeed, they had played a major role in the expansion of Prussia’s power in the 1860’s. Further improvements in transport and communications would be unlikely to greatly change the cost of territorial control. Accordingly, the per-capita levels of telephone calls (PHONES), railway lines (RAIL), and

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19 Innis [1951, 29] and McLuhan [1962, 236] argued that the diffusion of print technology is a precondition for nationalism.

20 Postman [1985] has contrasted the print medium – accessible only to those who have learned to see through the shapes of letters to the underlying meanings (p. 25) – with television – comprehensible with minimal skills to cultures around the world (p. 86).

21 See Showalter [1976].
motor vehicles (VEHICLES) should not have a significant impact on military spending.

The effect of per-capita G.N.P. on the relative level of government spending has been the subject of many studies. Most have found that the income elasticity of demand for public services is significantly less than unity. Consequently, in the case of total government-spending share, we would expect a negative coefficient for INCOME. The effect of changes in per-capita income on the military share is ambiguous. On the one hand, a richer country may be more likely to attract predators than a poorer country. On the other hand, once an essential level of security has been obtained, it may be possible to direct further increases in income to non-military purposes.

After the Franco-Prussian War, France was compelled to pay Germany an indemnity of five billion francs. As a result, public spending in Germany in 1872 was temporarily above its permanent level. We have assumed that this windfall effect of these reparations payments (REPDUM) was strongest in 1872 and declined linearly over the following three years, disappearing in 1876. Accordingly this variable may be expected to have a positive effect on military and total public spending from 1872 to 1876. In the years immediately preceding each of the world wars, there was an arms race between Germany and its potential opponents. Both, total public spending and military spending were consequently higher than they would otherwise have been. A dummy variable (WARDUM) having the value of unity for the two years preceding each of these wars was therefore added.

Under the Weimar constitution of 1919, the powers of the central government were strengthened relative to those of the states; for example, the central authority controlled all tax powers. The resulting decrease in political competition may be expected to permit a higher share of taxes to be collected. In addition, the terms of the Versailles Treaty had implications for both the overall level of public spending and military spending. Germany was compelled to pay reparations to France for the damages it had suffered. At the same time, its army was limited to 100,000 officers and men. However, the soldiers were not conscripts, as had been the case prior to 1914, but professionals who had to be paid the market wage. We therefore added a dummy variable (WEIDUM), having a value of one for the years of the Weimar Republic and zero otherwise, to each equation. The expected sign was positive for total expenditures and uncertain for military expenditures.

Finally, as a benchmark for assessing the spatial approach, we specified a conventional public choice model of government expenditures. For surveys of this literature, see BORCHERDING [1985], MUELLER [1987], [1989], and POMMEREHNE and KIRCHGÄSSNER [1988]. Following BORCHERDING [1985, 363], we

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22 See BORCHERDING [1985, 365] and HENREKSON [1990].
assumed that the public share is a function of the price for public services that
the decisive taxpayer faces, his income, and a set of shift variables.\textsuperscript{23} If there
are consumption externalities in publicly-provided goods, the price of such
goods to the individual citizen will be a decreasing function of the total number
of taxpayers. Accordingly, we let the tax price (PRICE) of public sector output
be represented by the inverse of the country’s population. Previous studies
indicating a price-inelastic demand (i.e., a price-elasticity between zero and
minus one) suggest that an increase in this variable should have a positive effect
on the public share.

4.2 The Data and Estimation Procedures

Because of the turmoil following the two world wars, there are gaps in most
time series for Germany – particularly those involving public expenditures. The
available data covered the period from 1872 to 1913, from 1925 to 1938, and
from 1950 to 1986, for a total of 93 annual observations. The sources for each
series are described in the Appendix. To reduce the danger of heteroscedasticity,
a logarithmic transformation was applied to all series but the dependent vari-
ables (which were expressed as percentages) and the dummy variables.

Almost all of the time series used were subject to a strong trend. To correct
for first-order autocorrelation, an initial set of estimates used the maximum
likelihood (ML) method proposed by Beach and McKinnon [1978], estimated
by a grid search procedure. Another set of estimates (not reported) was per-
formed on detrended values of all time series. However, extremely low values
for the Durbin-Watson statistics in the two equations suggested the continued
presence of nonstationarity.\textsuperscript{24} Accordingly, in a second set of reported esti-
mates for the spatial model, the linear trend filter was replaced by a first order
autoregressive filter:

\[ x_t = b_0 + b_1 x_{t-1} + e_t. \] (3.3)

With the exception of AREA, STATES and the dummy variables, each of the
explanatory variables was filtered separately with (3.3) before estimation of
(3.1) and (3.2). In order to have results comparable with those of the ML
procedure, in each equation we applied the same RHO that resulted from that
method to the dependent variables, AREA, STATES and the dummy variables.
The regression on these prewhitened values was then done by ordinary least

\textsuperscript{23} As Pommerehne and Kirchgässner [1988] suggest, other factors that might be
included in a positive public choice specification are income distribution and the roles of
interest groups and public bureaucracies. However, there are no available time series of
German data for these variables.

\textsuperscript{24} See Durlauf and Phillips [1988] for the use of the Durbin-Watson statistic as a
diagnostic against misspecification with detrended data.
squares (OLS). In a final pass, we repeated this same procedure, but omitted non-significant constant and dummy variables.\(^{25}\)

4.3 The Results

Column (1) of Tables 1 and 2 presents the results of the non-spatial public-choice specification for total government and military spending respectively. In both equations, the sign of the effect of PRICE is the opposite to that predicted. As for INCOME, in neither equation is the coefficient significantly different from zero. Only the shift variables in the total spending equation and the war dummy in the military spending equation have coefficients of the expected signs.

Columns (2), (3) and (4) in the tables show different specifications of the spatial-competition model. All perform better than the non-spatial version. The three sets of results for the spatial specification are quite similar, the principal difference being the sign of RADIOS in the government-share equation. Since the dependent variable in each pass was the same, the corrected R\(^2\) may be used to measure goodness of fit. On this basis, the versions of column (4) are those that best explain the data.

The results may be classified into three groups: first, those relating to spatial variables; second, those concerning technological factors; and third, other results. Of particular interest are the results for the three spatial variables. As predicted, a larger population (PEOPLE) tended to raise the total government share while increasing the share of military expenditures. A larger area (AREA) tended to lower the total government share while increasing the share of military expenditures.\(^{26}\) Political decentralization (STATES) had the expected negative effect on both total public expenditures and military expenditures as shares of G.N.P., although in the former case the marginal significance level was only ten percent. The spatial variables thus had a considerable degree of explanatory power.

In the case of the technological variables, the effects on total government spending were also consistent with our expectations. Per-capita increases in the number of large newspapers (PAPERS) tended to raise the total public share while radios (RADIOS) and television (TVS) tended to have the opposite, negative effect.\(^{27}\) These results suggest the possibility of a relationship between the rise and its subsequent stabilization of the public share over the past century on the one hand and the extension of the print medium and its subsequent displacement by electronic media on the other. As expected, the effects of diffusion of improved communications and transport technologies on German

\(^{25}\) Note that this filtering of the explanatory variables substantially reduced the degree of multicollinearity present in the original time series.

\(^{26}\) In the cases in Table 2 where PEOPLE and AREA had signs contrary to expectations, the coefficients were not significantly different from zero.

\(^{27}\) However, in the first pass, RADIOS had a significant positive effect.
Table 1
Non-spatial Versus Spatial Models of Government Spending as Share of G.N.P., Germany, 1872–1986

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>Expected sign</th>
<th>Non-spatial</th>
<th>Spatial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(1) a</td>
<td>(2) b</td>
</tr>
<tr>
<td>PRICE</td>
<td>(+)</td>
<td>- 945.9</td>
<td>27.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(361.1)</td>
<td>(12.7)</td>
</tr>
<tr>
<td>PEOPLE</td>
<td>(+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(18.4)</td>
</tr>
<tr>
<td>AREA</td>
<td>(−)</td>
<td>- 40.6</td>
<td>- 52.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.12)</td>
<td>(0.852)</td>
</tr>
<tr>
<td>STATES</td>
<td>(−)</td>
<td>- 2.16</td>
<td>1.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.12)</td>
<td>(0.852)</td>
</tr>
<tr>
<td>PAPERS</td>
<td>(+)</td>
<td>5.99</td>
<td>9.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.87)</td>
<td>(3.38)</td>
</tr>
<tr>
<td>RADIOS</td>
<td>(?)</td>
<td>4.94</td>
<td>5.82</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.04)</td>
<td>(5.30)</td>
</tr>
<tr>
<td>TVS</td>
<td>(−)</td>
<td>0.0837</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.446)</td>
<td>(0.431)</td>
</tr>
<tr>
<td>INCOME</td>
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<td>- 5.85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.50)</td>
<td>(3.49)</td>
</tr>
<tr>
<td>REPDUM</td>
<td>(+)</td>
<td>7.07</td>
<td>7.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.99)</td>
<td>(3.27)</td>
</tr>
<tr>
<td>WARDUM</td>
<td>(+)</td>
<td>2.37</td>
<td>4.63</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.09)</td>
<td>(0.987)</td>
</tr>
<tr>
<td>WEIDUM</td>
<td>(+)</td>
<td>4.95</td>
<td>6.71</td>
</tr>
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<td></td>
<td></td>
<td>(1.26)</td>
<td>(2.50)</td>
</tr>
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<td>CONSTANT</td>
<td></td>
<td>56.9</td>
<td>155.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(22.2)</td>
<td>(110.)</td>
</tr>
<tr>
<td>RHO</td>
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<td>0.997</td>
<td>0.951</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0114)</td>
<td>(0.0395)</td>
</tr>
<tr>
<td>RB(1)2</td>
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<td>0.9870</td>
<td>0.9915</td>
</tr>
<tr>
<td>RB(2)2</td>
<td></td>
<td>0.5636</td>
<td>0.6065</td>
</tr>
<tr>
<td>SSR</td>
<td></td>
<td>228.5</td>
<td>141.36</td>
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<tr>
<td>Durbin-Watson</td>
<td></td>
<td>1.576</td>
<td>1.726</td>
</tr>
</tbody>
</table>

Standard errors in parentheses.

a Maximum-likelihood grid search procedure used to correct for first-order autocorrelated errors.
b Dependent variable, STATES, AREA and dummies prewhitened with RHO of column (2). Other explanatory variables prewhitened with individual linear first order autoregressive filters.

RB(1)2; adjusted explained variation of original dependent variable.
RB(2)2; adjusted explained variation of prewhitened dependent variable.
Table 2
Non-spatial Versus Spatial Models of Military Spending as Share of G.N.P., Germany, 1872–1986

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>Expected sign</th>
<th>Non-spatial</th>
<th>Spatial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)*</td>
<td>(2)*</td>
<td>(3)*</td>
</tr>
<tr>
<td>PRICE</td>
<td>(+)</td>
<td>155.1</td>
<td>13.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(202.9)</td>
<td>(4.81)</td>
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<tr>
<td>PEOPLE</td>
<td>(+)</td>
<td>11.0</td>
<td>1.14</td>
</tr>
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<td></td>
<td></td>
<td>(12.8)</td>
<td>(4.80)</td>
</tr>
<tr>
<td>AREA</td>
<td>(+)</td>
<td>7.76</td>
<td>1.49</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(6.20)</td>
<td>(0.611)</td>
</tr>
<tr>
<td>STATES</td>
<td>(−)</td>
<td>1.21</td>
<td>1.49</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.575)</td>
<td>(0.611)</td>
</tr>
<tr>
<td>RAIL</td>
<td>(0)</td>
<td>4.40</td>
<td>7.83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(6.59)</td>
<td>(9.77)</td>
</tr>
<tr>
<td>PHONES</td>
<td>(0)</td>
<td>0.727</td>
<td>0.729</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.14)</td>
<td>(1.61)</td>
</tr>
<tr>
<td>VEHICLES</td>
<td>(0)</td>
<td>0.842</td>
<td>0.353</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.04)</td>
<td>(1.84)</td>
</tr>
<tr>
<td>INCOME</td>
<td>(?)</td>
<td>1.48</td>
<td>2.97</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.65)</td>
<td>(2.19)</td>
</tr>
<tr>
<td>REPDUM</td>
<td>(+)</td>
<td>1.31</td>
<td>1.14</td>
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<td></td>
<td>(2.23)</td>
<td>(2.99)</td>
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<tr>
<td>WARDUM</td>
<td>(+)</td>
<td>3.86</td>
<td>4.46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.613)</td>
<td>(0.623)</td>
</tr>
<tr>
<td>WEIDUM</td>
<td>(?)</td>
<td>0.565</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>(0.789)</td>
<td>(1.93)</td>
</tr>
<tr>
<td>CONSTANT</td>
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<td>35.3</td>
<td>13.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(6.46)</td>
<td>(28.4)</td>
</tr>
<tr>
<td>RHO</td>
<td></td>
<td>0.9713</td>
<td>0.9235</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0242)</td>
<td>(0.0501)</td>
</tr>
<tr>
<td>RB(1)</td>
<td></td>
<td>0.7917</td>
<td>0.8399</td>
</tr>
<tr>
<td>RB(2)</td>
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<td>0.7777</td>
<td>0.7793</td>
</tr>
<tr>
<td>SSR</td>
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<td>72.23</td>
<td>51.88</td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td></td>
<td>1.731</td>
<td>1.437</td>
</tr>
</tbody>
</table>

Standard errors in parentheses.

*a* Maximum-likelihood grid search procedure used to correct for first-order autocorrelated errors.

*b* Dependent variable, STATES, AREA and dummies prewhitened with RHO of column (2). Other explanatory variables prewhitened with individual linear first order autoregressive filters.

RB(1)\(^2\); adjusted explained variation of original dependent variable.

RB(2)\(^2\); adjusted explained variation of prewhitened dependent variable.
military spending were slight: none of the technological variables had a significant impact on the defense share of G.N.P.

Turn now to the other variables in the model. The effect of per-capita G.N.P. (INCOME) on public spending was significantly less than zero, as expected. Note, however, that the significant positive value of the constant term in the total public spending equation indicates the presence of other factors causing the public share to rise over time. The constant in the military spending equation was not significant, the corrected $R^2$ rising when it was dropped from the specification. The war dummy variable had the expected positive sign in both equations. The Weimar dummy had a significant positive effect on total spending, but no significant impact on military spending. The Franco-Prussian War reparations dummy was not significant, due most likely to the dropping of the first observation so as to make the estimation procedures comparable.

These results show that spatial variables may have an important impact in determining changes in public spending patterns. It is interesting to note that the results of the spatial public choice model imply that it was in the long-run interest of the dominant group in the German Federal Republic to extend the state's 1949 borders: other things being equal, a one percent increase in territory and population would increase net public revenues. \(^{28}\)

5. Conclusion

This paper has compared two different approaches to modeling political competition. The theory of efficient political markets focuses on the process by which competition among groups of self-interested individuals tends to result in a Pareto-optimal allocation of public resources. It assumes that the external boundaries of the state and its degree of decentralization are determined exogenously. In contrast, the spatial approach concentrates on the competition for territory and resources between states and between regions within a state. In modeling a decisive group that maximizes its rents, it assumes that internal political competition within states is imperfect and that borders are determined endogenously. Efficient political markets occur as a limiting case.

The choice between the two approaches depends on the importance of spatial factors. If voters are mobile, if their preferences are spatially homogeneous, and if no group has precedence in agenda setting, then the competitive model is appropriate. However, if these hypotheses do not apply, one should take account of imperfect spatial competition. We would argue that even in the long run in many modern democracies, the hypotheses of the efficient political

\(^{28}\) From the results of column (4), a one per cent increase in population and area with per-capita income constant would lead to an increase in revenues of 0.190% of G.N.P., and increase in control costs of 0.146% of G.N.P., leaving a net revenue gain of 0.044% of G.N.P.
markets model fail to hold. In empirical modeling of the public sector, therefore, one should consider such variables as area, population, the number of subunits, and communications and military technology.

In the case of Germany, over the period from 1872 to 1986, the results presented in this paper led to rejection of a conventional public choice specification consistent with the theory of efficient political markets, in favor of a spatial formulation. In the latter model, a larger population increased the cost of military control relative to income but also raised the tax share of income. Additional area tended to increase the military share but reduce the total public share. Decentralization by means of a federal structure lowered both military costs and total public spending. Finally, technological variables contributed to the rapid rise and subsequent stabilization of total public spending relative to income. Further research is required to determine whether similar results hold for other countries.

Summary

The hypothesis of efficient political markets is inconsistent with evidence from democratic states that voters are not indifferent to international boundaries and levels of decentralization, and that certain geographic groups may receive long-run rents. Here a model of spatial competition is proposed to explain such phenomena. Empirical tests with German public-spending data for 1872–1986 lead to rejection of a specification reflecting the efficient-political-markets hypothesis in favor of one derived from the spatial approach to public choice.

Zusammenfassung


Appendix: Sources of Data

Federal Republic of Germany, STATISTICHES BUNDESAMT, Statistisches Jahrbuch der Bundesrepublik Deutschland, Verlag Kohlhammer, Stuttgart.


Series and sources

General government expenditures: A, F
Defense expenditures: A, F
Population: A, F
Gross National Product: A, F
Gross National Product deflator: A, I
Area: A
Number of newspapers with 7 or more editions per week: S
Telephone calls: M, F
Length of railway line open: M, F
Radio receiving licenses: M, F
Television receiving licenses: M, F
Motor vehicles: M, F

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