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Two Approaches to Estimating
Public Expenditures

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TWO APPROACHES TO ESTIMATING
PUBLIC EXPENDITURES

Abstract: Traditionally, the demand for public expenditures has been estimated using as explanatory variables the average values of per capita income, as well as other variables. The results of this approach are disappointing which is due to the lacking theoretical basis. The public choice model, on the other hand, uses the political decision-making process (median voter model) to explain expenditures. Taking the same set of data, it is shown that the public choice approach yields superior results. It also offers a solution to the unfruitful discussion about the influence of "political" determinants of public expenditures.

June 1975

TWO APPROACHES TO ESTIMATING
PUBLIC EXPENDITURES

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This study has two goals: First, it compares two approaches to the problem of estimating public expenditures. On the one hand there is the traditional regression approach which uses as explanatory variables the average values of per capita income, as well as other variables. On the other hand there is a theoretically based public choice model which uses median values.

Secondly, it contributes to the age-old debate of whether the determinants of public expenditures for goods and services are "economic" or "political".

It will be shown that the median voter model is much better equipped at explaining the demand for publicly supplied goods than the traditional approach, which has been widely used in public finance, political science and political sociology. Our results point

to the need for a theoretical basis of empirical estimations, particularly in this area which has been dominated too long by "estimation without theory". Furthermore, a careful specification of the underlying public choice model makes the traditional separation between "economic" and "political" determinants ⁰absolote; it is much more important to firmly grasp the particular politico-economic nature of public expenditures.

The first part of this paper contrasts the traditional and the public choice approaches. They are tested with the same set of data in order to evaluate their performance (part two). The last part offers conclusions and some general remarks about empirical estimation in the field of public finance.

COMPARISON OF THE TWO APPROACHES

State of the Discussion

One of the first and most influential attempts¹⁾ at empirically estimating the determinants of publicly supplied goods and services with the help of multiple regression analysis has been undertaken by FABRICANT (1952). In his opinion the differences in

the expenditures of American states and communities may largely be attributed to differences in average family income, degree of urbanization and population density. Without any recourse to the theory of collective choice, but solely on the basis of ad hoc presumptions, he was able to statistically explain over 70% of the variance of per capita expenditures in the various political bodies. As this result also applied to such areas as education and welfare, which are of special political importance, it seemed safe to conclude that political factors such as voter participation, party competition, and decision rules are of minor practical importance. Successive studies (for a survey see BAHL 1969) have essentially come to the same conclusion.

As was to be expected this conclusion motivated political scientists and sociologists to enter the arena²⁾. They tested whether the inclusion of "political" variables representing the legislative, executive and administrative structures would lead to significant results. This approach was again basically non-theoretical, the explanatory variables having been introduced ad hoc. The empirical results attained were sensational for political scientists:

If the level of economic performance in the states and communities is kept constant, "political" variables turn out to have no significant influence on their expenditure behavior (even if - taken by themselves - they are significant). Whether voter participation is high or low, party competition weak or strong, whatever the distribution of power between the legislative and executive branches in the various states and communities - all these political factors seemed to be of no relevance to the explanation of public expenditures. E.g. DYE (1966, p. 293) concludes:

"Differences in the policy choices of states with different types of political systems turn out to be largely a product of differing socioeconomic levels rather than a direct product of political variables. Levels of urbanization, industrialization, income, and education appear to be more influential in policy outcomes than political system characteristics".

Only recent empirical research³⁾ indicates that DYE's conclusion may be premature. It shows that even if political variables do not affect the absolute level of public expenditures per capita, they do have the largest influence by far upon their distribution between the various classes of income and population.

The study by FRY and WINTERS (1970), which is one of the most typical ones showing the empirical relevance of "politics" for public expenditure decisions, has been repeated by BOOMS and HALLDORSON (1973). Introducing some methodological improvements⁴⁾, they repeat the test using again averages of the variables concerned. They came, however, to the opposite conclusion: The distribution of public income and expenditures is affected by political determinants only to a minor degree. It seems that it is only a matter of time until someone finds the opposite result by making a minor modification of assumptions.

The Public Choice Model

The confused state of the discussion is no accident as the approaches discussed lack a theoretical basis. The studies have been undertaken in analogy with econometric demand studies for goods and services traded on the market. In these studies it was not taken into account that the demand for publicly supplied goods and services is the result of a collective decision-making process of a quite different nature. It is necessary to carefully specify the particular political choice process which is used to determine public expenditures.

In a political body in which voters directly decide by simple majority about the quantity of public goods - as e.g. in American and Swiss communities - the median voter position is decisive⁵⁾. This is true as long as the tax system remains unchanged. If, on the other hand, the quantity of public goods and their finance are determined simultaneously, there is an incentive to act strategically, i.e. the free-rider problem arises.

The median voter model allows one to derive income and price elasticities in the demand for public goods by cross-section analysis. For empirical analysis, it is necessary to take into account the various degrees of "publicness" of a public good.

With pure public goods (in the sense of SAMUELSON) the consumption of one person does not impair the consumption of other persons. The larger the community, the more the people may use the same good and cet. par. the smaller each individual's cost contribution. Thus, the increasing size of a community leads to economies of scale in the consumption of public goods. With impure goods the consumption quality falls continually with the number of users. The more people (n) consume the good x_i , the lower

the individually consumable quantity ($q_{x_i}^{IN}$), due to crowding for example. Denoting q_{x_i} as the (physical) quantity of public good i supplied, this relationship may be formalized as⁶⁾

$$q_{x_i}^{IN} = q_{x_i} \cdot n^{-\delta} \quad (1)$$

δ indicates the "degree of publicness" of good x_i : With a pure public good, q_{x_i} is by definition identical to $q_{x_i}^{IN}$, such that $\delta = 0$. The more the individual consumable quantity falls with increasing number of users, the larger δ is. If each consumer uses only the n th share of q_{x_i} , there are no economies of scale in consumption, i.e. x_i is a private good, and $\delta = 1$. If there are decreasing returns to scale, $\delta > 1$.

The individually consumable quantity of the public good i , $q_{x_i}^{IN}$, is relevant to the median voter's function. His budget constraint is

$$\sum p_{x_m} \cdot q_{x_m} + \hat{t}_j \cdot \bar{p}_{x_i} \cdot q_{x_{ij}} = \hat{Y}_j \quad (2)$$

where

q_{x_m} = quantity of goods traded in the market
($m = 1, 2 \dots M$);

p_{x_m} = market price of these goods;

\hat{t}_j = tax share (i.e. relative contribution to the costs of public goods production) of the median voter in community j;

\bar{p}_{x_i} = the (constant) unit costs of production or "price" of the public good i;

\hat{Y}_j = median income in community j.

Total income is spent on marketed goods ($\sum p_{x_m} \cdot q_{x_m}$) or is taxed away in order to finance the production costs of public goods ($\hat{t}_j \cdot \bar{p}_{x_i} \cdot q_{x_{ij}}$). Substituting (1) into (2) gives

$$\sum p_{x_m} \cdot q_{x_m} + \hat{t}_j \cdot \bar{p}_{x_i} \cdot q_{x_{ij}}^{IN} \cdot n_j^\delta = \hat{Y}_j \cdot n_j^\delta \quad (3)$$

n_j now indicates the population size of community j. The median voter's demand for individually consumable units of the public good thus depends on his income (\hat{Y}_j) and the "tax price" ($\hat{t}_j \cdot \bar{p}_{x_{ij}} \cdot n_j^\delta$). Using a constant elasticity demand function

$$\hat{x}_{ij}^{IN} = k \cdot \hat{Y}_j^\alpha \cdot (\hat{t}_j \cdot \bar{p}_{x_{ij}} \cdot n_j^\delta)^\beta \quad (4)$$

As the political decision is in terms of the physical quantity of public goods x_{ij} , the relevant demand function of the median voter is

$$\hat{x}_{ij} = k \cdot \hat{Y}_j^\alpha \cdot (\hat{t}_j \cdot \bar{p}_{x_{ij}} \cdot n_j^\delta)^\beta \cdot n_j^\delta \quad (5)$$

Assuming equal unit costs of production for public goods in all communities ($\bar{p}_{x_{ij}} = \bar{p}_{x_i}$, for all j), and setting $\gamma = \delta(1 + \beta)$, the demand function used for empirical estimation is

$$\log \hat{x}_{ij} = c + \alpha \log \hat{Y}_j + \beta \log \hat{t}_j + \gamma \log n_j, \quad (6)$$

where $c = \log k$.

This model for the explanation of public expenditures of various categories derived from the theory of collective choice has been confronted with the traditional regression approach in the following manner:

$$\log x_{ij} = c' + \alpha' \log \bar{Y}_j + \beta' \log \bar{t}_j + \gamma' \log n_j, \quad (7)$$

where \bar{Y}_j and \bar{t}_j are average income and average tax shares, respectively.

EMPIRICAL TEST OF THE TWO MODELS

The performance of the two models given by equation (6) and (7) were tested by applying them to the same set of empirical data. This has not been mentioned in the literature up to the present, but the two approaches have been empirically estimated in isolation.

The two models were tested in a cross-section of seventy-four political communities (Gemeinden) in the Swiss canton Baselland. The institutional set-up conformed to the conditions necessary for the application of the theoretically oriented public choice model (as well as, of course, for the traditional ad hoc approach): After a period of discussion, decisions can be taken by direct simple majority vote; it is possible to propose changes in a project from the floor; a very small number of citizens are necessary in order to call an assembly. The tax system consists of (until recently) proportional taxes on income and wealth, a fact which simplifies the analysis.

Table 1 shows the regression estimates (SSLS) for the median-voter model. In order not to commit a specification error due to the possible influence of structural differences in the communities, the regression equation (6) has been amended by variables showing the influence of growth, density and age composition in the population⁷⁾.

Table 1

Median Voter Model: Determinants of Public Expenditures for various categories^{a)}
(74 political communities of the Canton of Baselland, 1969)

Spending categories	demand elasticities w.r. to			degree of "publicness"	population				constant	R ²
	income	tax share	size of population		growth rate	density	share of people aged 0-19 years	share of people aged over 65 years		
E 1 General Administration	.526* (1.710)	-.247 (1.009)	.747* (3.039)	.992	—	-.002 (.679)	.007 (.117)	.070 (1.051)	1.550	.950
E 2 Education	.358* (1.910)	-.320* (2.153)	.654* (4.354)	.962	-.023* (2.456)	-.001 (1.092)	.020 (.532)	—	3.411	.980
E 3 Culture	3.802* (1.699)	-5.238* (2.879)	-3.758* (2.052)	.887	—	—	.178 (.412)	.232 (.456)	24.863	.577
E 4 Health, Recreation and Sports	1.459* (1.829)	.354 (.574)	1.446* (2.316)	1.070	-.116* (2.615)	—	.469* (3.056)	.136 (.711)	-10.045	.801
E 5 Roads	-1.004* (1.730)	-.684 (1.506)	.818* (1.778)	2.589	.029 (1.169)	-.007 (1.208)	—	—	10.197	.872
E 6 Social assistance	1.037* (2.358)	.838* (2.464)	1.814* (5.273)	.987	-.011 (.464)	.001 (.188)	-.009 (.101)	.204* (1.933)	-10.606	.928
E 7 Fire protection	.550 (1.244)	-.331* (1.687)	.337 (1.210)	.564	-.012 (.717)	—	—	—	2.124	.870
E 8 Total ^{b)}	.320* (2.421)	-.264* (2.577)	.746* (7.219)	1.014	-.001 (.141)	-.002* (2.249)	.001 (.009)	.096* (3.038)	3.223	.991

a) Figures in paranthesis indicate t-values; starred figures indicate statistically significant values at a 95% level of security.

b) Additional including current expenditures for police. Not included are expenditures for military purposes, churches, water and interest payments.

Most of the parameters estimated and reproduced in table 1 show the theoretically expected sign and are statistically significant. With one exception, all the income elasticity estimates are positive and statistically significant. The elasticity of the tax share is expected to be negative. This is indeed true for all but one value, which is statistically significant. Of all income and "tax price" elasticities, there are thus only two which may be said not to conform to theoretical expectations.

The parameter estimates for the degree of "publicness", δ , are in general close to one indicating neither positive nor negative economies of scale in consumption. However, there are some exceptions. Fire protection seems to be the expenditure category with the largest public good characteristic: When the size of the population increases, the individual citizen does not seem to experience any significant reduction of protection. To a somewhat smaller extent this also applies to cultural services and education. The opposite seems to be true for health, recreation and sports, and in particular for local roads. The value δ over 2.5 indicates large diseconomies of scale in use: As the number of people increases, an individual

citizen's consumption potential decreases.

It should be noted that only a few coefficients relating to the structural characteristics of the population turn out to be statistically significant. Some of the significant influences may be readily explained by taking into account the (possible) merit good nature of expenditures for social assistance, as well as for health, recreation and sports. In the first case there is a statistically significant influence of the share of people over 65 years of age in the population, in the second case of the age-group below 19 years of age.

The estimation results obtained correspond closely to those obtained by BORCHERDING and DEACON (1972) and by BERGSTROEM and GOODMAN (1973) in US communities. The estimates on the basis of the median voter model (eq. 6 and table 1) have now been confronted with the traditional ad hoc model, which uses average values of income and "tax share prices". Most econometric regression approaches do not consider the influence of taxation and this is a grave specification error (see WILDE 1972). The average approach tested here is thus improved. Equation (7) is amended by the same population variables as in the estimate of median values. The results are shown in table 2.

Table 2

Traditional Model (Average Values): Determinants of Public Expenditures for various categories^{a)}
(74 political communities of the Canton of Baselland, 1969)

Spending categories	demand elasticities w.r. to			population				constant	R ²
	income	tax share	size of population	growth rate	density	share of people aged 0-19 years	share of people aged over 65 years		
E 1 General Administration	.321 (1.547)	1.911* (1.706)	2.892* (2.589)	-.016 (1.149)	—	—	—	-14.684	.950
E 2 Education	.182 (1.361)	.254 (.350)	1.233* (1.709)	-.019* (2.001)	-.002 (.926)	.009 (.224)	—	-.473	.979
E 3 Culture	.668 (.607)	3.914 (.548)	4.880 (.686)	—	—	-.577 (1.506)	-.560 (1.326)	-31.529	.652
E 4 Health, Recreation and Sports	.361 (.696)	.554 (.186)	1.785 (.603)	-.112* (2.821)	—	.476* (2.871)	—	-7.142	.789
E 5 Roads	-.140 (.322)	.901 (.389)	2.101 (.914)	.019 (.625)	-.012* (2.249)	-.107 (.818)	—	-5.180	.857
E 6 Social assistance	-.124 (.370)	-2.042 (1.139)	-.881 (.495)	.007 (.271)	—	.033 (.324)	.094 (.805)	17.002	.912
E 7 Fire protection	.380 (1.491)	-2.465* (1.835)	-1.790 (1.341)	—	—	-.072 (.937)	-.116 (1.472)	20.377	.888
E 8 Total ^{b)}	.231* (2.474)	.497 (.995)	1.505* (3.035)	.001 (.008)	-.002* (1.971)	-.006 (.199)	.104* (3.193)	-2.492	.990

a) Figures in paranthesis indicate t-values; starred figures indicate statistically significant values at a 95% level of security.

b) Additional including current expenditures for police. Not included are expenditures for military purposes, churches, water and interest payments.

The value of δ has not been calculated, as it is of no interest in this context. As may easily be seen, practically none of the parameter estimates are statistically significant. This applies to income and tax price elasticities as well as to the effects of the population structure. For the explanation of the various expenditure characteristics, no income elasticity and only two tax price elasticities have a statistically significant influence. The regression equation for total expenditure yields better results primarily due to an aggregation effect (see WEICHER and EMERINE 1973).

CONCLUSION

The (statistical) superiority of the median voter approach based on a collective choice model indicates that the debate about whether political or economic factors determine public expenditures is unfruitful. It moreover shows the usefulness of proceeding with an explicit politico-economic model in the explanation of public expenditures. This is true at least for the particular example studied. It seems acceptable, however, to generalize this experience: As public expenditures are determined in a political context,

it is necessary to carefully specify the underlying politico-economic model. For local expenditures decided by direct vote, the median voter model is appropriate. In many cases, public expenditures are decided by parliamentary procedures and are subject to a strong bureaucratic influence. In that case, the underlying politico-economic model must be appropriately modified. It is time that public expenditure studies as well as other empirical studies in public finance leave the phase of "estimation without theory" and turn to the testing of carefully specified politico-economic relationships.

N O T E S

1. There are some earlier studies in this tradition, see e.g. COLM (1936).

2. E.g. DAWSON and ROBINSON (1963), DYE (1966) SHARKANSKY and HOFFERBERT (1969). For a survey see HOFFERBERT (1972).

3. Originating from JACOB and LIPSKY (1968) and PULSIPHER and WEATHERBY (1968): DYE (1969), FRY and WINTERS (1970) and even more recently DELEON (1973), USLANER and WEBER (1975).

4. The major shortcoming of the FRY and WINTERS study lies in the fact that they take the national distribution of families and unattached individuals per income class, instead of the distribution within each state.

5. This has already been shown by BLACK (1948) and generalized by RAE and TAYLOR (1971).

6. See BORCHERDING and DEACON (1972, esp. p. 893).

7. For a detailed description see POMMEREHNE (1974).

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