Volume Title: City Expenditures in the United States

Volume Author/Editor: Harvey E. Brazer

Volume Publisher: NBER

Volume ISBN: 0-87014-380-8

Volume URL: http://www.nber.org/books/braz59-1

Publication Date: 1959

Chapter Title: Factors Associated with Variations in City Expenditures

Chapter Author: Harvey E. Brazer

Chapter URL: http://www.nber.org/chapters/c9202

Chapter pages in book: (p. 13 - 65)

sharply. New England's cities remain at the top, with outlays averaging $34.49 per person, but they are followed closely by the cities of the Pacific states, while those of the Middle Atlantic states rank third. Ranking seventh, eighth and ninth are the cities of the West North Central, East South Central and West South Central states. These three divisions, in different order, also rank seventh, eighth and ninth with respect to mean total general operating expenditures.

Table 5 reveals that this same general rank pattern prevails for mean per capita expenditures on police, fire protection and general control, with the highest average expenditures regularly found for cities in New England and the Middle Atlantic and Pacific states and the lowest in the West North Central, East South Central and West South Central states. There is some deviation from this pattern, however, in the case of operating expenditures for highways, and the pattern is quite completely lost in the cases of recreation and sanitation.

Mean per capita expenditures for cities grouped within the four geographic regions suggest that for all categories of expenditure except total general operating, recreation, and sanitation, cities in the Northeastern and Western states exhibit average expenditure levels that are consistently high and, on the whole, not very different in magnitude. North Central and Southern cities, on the other hand, spent decidedly lesser average amounts which also differ comparatively little from each other. However, with respect to mean per capita total general operating expenditures, the $68.80 spent by Northeastern cities sets them distinctly apart from the other three regions, whose average per capita outlays range from $41.72 to $36.52. Similarly, with respect to recreation, Western city expenditures, at $3.36 per capita, are markedly higher than the $2.31 to $2.16 spent by cities of the South, the Northeast, and the West Central states. But these same cities of the Western region spent only $3.27 per capita for sanitation, considerably less than the $4.65 spent by the cities of the third-ranking North Central region.

These very substantial differences indicate that influences shaping city expenditure extend well beyond individual state lines.

FACTORS ASSOCIATED WITH VARIATIONS IN CITY EXPENDITURES

In recent years several students of public finance have concluded that there is a significant and positive relationship between municipal expenditures per capita and the population size of the city. For a group of fifty-six second and third class cities in New York State, covered in a study conducted by Donald H. Davenport, there was observed positive correlation between per capita expenditures and population size.[18] Mabel L. Walker found that "per capita costs of government increase rapidly as the population increases."[19] Similar statements have been published by Berolzheimer, Colm and associates, Fabricant, and Hansen and Perloff.[20]

The group working under Gerhard Colm at the New School in 1935 also found a positive relationship between per capita "wealth" and police expenditure per capita, and Brecht was able to conclude that density of population and per capita expenditures are closely related.[21]

The scope of the inquiry pursued by Professor Amos H. Hawley in an article published in 1951[22] is much broader than that of any of its predecessors. His data pertains to seventy-six central cities of 100,000 or more population (1940) and their metropolitan areas. Excluded are New York City, because of "its exceptional size," and cities which, although large enough to qualify, lie within the metropolitan areas of larger central cities.

Hawley examined the relation between per capita total, operating and capital improvement expenditures and eighteen characteristics of the central city and its metropolitan area. Of the latter, population density and housing density in the central city and population size, number of white collar workers, per cent of population in incorporated municipalities, per cent of the total area population, and housing density in the satellite area proved to be most important in their effect on total and operating expenditures.[23] His most interesting finding, confirming his initial hypothesis, is

[18]*An Analysis of the Cost of Municipal and State Government and the Relation of Population to Cost of Government, Net Taxable Income and Full Value of Real Property in New York State* (1926), p. 56. The expenditure variables were expressed in terms of "average costs, 1917-21" per capita of 1920 populations. The simple correlation coefficients relating population size to per capita average expenditures were as follows: total, .554; general government, .181; protection, .668; sanitation, .496; health, .714; charities, .177; and bond interest, .443.

[19]Mabel L. Walker, *Municipal Expenditures* (the Johns Hopkins Press, 1930), p. 117.

[20]Josef Berolzheimer, "Influences Shaping Expenditure for Operation of State and Local Governments," *The Bulletin of the National Tax Association*, Vol. XXXII, No. 6, p. 173; Gerhard Colm *et al.*, "Public Expenditures and Economic Structure in the United States," *Social Research*, Vol. III, 1936, p. 75; Solomon Fabricant, *The Trend of Government Activity in the United States Since 1900* (National Bureau of Economic Research, 1952), p. 129; and, Alvin H. Hansen and Harvey S. Perloff, *State and Local Finance in the National Economy* (W. W. Norton and Co., 1944), p. 72.

[21]Arnold Brecht, "Three Topics in Comparative Administration," *Public Policy*, 1941, pp. 305-317.

[22]"Metropolitan Population and Municipal Government Expenditures in Central Cities," *Journal of Social Issues*, Vol. VII, 1951, pp. 100-108 and supplementary mimeographed tables, reprinted in Paul K. Hatt and Albert J. Reiss, Jr., ed., *Cities and Society* (revised, 1957), pp. 773-782.

[23]The multiple correlation coefficients are .67 and .68, respectively, compared with

that the size of municipal government expenditures in central cities is more closely related to the population size of the satellite area than to the population of the central city itself. Moreover, pairing population size of the central city with such variables as population of the satellite area and proportion of the total area population in the satellite area adds absolutely nothing to the proportion of variation in the dependent variables that is "explained."[24] Thus city population size in itself appears to be of importance only when other relevant variables are left out of the analysis, as in the earlier studies noted above.

The recent study by Scott and Feder[25] of 192 California cities with 1950 populations of 2,500 or more is comprehensive and rigorous in its analysis. They examined the relationship between 1950 municipal expenditures per capita (excluding public service enterprise expenditures and those financed through special assessments) and twelve "independent" variables, six of which they retained for their multiple regression analysis.[26] Statistically significant regression coefficients were found for property valuations per capita (adjusted to estimated market value), retail sales per capita, 1940-1950 rate of growth of population, and median number of persons per occupied dwelling unit, while those for 1950 population size and density were not significantly greater than zero.[27] The multiple correlation coefficient was found to be 0.77.[28]

.76 and .77 when all 18 independent variables are taken into account (*ibid.*, p. 105 and table 3). For capital outlays R = .39 when the seven variables indicated in the text are taken into account.

[24]For population of the satellite area and the proportion of the total area population in the satellite area the simple r's for the three dependent variables are .55, .56, and .20 and .56, .58, and .17. The corresponding R's obtained when population size of the central city and each of these two variables pertaining to the satellite areas are coupled are .55, .56, and .20 and .56, .58, and .18 (*ibid.*, tables 1 and 2).

[25]Stanley Scott and Edward L. Feder, *Factors Associated with Variations in Municipal Expenditure Levels* (Bureau of Public Administration, University of California, 1957).

[26]Among the variables rejected on the basis of scatter diagrams and simple correlation coefficients were median family income in 1949 and the percentage of the population engaged in manufacturing (*ibid.*, p. 1).

[27]The regression equation is:

$$\begin{aligned} X_7 = 42.73 &+ \underset{(0.000006)}{0.000009}\,X_1 + \underset{(0.237)}{1.022}\,X_2 + \underset{(0.0004)}{0.003}\,X_3 \\ &- \underset{(3.256)}{7.014}\,X_4 - \underset{(0.013)}{0.031}\,X_5 + \underset{(0.0002)}{0.0028}\,X_6, \end{aligned}$$

where X_1 = population size; X_2 = retail sales per capita; X_3 = density of population; X_4 = median number of persons per occupied dwelling unit; X_5 = rate of growth of population; X_6 = property valuation per capita; and X_7 = municipal expenditures per capita (*ibid.*, pp. 3-4).

[28]Curvilinear correlation techniques were also used, but the details of this analysis are not presented. Using average per capita expenditures for the years 1949 to 1951 and the same six independent variables, a coefficient of multiple correlation of 0.84 was obtained (*ibid.*, p. ix).

There appear to have been no other attempts to apply regression or other statistical techniques to the factors associated with variations in city expenditures. This part of our study develops statistical measures of the association between such expenditures and related economic and demographic characteristics. In addition, we examine the differences in per capita expenditures of cities grouped according to a simple classification which is designed to reflect, among other things, the socio-economic role of the city.

Scope and Method

Our statistical analysis of the relationships between per capita expenditures and selected "independent" variables is applied to five groups of cities. The first consists of the 462 cities having 1950 populations of 25,000 or more for which the relevant data are available. As we have seen, forces peculiar to individual states appear to influence per capita city expenditures within the various functional categories. It is desirable, therefore, to hold these forces constant in order to measure more precisely the association between expenditures and the independent variables. Thus, from the 462 cities we have separated three groups: the thirty-five in California, thirty in Massachusetts and thirty-two in Ohio. While it would have been possible to expand the scope of our analysis, no other states offer a sample as large as thirty and it is doubtful that further analyses would warrant the effort. The states selected represent three of the four major geographic regions; their cities rank high (Massachusetts), about average (California) and comparatively low (Ohio) in average general operating expenditures per capita. They represent as well, in the same order, cities experiencing relatively slow growth or actual decline in population and economic activity, very rapid growth, and moderate rates of growth.

The fifth group of cities consists of the forty, other than Washington, D.C., whose 1950 populations exceeded 250,000. These form a more homogeneous group in terms of population size, but the major reason for their selection is that the expenditure data are available for their overlying units of local government, including counties, school districts and special districts. In addition, it is possible, for each of these cities, to compute the ratio of the city's population to that of its metropolitan area, as defined by the Bureau of the Census.

The principal method employed here is least-squares multiple regression analysis. That is, the solution of the "normal" equations provides regression or estimating equations that describe the average relationships between the dependent (per capita expenditures) and the independent variables. On the assumption that all of the relationships among our variables are linear, the sum of the squared deviations of the estimated values of the dependent variables from the observed values is reduced to its least possible magnitude. Were we dealing with but one dependent and one independent variable at a time, our equation would in each case describe the line of best fit through our observed values. This conclusion holds with respect to the multi-variate equations, except that our "line" has not two but generally three or more dimensions.[29]

Our results are presented in terms of regression, "beta," elasticity and multiple correlation coefficients. The regression coefficient is, in effect, the "weight" assigned to a particular independent variable when the regression equation is used to estimate per capita expenditures, the other independent variables having been taken into account.

The usefulness of the regression coefficient is limited by the fact that it is not independent of the units in which the original values are expressed. The beta coefficient, on the other hand, is independent in this sense and enables us to compare directly the relative importance of each of the independent variables in "explaining" variations among cities in per capita expenditures. It is obtained simply by multiplying the regression coefficient by the ratio of the standard deviation of the independent variable to the standard deviation of the dependent variable. Thus a beta coefficient of 0.5 tells us that a change of one standard deviation in the independent variable is associated with a change in the dependent variable equal to 0.5 of its standard deviation.[30]

From the regression coefficients we derive as well measures of elasticity of expenditures with respect to the independent variables. The elasticity coefficient may be defined as the percentage change in the dependent

[29]If the results are to be fully valid, the distributions of the variables must be normal or approximately so. Obviously, in the case of the population-size variable this condition is not fulfilled. Considerable departure from normality is found as well in the distribution of the values of the intergovernmental revenue variable. This *caveat*, therefore, must be kept in mind in any evaluation of the measures obtained. Since the number of observations is large, however, even substantial departures from normality are unlikely to bring gross distortion. Moreover, the statistical analysis consistently confirms impressions gained from our scatter diagrams.

[30]The square of the beta coefficient provides an approximation of the relative importance of the independent variable to which it refers. Alternatively, one may readily compute the coefficients of separate determination, each of which may be regarded as measuring the separate contribution of a given independent variable to the "explanation" of variation in the dependent variable (see Frederick C. Mills, *Statistical Methods*, 3rd edition, 1955, pp. 646-7 and Mordecai Ezekiel, *Methods of Correlation Analysis*, 2nd edition, 1941, pp. 217-8). The coefficient of separate determination is the beta coefficient of the independent variable multiplied by the simple correlation coefficient measuring the degree of association between that independent variable and the dependent variable. These correlation coefficients are given in Appendix C.

variable (per capita expenditure) that is associated with a 1 per cent change in the specified independent variable, the others having been taken into account, computed at the mean points of the two variables. It is the regression coefficient multiplied by the ratio of the mean of the independent variable to the mean of the dependent variable. The elasticity coefficients, being relatives, are, like the beta coefficients, entirely comparable. Although these coefficients are valid approximations only for very small changes in the independent variable, they provide a simple measure of the "sensitivity" of the dependent variable to changes in the independent variable. We may find, for example, that there is a close association between the two, as indicated by the value of the beta coefficient, but if the standard deviation of the independent variable is large, the rate of change (at the mean) of the one variable with respect to the other may be very small.

The coefficient of multiple correlation provides an index of the usefulness of the regression or estimating equation. It is a measure of the degree of association between the dependent variable and the independent variables combined. Its square gives us the coefficient of determination, the proportion of variation in the dependent variable "explained" by the independent variables.

The other statistical technique used is analysis of variance. As in its application to amounts spent per capita by cities grouped by states, it permits us to draw conclusions about the meaningfulness of our groupings of cities on other bases. It enables us to state with confidence whether or not differences among groups of cities in average levels of expenditure may be due merely to chance. Essentially, analysis of variance involves a comparison of variance, or deviations from the mean, within groups with variance between groups.

Factors Associated with Variation in Per Capita Expenditures of 462 Cities in 1951 – the Independent Variables

The Census Bureau's annual *Compendium of City Government Finances* readily supports the widely accepted assertion that there is a positive relationship between per capita city expenditures and population size.[31] But closer examination, based on twelve rather than six class intervals,[32]

[31] *Compendium, 1951*, p. 10. Per capita total general operating expenditures in 1951 are reported at $64.71 for cities with populations of more than 1 million, $62.83 (500,000 to 1,000,000), $43.64 (250,000 to 500,000), $46.95 (100,000 to 250,000), $43.24 (50,000 to 100,000), and $40.81 (25,000 to 50,000). Closely similar patterns are observable in both earlier and more recent issues of the *Compendium*.

[32] The class intervals used in our analysis are 25,000 up to 250,000, 250,000 to 500,000, 500,000 to 1,000,000, and over 1,000,000.

indicates that the relationship is at best highly superficial, for the variation between groups of cities is not significantly greater than that within these groups.[33] However, in the case of police protection, highways and the combined common functions, there does appear to be a systematic association between per capita expenditures and population size.[34]

Expenditures may be an increasing function of city size for cities with more than 25,000 inhabitants because of diseconomies of scale, because as the population size of the city increases more services become economically feasible or necessary, or because the population variable is associated with other factors, such as income and population density, which, in turn, account for the apparent association between per capita expenditures and city size.[35] Both logic and our preliminary statistical analysis, as well as earlier studies, appear to justify inclusion of population size among our independent variables, despite the more recent findings of Hawley and Scott and Feder.

Municipal expenditures under several of the major functional catego-

[33]For total general operating expenditure per capita the ratio of variance between groups to variance within groups (F) is 1.43, a ratio attributable to chance, since the $F_{0.95}$ value is 1.81.

[34]The F values are, respectively, 5.87, 2.73 and 1.99. The simple correlation coefficients, in the same order, are 0.24, –0.06 and 0.14 (see C-1).

[35]Density and population size are in fact related, the correlation coefficient being 0.27. Following his suggestion that per capita expenditures tend to increase with the population size of the city, Fabricant (*op. cit.*, p. 129, fn. 15) remarks upon the positive relationship between city size and per capita income. Conceivably there is such a relationship, but when the level of income is measured by median family income instead of per capita income (a statistic that is not available for cities), it does not emerge. The simple correlation coefficient relating median family income and population size is 0.02. Edwin Mansfield in his recent study "City Size and Income, 1949," in *Regional Income: Studies in Income and Wealth, Volume Twenty-one* (Princeton University Press for the National Bureau of Economic Research, 1957), finds that "median income appears to rise with city size" (p. 306). But Mansfield defines the city to include its metropolitan area as defined by the Census Bureau, uses median incomes of "consumer units," that is, families and unrelated individuals, and includes in his analysis cities having populations ranging from 2,500 to 25,000. When each urban place is considered a city, for cities with populations of 25,000 or more, there is little or no observable association between city size and income. His figures are (p. 304, fn. 53):

City Size	*Mean Median Income*
25,000 - 49,999	$2,890
50,000 - 99,999	2,993
100,000 - 249,999	2,826
250,000 - 499,999	2,915
500,000 and over	2,954

The apparent absence of association between median family income and city size is probably due in large measure, as Mansfield's data imply, to the tendency for higher income families in metropolitan areas to live in residential suburbs outside of the core city.

ries are likely to be associated with the extent to which people live close to each other. In the case of streets and highways, for example, it seems obvious that as the density of population increases expenditures per person will decline, since it is unlikely that greater traffic volume will offset the fact that as population density rises per capita mileage to be maintained falls off. On the other hand, the need for police and fire protection and sanitation is likely to be positively related to population density.

Our third independent variable is rate of growth of population, the difference between 1950 and 1940 expressed as a percentage of the 1940 population. As a city's population grows, the need for public services increases, but per capita operating expenditures may be expected to lag as existing facilities are used more intensively, either because of existing excess capacities or because budgetary allocations commonly do not keep pace with the expansion of service requirements. We should expect, therefore, to find an inverse relationship between growth of population and per capita expenditures.

The period 1940-1950 is probably too long to serve as an ideal base for this variable, particularly because of the impact of the war on the first five years. For example, one city's population may show a 25 per cent rate of growth for the period, compounded of a 30 per cent rise to 1946 and a decline of 5 per cent from 1946 to 1950, while another city with the same decennial rate of growth may have experienced all of it in the postwar years. Thus, despite similar population growth over the ten-year period, some cities may have reached a static position while others, by 1950, were growing at an accelerating rate. This factor is likely to obscure the association between population growth and expenditures. Nevertheless, the hypothesis is sufficiently compelling to warrant statistical testing, despite shortcomings that would be substantially reduced if reliable estimates of population were available for, say, 1945 or 1946.

The 1950 Census makes available, for the first time, estimates of personal income by cities. The fourth variable employed in this study is median family income for each city.[36] As the incomes of members of the community rise they may be expected to seek higher planes of living in the public as well as in the private sector of the economy. People who can afford to operate higher-valued automobiles can also afford better street

[36]Family income, rather than incomes of "families and unrelated persons," was selected in order to eliminate what was felt to be the distorting influence in some cities of large groups of single persons, such as college students, reporting little or no income. Such persons' incomes were not believed to be sufficiently relevant. A third alternative, per capita income, is not available. As defined in the 1950 Census, income is essentially the same as "personal income" reported in the National Income accounts of the Department of Commerce. The estimates, which are for the calendar year 1949, were derived from interviews of a 20 per cent sample.

maintenance; full enjoyment of the former may be impossible without the latter. Similar complementarities may be seen as well with respect to police and fire protection, recreation and sanitation. With respect to certain other functions, such as public welfare and health and hospitals, however, the association with income could conceivably be negative.

High income levels in a particular city, especially where they reflect high wages,[37] require the municipal government, in competition with private employers, to pay higher wages and salaries than in a low-income community. Moreover, to the extent that local income and price levels are closely associated, the income level may also reflect prices paid by the city for materials and contractual services.

Finally, there is likely to be a positive association between income and the value of residential property and hence in the size of a portion of the property tax base.

After consideration of various alternatives[38] it was decided to state the fifth variable in terms of the percentage of population employed within the corporate boundaries of each city in retail and wholesale trade, personal, business and repair services, and manufacturing.[39] This variable is designed to take into account several factors, the most important of which is the comparative extent to which cities provide services on behalf of nonresidents (customers and employees) and on behalf of places of business as such. The latter's contribution to the property tax base should also be reflected in it. In general, therefore, we should expect to find a positive association between per capita expenditures and employment.

While it appears to be preferable to the available alternatives, the employment variable contains many deficiencies. It certainly understates the importance, in accounting for levels of expenditure, of many kinds of

[37]Which seems likely when *median* rather than *mean* incomes are employed in the analysis.

[38]Including value added by manufacture per capita and per capita volumes of receipts in trade and services. These were rejected because a comprehensive measure of business activity was believed preferable. It would make little difference whether value-added or employment were used for manufacturing; for a random sample of 47 drawn from the 462 cities the correlation coefficient measuring the association between the two was 0.99. For trade and services gross receipts possess widely varying degrees of importance in terms of their implications for local municipal service requirements. A dollar in gross receipts in wholesale trade, for example, is not reasonably additive for our purposes to a dollar in receipts from local retail trade, nor is the latter equivalent to a dollar in mail order receipts. The various components of trade and services might have been treated individually, but this would have required costly computation. On the other hand, the employment data appear to be a reasonable "common denominator."

[39]The data, originally presented in the Census of Business, 1948, and the Census of Manufactures, 1947, for reasons of convenience were derived from Bureau of the Census, *County and City Data Book, 1952* (A Statistical Abstract Supplement).

services, particularly those directed to vacationers. The relative importance of manufacturing, on the other hand, is probably overstated, and it excludes entirely employment in construction, transportation, public utilities, mining, financial services and government, for which comparable data are not available.

It is commonly believed that government funds are spent with a freer hand when the spending unit is not responsible for their collection. Moreover, state aid is often the alternative to state assumption of direct fiscal responsibility for particular functions, most frequently in the fields of health and welfare, less often in the cases of teacher pension plans and community colleges, highways and other functions. This feature of state aid, together with the fact that so large a part of it is earmarked for public welfare and education,[40] which account for the largest part of city expenditures on the "optional" functions, may indirectly provide an approximate quantification of differences among the states in the distribution among governmental units of functional responsibilities. Furthermore, insofar as the level of municipal expenditures is determined by the availability of funds, revenue received from other governments, which comprised about 20 per cent of total general revenue for cities with 25,000 or more in population in 1951,[41] is certainly of major importance.[42]

[40]In 1952, $365 million out of a total of $915 million in state aid to cities was accounted for by grants-in-aid of or shared taxes earmarked for public welfare and education. A further $168 million was earmarked for highways. These three functions, therefore, absorbed almost 60 per cent of state aid received by cities. Bureau of the Census, *State Payments to Local Governments in 1952*, p. 8.

[41]$971 million of total general revenue of $4,813 million (*Compendium of City Government Finances in 1951*, p. 26).

[42]It has been objected, by Professor Clarence Heer and Mr. Robert E. Lipsey, that intergovernmental revenue per capita is not a truly "independent" variable. In the case of functions supported by matched grants the level of the city's expenditures will, in part at least, determine the amount received in state aid. Within states, per capita grants, if distributed uniformly among cities, become, in effect, a part of the constant term in our regression analysis. Thus on both counts the usefulness or appropriateness of this variable in the within-state analyses is questionable. Among cities located in different states, however, among which aid programs vary widely, the intergovernmental revenue per capita variable appears to me to be useful because the availability of the aid program may still be said to induce the expenditure by the city and for the reasons indicated in the text. This view is, I believe, supported by the fact that there is, for the forty large-city areas, a negative correlation between intergovernmental revenue per capita for other than education and state per capita expenditures for welfare ($r = -.48$, see Appendix Table, C-5).

Professor Harold M. Groves, in commenting on an earlier draft of this study, suggested that "The institution of aids and shared taxes . . . increases expenditures . . . because it reduces inter-territorial competition. . . ." That is, expenditures financed out of local tax revenues may be held down as a consequence of the restraint upon local tax rates imposed by inter-territorial competition for residents and business plants; thus the greater the reliance upon state funds the higher may local expenditures be expected to be, other things remaining equal.

Thus our hypothesis that there is a positive relationship between intergovernmental revenue[43] and per capita city expenditures. Stating the variable in per capita terms does not permit direct examination of the question of whether or not the substitution of state for city taxes, coupled with the broader taxing powers ordinarily enjoyed by the state, is conducive to higher municipal expenditures. The virtues of this approach, however, appear to outweigh those of the alternative used in preliminary analysis, namely the ratio of state aid to locally collected taxes. This ratio was found to vary closely with local tax receipts, particularly within states, so that a low ratio is frequently the result of comparatively large amounts of state aid accompanied by even larger comparative amounts in tax receipts and, of course, high per capita expenditures. Conversely, a high ratio is often the product of a low level of both state aid and tax collections and is accompanied by a low level of expenditures.[44]

Certain other variables readily suggest themselves as candidates for inclusion in the regression analysis. Some of these were examined. The data concerning others are either inadequate or not available. Among the former were the National Association of Fire Underwriters' ratings of city fire departments (in terms of "deficiency points"), temperature range and range-to-January mean ratio (difference between mean July and mean January temperatures and the ratio of this difference to mean January temperature) and state per capita direct expenditure on highways. In each instance both scatter diagrams and linear correlation analysis failed to reveal any association between the independent variable and the relevant per capita expenditures.[45]

Taxable property values, if they could be obtained for all cities on a

[43]Of the $971 million in intergovernmental revenue $872 million consisted of state funds. The remaining $99 million consisted, in indeterminable proportions, of federal aid and a variety of local transfers, not always in the nature of aids (*ibid.*).

[44]The ratio of state aid to locally collected taxes was abandoned as one of the independent variables after it was found to be associated positively and in statistically significant degree only with total general operating and fire protection expenditures. The association was consistently negative within the states of California, Massachusetts and Ohio. Its abandonment was the consequence of both the lack of substantial statistical support for the hypothesis and the insistent and searching criticism of C. Harry Kahn of its use in an earlier draft of this paper.

[45]The usefulness of the fire department ratings is undoubtedly reduced substantially by the fact that city departments are rated only once every twenty-five years (see *The Municipal Year Book, 1956*, International City Managers' Association, 1956, pp. 372-3).

For highways of like construction we should certainly expect the temperature factor to influence maintenance or operating expenditures. However, failure to observe a relationship between highway *operating* expenditures and temperature may be explicable in the fact that construction specifications may be expected to take into account the influence of this factor, so that its effects may be seen in variations in capital rather than operating costs.

uniform basis, would undoubtedly contribute substantially to the explanation of variation in expenditures; as would a more direct measure than the employment variable of the number of nonresident persons using city facilities. A breakdown for each city of state aid by purpose for which the funds are earmarked would be likely to be far more useful for purposes of the regression analysis than the simple total of intergovernmental revenue. Obtaining the necessary data in each of these cases would obviously be a major undertaking. For states in which equalization for property tax purposes is adequately performed, however, at least the first and third of these variables should be available.[46]

Results of the Regression Analysis

The results of the regression analysis for the 462 cities are presented in Tables 6, 7, and 8. The constant terms and regression coefficients of Table 6 provide the regression or estimating equations for this group of cities for each of the expenditure categories, while the coefficients of multiple correlation indicate the degree to which the observed expenditure values correspond to those obtained by the estimating equation.[47] The beta coefficients of Table 7 give us useful measures of the relative importance of each of the independent variables taken into account in explaining variations in per capita expenditures. Finally, the elasticity coefficients in Table 8 provide approximations to the percentage change in the expenditure variable that is associated with a 1 per cent change in the independent variable, at the mean points of the two variables.[48]

[46]Scott and Feder, *op. cit.*, p. 4, found that equalized property valuations per capita for 192 California cities explained a far larger part of variation in city expenditures than any of their other variables. For the regression analysis applied to the forty large cities and their overlying units of local government, it was possible to take into account the ratio of city to metropolitan area population and to obtain a partial breakdown of intergovernmental revenue classified by function or purpose (see pp. 47-60).

[47]A multiple correlation coefficient of 1 would indicate that the observed and estimated values were identical. In this case the independent variables taken into account could be said to explain all of the variation among cities in per capita expenditures. At the other extreme, a coefficient of 0 would indicate that the independent variables were of no help whatever in estimating expenditures and that the mean value of such expenditures would be as good an estimate as we could obtain.

[48]In Tables 6 through 20 the variates for which statistically significant coefficients were not obtained (using the 0.05 level of significance; that is, where the ratio of the coefficient to its standard error, t, is not equal to approximately 2 or more) have been deleted, with some exceptions in Tables 9 through 20 relating to the cities of California, Massachusetts and Ohio and the forty large cities. Several of the coefficients shown in the latter group of tables are as low as 1.5 to 1.9 times their standard errors. In the deletion of variables, the least significant was eliminated first, then the least significant of the remaining, and so on. Where the t value was as high as 1.5 the variable was generally retained if it contributed as much as 4 per cent to the proportion of the total variance explained.

TABLE 6

Regression Coefficients: Per Capita Expenditures of 462 Cities in Relation to Selected Variables, 1951

Expenditure Category	*Constant Term*	*Population in 1950* (thousands)[a]	*Density of Population in 1950* (thousands per square mile)[a]	*Rate of Growth of Population 1940-1950* (per cent)[a]	*Median Family Income in 1949* (hundreds of dollars)[a]	*Employment per 100 of Population in Manufacturing (1947), Trade and Services (1948)*	*Intergovernmental Revenue Per Capita, 1951* (dollars)[a]	*Coefficient of Multiple Correlation*
Total general operating	25.011	....	0.919 (0.179)	−0.063 (0.027)	....	....	1.740 (0.076)	0.756
Common functions	11.061	....	0.290 (0.079)	....	0.303 (0.064)	0.067 (0.032)	0.311 (0.034)	0.501
Police	1.810	0.0007 (0.0002)	0.162 (0.021)	....	0.061 (0.016)	0.025 (0.008)	0.033 (0.009)	0.510
Fire	2.803	....	0.080 (0.020)	−0.007 (0.003)	0.051 (0.015)	....	0.084 (0.008)	0.519
Highways (non-capital)	3.161	....	−0.136 (0.019)	....	0.066 (0.016)	....	0.046 (0.008)	0.403
Recreation (non-capital)	0.761	....	....	....	0.038 (0.012)	....	0.028 (0.007)	0.242
General control	1.768	....	0.031 (0.016)	....	0.028 (0.013)	....	0.041 (0.007)	0.312
Sanitation (non-capital)	1.283	....	0.073 (0.022)	....	0.054 (0.018)	....	0.041 (0.009)	0.309

The standard errors of the regression coefficients appear in parentheses below each coefficient.

[a]Units of measurement are the same in all subsequent tables.

TABLE 7

Beta Coefficients: Per Capita Expenditures of 462 Cities in Relation to Selected Variables, 1951

Expenditure Category	*Population in 1950*	*Density of Population in 1950*	*Rate of Growth of Population 1940-1950*	*Median Family Income in 1949*	*Employment per 100 of Population in Manufacturing (1947), Trade and Services (1948)*	*Intergovernmental Revenue Per Capita, 1951*
Total general operating	....	0.160 (0.031)	−0.074 (0.032)	....	....	0.706 (0.031)
Common functions	....	0.150 (0.041)	....	0.195 (0.041)	0.086 (0.041)	0.378 (0.041)
Police	0.122 (0.042)	0.331 (0.042)	....	0.156 (0.041)	0.125 (0.041)	0.160 (0.041)
Fire	....	0.167 (0.041)	−0.099 (0.042)	0.133 (0.040)	....	0.411 (0.041)
Highways (non-capital)	....	−0.303 (0.043)	....	0.182 (0.043)	....	0.238 (0.043)
Recreation (non-capital)	....	....	....	0.138 (0.045)	....	0.190 (0.045)
General control	....	0.087 (0.045)	....	0.096 (0.045)	....	0.267 (0.045)
Sanitation (non-capital)	....	0.151 (0.045)	....	0.139 (0.045)	....	0.200 (0.045)

The standard errors of the beta coefficients appear in parentheses below each coefficient.

TABLE 8

Elasticity Coefficients: Per Capita Expenditures of 462 Cities in Relation to Selected Variables, 1951

Expenditure Category	*Population in 1950*	*Density of Population in 1950*	*Rate of Growth of Population 1940-1950*	*Median Family Income in 1949*	*Employment per 100 of Population in Manufacturing (1947), Trade and Services (1948)*	*Intergovernmental Revenue Per Capita, 1951*	*Arithmetic Mean* (dollars)
Total general operating	....	0.128	–0.033	....	....	0.379	47.54
Common functions	....	0.068	....	0.367	0.060	0.114	28.26
Police	0.015	0.177	....	0.349	0.102	0.057	6.04
Fire	....	0.091	–0.029	0.303	....	0.150	5.78
Highways (non-capital)	....	–0.180	....	0.453	....	0.095	5.00
Recreation (non-capital)	....	....	....	0.557	....	0.122	2.36
General control	....	0.062	....	0.283	....	0.126	3.34
Sanitation (non-capital)	....	0.119	....	0.458	....	0.106	4.04
Arithmetic mean	130.996	6.624	24.498	34.30	25.15	10.35	

The coefficients of multiple correlation shown in column 8 of Table 6, ranging in magnitude from 0.76 for total general operating expenditures to 0.24 for recreation, suggest that the proportion of variation in per capita expenditures among the 462 cities in 1951 accounted for by the independent variables ranged from 57 to as low as 6 per cent. Obviously, therefore, important causal forces have been left out of the analysis. Nevertheless, the regression equations add, in varying degrees, to our knowledge of variations in per capita expenditures. For example, the computed value of per capita general operating expenditures for a given city is a more meaningful measure of the amount the city may be expected to spend, if it behaves in "average fashion," than is the mean value of that variable for the 462 cities. We have, in addition, measured quantitatively the effects upon expenditures of the six factors taken into account in our analysis.[49]

We find that the association between population size and per capita expenditures is statistically significant only with respect to police protection when the other factors are taken into account.[50] Of the four independent variables employed in the regression analysis for this function, population size is least important, as measured by the magnitude of the beta coefficients of Table 7. At 0.015 its elasticity coefficient is also very low, suggesting that a difference of 1 per cent in population size,[51] at the mean points of the two variables, is accompanied by a difference of less than one-tenth of one cent in police expenditures per capita. Thus, while population size and police protection outlays are related, the regression and elasticity coefficients suggest that the direction of movement of these outlays as population size increases is very close to horizontal.

The fact that the association between per capita expenditure and population size is not closer may be due in considerable part to the discrepancy between the census count of the number of people whose "usual place of abode" is a given city and the number for whom that city provides services. This is likely to be of particular importance in the case of resort cities, such as Miami Beach and Atlantic City, and industrial suburbs like Hamtramck and Highland Park, Michigan.

[49]The regression equations do not provide more than approximations to the influence of the independent variables upon per capita city expenditures. The functional relationships are less than perfectly linear, there may be errors in the reporting of data for both dependent and independent variables, and there are varying lags in time between the dates or years to which the data relate and the fiscal year 1951, as well as other deficiencies in the independent variables, some of which were described above.

[50]As may be seen in Table C-1, the simple correlation coefficients are also very low, below 0.10 for four of the eight expenditure categories and as high as 0.24 only in the case of police protection.

[51]Approximately 1,310.

Whereas population size as such is of virtually no importance, density of population is clearly associated with all expenditure categories except recreation. As we should expect, the relationship is negative with respect to highways and positive for each of the other categories. For police protection and highway and street maintenance the beta coefficients obtained for density of population are very much higher than they are for the other independent variables, while in the cases of total general operating expenditure, fire protection and sanitation, only intergovernmental revenue per capita is, in these terms, of greater importance.

The elasticity coefficients range from 0.18 for police and --0.18 for highways to 0.06 for general control, suggesting that a difference of 1 per cent in population density (at the mean), about seventy persons per square mile, is associated with a difference in highway expenditures of approximately $0.014, slightly more for police protection, about $0.06 for total general operating expenditure, $0.005 for sanitation and fire protection and $0.002 for general control.

The third characteristic of a city's population taken into account, its rate of growth, generally appears to be of only minor importance in shaping municipal expenditures. Our coefficients of regression for this variable are statistically significant only with respect to total general operating expenditure and fire protection. In the case of these two categories the statistical analysis supports our hypothesis that city expenditures tend to lag behind growth in population. However, the beta coefficients, each of which is lower than −0.1, suggest that this variable explains little of the variation in per capita expenditures.[52] The elasticity coefficient, −0.03 in both instances, is also very low.

The relationship between median family income and per capita expenditures is positive with respect to all functional categories and is decidedly statistically significant except in the case of total general operating expenditure. For the combined common functions the beta coefficient relating income to expenditures, at 0.195, is higher than the population density and employment coefficients but far lower than that for intergovernmental revenue. Median family income also ranks second in importance, in these terms, in the cases of general control and recreation. However, for the common functions, in total and individually, per capita expenditures, at the means, appear to respond more sharply to differences in income than to differences in any of the other independent variables; the elasticity

[52]The coefficients of "partial determination" (beta coefficient multiplied by simple correlation coefficient), which provide approximations to the proportions of variation explained by the independent variable, are 0.017 for general operating expenditure and 0.021 for fire protection. See pp. 46-47, however, where in the case of the very rapidly growing cities of California, rate of growth of population assumes much greater importance.

coefficients range from 0.557 for recreation to 0.283 for general control.

Per capita city expenditures tend to increase as the ratio of employment in manufacturing, trade and services to population rises. But the regression coefficient is high enough to be statistically significant only with respect to the combined common functions and police protection. In the former case it is barely significant, while in the latter the beta coefficient relating the employment variable to expenditures is approximately equal to the population coefficient and lower than those for population density, income and intergovernmental revenue per capita.

The elasticity coefficients for the combined common functions and police protection are 0.060 and 0.102. Thus a rise of 1 per cent or 0.25 in the number employed within the city per 100 population in manufacturing, trade and services, is associated at the mean with per capita increases of about $0.02 and $0.006 in expenditure on the common functions and police protection, respectively.

Failure of the regression analysis to lend more support to our hypothesis regarding the association between the employment variable and municipal expenditures may be ascribable in part to deficiencies in the variable itself.[53] In addition, variation among cities in industrial structure is likely to obscure substantially the influence of this variable. Some industries make heavy demands for refuse removal and sewerage, for example, while others require very little of such services. Similarly, variation in types of structures, in processes and the nature of materials employed, and so forth, call for widely different degrees of fire protection. Again, in a one-industry city many services and facilities which are typically provided by municipal government may be privately financed. Furthermore, the employment variable can, at best, provide only a very rough measure of the contribution to the property tax base of industrial and commercial property because wide differences in capital-to-labor ratios are not taken into account. A chemical plant employing 1,000 persons may have plant and equipment valued at $20 million or more, for example, while a furniture factory with the same number employed may use tangible property valued at much less.

Intergovernmental revenue per capita is the only one of the six independent variables for which the regression coefficients are statistically significant for all expenditure categories. The association, as we should expect, is consistently positive. In explaining variation in per capita expenditures it ranks first in the case of all functions except police protection and highways, for which population density is of greater influence.[54]

[53]See p. 21.

[54]Both in terms of the magnitude of the beta coefficients and that of the coefficients of partial determination.

The average relationships suggested by the regression coefficients are most easily read in column 7 of Table 6, since the dependent and independent variables are expressed in terms of dollars. Thus we find that a $1.00 difference in intergovernmental revenue per capita is associated with a difference of $1.74 in total general operating expenditure per capita, $0.33 in expenditure on the combined common functions and $0.03 to $0.08 per capita for the individual functions.

The importance of this variable in measuring the extent to which cities are responsible for education and welfare, for which so large a part of state aid to cities is earmarked, is pointed up as well as by the fact that the beta coefficient for total general operating expenditures,[55] at 0.706, is far higher than it is for any of the other expenditure categories. Cities are typically responsible for the administration of most (frequently all) services included within the common functions. On the other hand, varying practices obtain both among and within states in the case of the "optional" functions, practices that are closely linked with amounts received by cities from other governments. It seems likely, therefore, that the influence of the intergovernmental revenue variable reflects largely a simple availability-of-revenue factor with respect to the common functions and a combination of the latter and differences in the distribution of functional responsibilities in the case of total general operating expenditure. In view of the somewhat questionable nature of the "independence" of this variable, however, the relationship suggested by our statistical analysis should be interpreted with considerable caution.[56]

Our earlier analysis of the relationships among per capita expenditures under the eight categories[57] indicated that we were highly unlikely to find that variations in expenditures were subject, in consistent fashion, to a simple array of forces. In fact, we find that only three of our eight expenditure categories – highways, general control and sanitation – are significantly associated with the same combination of independent variables: density, income and intergovernmental revenue. The density factor is inversely related to highway expenditures, positively related to the other two. Moreover, as Table 7 best illustrates, the degree of association between the independent variables and each of the dependent variables covers, generally, a very wide range.

With multiple correlation coefficients ranging from 0.756 to 0.242, we know that important forces have been left out of our equations. These

[55]Education and public welfare account for close to 30 per cent of total general operating expenditures and approximately 80 per cent of the difference between total general operating expenditures and total outlays on the combined common functions.

[56]See footnote 42, above.

[57]See pp. 4-5.

forces would certainly include social characteristics of the population such as cultural and political values and traditions and ethnic structure; the age and physical condition of existing public facilities; the nature of commercial and industrial activities and their requirements for public services; the distribution of family income about the median; topographical features and their influence upon transportation, communications and population distribution; governmental structure and efficiency; tax structure and rate and indebtedness limits; differences in the distribution of functional responsibilities, taken into account only indirectly and imperfectly; the place of the city within the metropolitan complex; and undoubtedly many others. The importance of these forces is indicated by the cities whose expenditures are far higher or lower than those suggested by our regression equations. We should expect the per capita expenditures of approximately two-thirds of the 462 cities to lie within the range of the values provided by the regression equations plus or minus one standard error of estimate; 95 per cent of them should fall within the range of the computed values plus or minus twice the standard error of estimate.[58] The residuals from the regression analysis, that is, the difference between the observed and computed values of per capita expenditures, are presented in Appendix E.

For total general operating expenditures, twenty-one cities spent more in 1951 than the amounts suggested by their population densities, rates of population growth and intergovernmental revenue per capita, the three variables taken into account in the regression equation (Table 6), plus twice the standard error of estimate. Of these, ten are in New Jersey, three in Massachusetts and three in Florida. These include Daytona Beach, Fort Lauderdale and Miami Beach, Florida, and Atlantic City, New Jersey, each of which, as a major resort city, serves, for at least part of the year, a number of people that is far in excess of its census population. Three others, Monroe, Louisiana, Galveston, Texas, and Beloit, Wisconsin, engaged in very high expenditures of an extraordinary nature. Galveston, through its city budget, spends large sums[59] on port facilities, and the other two, in fiscal 1951, made very large, nonrecurring outlays for education which were not classified as capital outlays. Ten of the twenty-one cities are part of the intensely industrialized high-income complex of northern New Jersey, including Newark and Jersey City, and southern

[58] The standard error of estimate is the square root of the sum of the squared deviations of the observed from the computed per capita expenditures divided by 462, the number of observations. The standard error of estimate for total general operating expenditure is $18.49 and for the combined common functions it is $8.17.

[59] In excess of $3 million, compared with total general operating expenditure of $5,248,000 (*Compendium of City Government Finances in 1951*, pp. 52-53).

Connecticut (Stamford). The four others are Boston, Fitchburg and Quincy in Massachusetts and Nashua, New Hampshire. With the exception of the resort cities and Beloit, Galveston and Monroe, all twenty-one are responsible for the administration of education and welfare and almost all of them are major metropolitan centers or their industrial satellites.

Similar characteristics are exhibited by the forty-nine additional cities that spent in excess of one standard error beyond the amounts suggested by the regression equation for total general operating expenditure. Among the total of seventy such cities (forty-nine plus twenty-one) we find eleven of the twelve Connecticut cities, eight of thirteen in Florida, seven of thirty in Massachusetts, twenty of twenty-seven in New Jersey and six of the twenty-eight New York cities included in this study. Thus, fifty-two of the seventy cities are concentrated in five states, the remaining eighteen being scattered among twelve other states. The same kind of concentration within a few states is also to be seen in the case of those cities whose expenditures fell below the computed value by more than one standard error.[60] Illinois with six of its twenty-six cities, Ohio with seventeen of thirty-two and Pennsylvania with eight of twenty-six, accounted for thirty-one of forty-nine such cities. Thus, as was indicated in our earlier analysis of expenditures of cities grouped by state,[61] forces peculiar to the state in which a city is located appear to exercise a marked influence; this is indicated largely by differences in the allocation of functional responsibilities that are only roughly and inadequately measured by differences in intergovernmental revenue per capita. Moreover, other forces not taken into account, such as those listed above, are not randomly distributed but vary markedly among states.[62]

A somewhat different picture emerges when the role of the optional functions, education and welfare in particular, is eliminated and the combined common functions are analyzed.[63] Among the sixteen cities whose expenditures exceeded the amounts indicated by the regression equation by more than twice the standard error of estimate are seven for which the

[60]There were none below the computed value by more than twice the standard error of estimate.

[61]See pp. 5-11.

[62]Through the application of the analysis of variance the hypothesis that the variation in the residuals between states is not significantly different from variation within states was tested. The 'F' value obtained was 11.5, compared with the F .99 value of 1.6. Thus we reject this hypothesis and may conclude that forces other than those taken into account in the regression equation, forces associated with the state in which the city is located, appear to influence the level of per capita total general operating expenditure.

[63]In this case the independent variables are population density, income, employment and intergovernmental revenue per capita.

census population heavily understates the number for whom public services must be provided. These are Daytona Beach, Fort Lauderdale, Miami Beach and Orlando, Florida, Reno, Nevada, and Atlantic City, New Jersey, all of which serve a large part-year nonresident vacationing or tourist population, and Rochester, Minnesota, whose medical center attracts many thousands of nonresidents each year. The other nine cities in this group may be divided into two classes. The first includes four industrial satellites: Bayonne and Linden, New Jersey, and Lackawanna and Niagara Falls, New York (the latter possessing as well some of the characteristics of the resort communities); while the second group consists of cities which, in general, are very high income suburban municipalities including Newton, Massachusetts, and New Rochelle and White Plains, New York. The concentration of these cities within a few states is slightly less marked than in the case of total general operating expenditure; eleven of the sixteen are in Florida, New Jersey, and New York.

Only two cities spent less than the computed amount minus twice the standard error of estimate – Berwyn, Illinois and Cambridge, Massachusetts.

There are forty-nine additional cities whose per capita expenditures fall between one and two standard errors beyond their computed values and fifty-seven for which they lie within the same limits below these values. Again, most of the cities are to be found in a very small number of states. Forty-one of the high-expenditure cities[64] are located in seven states – California (nine), Connecticut (five), Florida (five), Massachusetts (seven), Michigan (four), New Jersey (eight) and New York (three). The concentration at the lower end of the scale is even greater, with nineteen of Illinois' twenty-six cities and eleven of Pennsylvania's twenty-six making up more than half of the total.

Predominant among the cities which spent substantially more than we should expect on the common functions are those that comprise the core of major metropolitan areas,[65] heavily industrialized suburban or satellite cities, and those, including the resort communities, which for other than industrial reasons serve a much larger number of people than is indicated in the census count. On the other hand, cities that are not part of metropolitan complexes, that is, "independent" cities, industrial suburbs in Illinois and Pennsylvania, and low-income suburbs, are found with highest relative frequency among the cities whose expenditures are well below the levels indicated by the independent variables in the regression analysis.

[64]Fifty-five of the total of sixty-five, including the cities with expenditures in excess of twice the standard error above the computed values.

[65]See pp. 52 and 53 for definition of the metropolitan area and the distinction between "major" and "minor" metropolitan areas.

Thus the state of location appears to be a major factor of "disturbance."[66] This may encompass, in addition to differences in the distribution of functional responsibilities, differences in the politics, ethnic background and culture of the population, climatic and topographical features, tax and debt limits, as well as other factors. The fact that cities as political entities differ in varying degrees in population size and geographic area from their metropolitan areas or economic entities probably contributes as well to unexplained differences in expenditures. Cities play varying economic roles: some are "dormitory" suburbs for the poor or for the well-to-do; others are well-integrated, geographically, economically and socially separate centers for industry, commerce and residences; still others are cities within cities that have retained political independence, a heavy industrial concentration and often little else. These differences too, as our subsequent analysis will indicate,[67] appear to influence the level of per capita expenditures. In addition, census population figures are, for our purposes, inevitably misleading. For example, college and university students are included in a city's population but vacationers are not. In such cases per capita expenditures do not represent truly comparable expenditures "per person served." As we have already noted, median family income is probably not wholly satisfactory as the income variable, and the employment variable leaves much to be desired. Finally, despite the efforts of the Census Bureau, differences in accounting procedures and some lack of uniformity in reporting expenditures probably contribute to the variance that remains unexplained.

In a limited way it is possible to eliminate or take into account in quantitative analysis some of these factors. Differences among the states in the distribution of functional responsibilities and other forces[68] may be abstracted from by examining separately the relationships between expenditures and the independent variables for cities within individual states. In addition, for the forty largest cities having overlying units of local government we are able to combine the outlays of all local governments, thus minimizing differences in local governmental structures and in the distribution of responsibilities among local units. We can also take into account the ratio between each city's population and that of its standard metropolitan area. Finally, we classify cities according to certain of their

[66]Again, analysis of variance in the residuals, designed to test the hypothesis noted in footnote 62, above, was applied to the common function category and to each of the individual expenditure categories. The 'F' value ranged from 7.3 for the combined common functions to 3.6 for highways, compared with the F .99 value of 1.6.

[67]See pp. 61-65.

[68]To an extent that varies among the states these differences will, of course, persist within states.

TABLE 9

Regression Coefficients: Per Capita Expenditures of 35 California Cities in Relation to Selected Variables, 1951

Expenditure Category	*Constant Term*	*Population in 1950*	*Density of Population in 1950*	*Rate of Growth of Population 1940-1950*	*Median Family Income in 1949*	*Employment per 100 of Population in Manufacturing (1947), Trade and Services (1948)*	*Intergovernmental Revenue Per Capita, 1951*	*Coefficient of Multiple Correlation*[a]
Total general operating	25.099	....	....	−0.075 (0.032)	....	0.617 (0.303)	1.016 (0.296)	0.710 *0.675*
Common functions	29.381	....	....	−0.058 (0.023)	....	0.449 (0.219)	....	0.584 *0.548*
Police	4.644	0.002 (0.001)	....	−0.010 (0.007)	....	0.205 (0.063)	....	0.661 *0.618*
Fire	4.419	....	....	−0.011 (0.007)	....	0.099 (0.064)	0.125 (0.062)	0.562 *0.500*
Highways (non-capital)	9.024	....	−0.410 (0.109)	−0.011 (0.005)	....	....	....	0.594 *0.559*
Recreation (non-capital)	0.927	....	....	−0.010 (0.005)	0.096 (0.055)	....	....	0.431 *0.368*
General control	3.048	....	....	−0.006 (0.004)	....	....	0.142 (0.042)	0.557 *0.517*
Sanitation (non-capital)	−0.413	....	....	−0.011 (0.005)	0.138 (0.050)	....	−0.086 (0.047)	0.618 *0.567*

The standard errors of the regression coefficients appear in parentheses below each coefficient.

[a] "Ezekiel's Correction" (italics) has been applied to the multiple correlation coefficients to correct for the number of variables in each equation.

The standard errors of the regression coefficients appear in parentheses below each coefficient.

a "Ezekiel's Correction" (italics) has been applied to the multiple correlation coefficients to correct for the number of variables in each equation.

TABLE 10

Beta Coefficients: Per Capita Expenditures of 35 California Cities in Relation to Selected Variables, 1951

Expenditure Category	*Population in 1950*	*Density of Population in 1950*	*Rate of Growth of Population 1940-1950*	*Median Family Income in 1949*	*Employment per 100 of Population in Manufacturing (1947), Trade and Services (1948)*	*Intergovernmental Revenue Per Capita, 1951*
Total general operating	....	....	–0.324 (0.137)	....	0.281 (0.138)	0.440 (0.128)
Common functions	....	....	–0.384 (0.155)	....	0.317 (0.155)	....
Police	0.222 (0.137)	....	–0.212 (0.146)	....	0.473 (0.146)	....
Fire	....	....	–0.273 (0.161)	....	0.252 (0.162)	0.303 (0.150)
Highways (non-capital)	....	–0.535 (0.142)	–0.282 (0.142)	....	....	....
Recreation (non-capital)	....	....	–0.298 (0.160)	0.282 (0.160)	....	....
General control	....	....	–0.223 (0.147)	....	....	0.493 (0.147)
Sanitation (non-capital)	....	....	–0.330 (0.143)	0.395 (0.144)	....	–0.264 (0.144)

The standard errors of the beta coefficients appear in parentheses below each coefficient.

TABLE 11

Elasticity Coefficients: Per Capita Expenditures of 35 California Cities in Relation to Selected Variables, 1951

Expenditure Category	*Population in 1950*	*Density of Population in 1950*	*Rate of Growth of Population 1940-1950*	*Median Family Income in 1949*	*Employment per 100 of Population in Manufacturing (1947), Trade and Services (1948)*	*Intergovernmental Revenue Per Capita, 1951*	*Arithmetic Mean (dollars)*
Total general operating	....	....	−0.116	....	0.256	0.247	40.97
Common functions	....	....	−0.109	....	0.229	....	33.38
Police	0.036	....	−0.078	....	0.447	....	7.80
Fire	....	....	−0.108	....	0.254	0.188	6.63
Highways (non-capital)	....	−0.423	−0.114	....	....	....	5.87
Recreation (non-capital)	....	....	−0.146	0.920	....	....	4.09
General control	....	....	−0.101	....	....	0.349	4.05
Sanitation (non-capital)	....	....	−0.197	1.563	....	−0.247	3.46
Arithmetic mean	156.571	6.057	63.03	39.22	17.02	9.96	

TABLE 12

Regression Coefficients: Per Capita Expenditures of 30 Massachusetts Cities in Relation to Selected Variables, 1951

Expenditure Category	*Constant Term*	*Population in 1950*	*Density of Population in 1950*	*Rate of Growth of Population 1940-1950*	*Median Family Income in 1949*	*Employment per 100 of Population in Manufacturing (1947), Trade and Services (1948)*	*Intergovernmental Revenue Per Capita, 1951*	*Coefficient of Multiple Correlation*[a]
Total general operating	100.532	0.078 (0.019)	....	....	....	....	....	0.616 *0.598*
Common functions	−2.398	0.029 (0.009)	....	....	1.105 (0.336)	....	....	0.647 *0.613*
Police	5.546	0.011 (0.002)	0.075 (0.041)	....	....	....	....	0.810 *0.795*
Fire	9.142	0.005 (0.002)	....	−0.069 (0.044)	....	....	....	0.536 *0.484*
Highways (non-capital)	6.204	....	−0.169 (0.080)	....	0.202 (0.141)	....	−0.136 (0.069)	0.622 *0.562*
Recreation (non-capital)	−5.479	0.003 (0.001)	0.069 (0.029)	....	0.218 (0.047)	....	....	0.765 *0.733*
General control	5.029	0.006 (0.002)	....	....	....	−0.055 (0.022)	....	0.596 *0.554*
Sanitation (non-capital)	−10.697	0.005 (0.003)	....	....	0.447 (0.106)	....	....	0.649 *0.615*

The standard errors of the regression coefficients appear in parentheses below each coefficient.

[a] "Ezekiel's Correction" (italics) has been applied to the multiple correlation coefficients to correct for the number of variables in each equation.

TABLE 13

Beta Coefficients: Per Capita Expenditures of 30 Massachusetts Cities in Relation to Selected Variables, 1951

Expenditure Category	*Population in 1950*	*Density of Population in 1950*	*Rate of Growth of Population 1940-1950*	*Median Family Income in 1949*	*Employment per 100 of Population in Manufacturing (1947), Trade and Services (1948)*	*Intergovernmental Revenue Per Capita, 1951*
Total general operating	0.616 (0.149)	....	....	....	....	....
Common functions	0.469 (0.147)	....	....	0.483 (0.147)	....	....
Police	0.707 (0.120)	0.221 (0.120)	....	....	....	....
Fire	0.444 (0.163)	....	−0.255 (0.163)	....	....	....
Highways (non-capital)	....	−0.335 (0.159)	....	0.235 (0.164)	....	−0.333 (0.169)
Recreation (non-capital)	0.317 (0.135)	0.316 (0.134)	....	0.588 (0.127)	....	....
General control	0.511 (0.156)	....	....	....	−0.395 (0.156)	....
Sanitation (non-capital)	0.242 (0.147)	....	....	0.621 (0.147)	....	....

The standard errors of the beta coefficients appear in parentheses below each coefficient.

TABLE 14

Elasticity Coefficients: Per Capita Expenditures of 30 Massachusetts Cities in Relation to Selected Variables, 1951

Expenditure Category	*Population in 1950*	*Density of Population in 1950*	*Rate of Growth of Population 1940-1950*	*Median Family Income in 1949*	*Employment per 100 of Population in Manufacturing (1947), Trade and Services (1948)*	*Intergovernmental Revenue Per Capita, 1951*	*Arithmetic Mean (dollars)*
Total general operating	0.069	....	....	....	....	....	107.97
Common functions	0.073	....	....	0.991	....	....	37.66
Police	0.147	0.074	....	....	....	....	7.12
Fire	0.052	....	−0.044	....	....	....	9.21
Highways (non-capital)	....	−0.180	....	1.025	....	−0.777	6.66
Recreation (non-capital)	0.114	0.183	....	2.763	....	....	2.66
General control	0.128	....	....	....	0.340	....	4.15
Sanitation (non-capital)	0.092	....	....	3.109	....	....	4.86
Arithmetic mean	95.000	7.087	5.90	33.77	25.69	38.07	

TABLE 15

Regression Coefficients: Per Capita Expenditures of 32 Ohio Cities in Relation to Selected Variables, 1951

Expenditure Category	*Constant Term*	*Population in 1950*	*Density of Population in 1950*	*Rate of Growth of Population 1940-1950*	*Median Family Income in 1949*	*Intergovernmental Revenue Per Capita, 1951*	*Coefficient of Multiple Correlation*[a]
Total general operating	−0.137	0.020 (0.008)	....	....	0.337 (0.124)	1.622 (0.658)	0.756 *0.725*
Common functions	5.451	0.017 (0.003)	....	....	0.486 (0.066)	....	0.841 *0.828*
Police	0.287	0.006 (0.001)	0.156 (0.087)	0.039 (0.009)	0.073 (0.022)	....	0.844 *0.819*
Fire	−0.243	0.003 (0.001)	....	....	0.131 (0.022)	....	0.760 *0.741*
Highways (non-capital)	3.748	....	−0.107 (0.069)	....	0.052 (0.019)	....	0.499 *0.444*
Recreation (non-capital)	−0.584	0.003 (0.001)	....	....	0.049 (0.014)	....	0.669 *0.640*
General control	1.463	....	....	....	0.033 (0.015)	....	0.369 *0.328*
Sanitation (non-capital)	−3.565	0.004 (0.001)	0.216 (0.090)	....	0.151 (0.023)	....	0.834 *0.814*

The standard errors of the regression coefficients appear in parentheses below each coefficient.

[a] "Ezekiel's Correction" (italics) has been applied to the multiple correlation coefficients to correct for the number of variables in each equation.

TABLE 16

Beta Coefficients: Per Capita Expenditures of 32 Ohio Cities in Relation to Selected Variables, 1951

Expenditure Category	*Population in 1950*	*Density of Population in 1950*	*Rate of Growth of Population 1940-1950*	*Median Family Income in 1949*	*Intergovernmental Revenue Per Capita, 1951*
Total general operating	0.393 (0.163)	....	....	0.340 (0.125)	0.402 (0.163)
Common functions	0.501 (0.101)	....	....	0.740 (0.101)	....
Police	0.565 (0.116)	0.216 (0.121)	0.462 (0.111)	0.361 (0.107)	....
Fire	0.313 (0.122)	....	....	0.732 (0.122)	....
Highways (non-capital)	....	−0.250 (0.161)	....	0.434 (0.161)	....
Recreation (non-capital)	0.513 (0.139)	....	....	0.497 (0.139)	....
General control	....	....	....	0.369 (0.170)	....
Sanitation (non-capital)	0.319 (0.117)	0.282 (0.117)	....	0.697 (0.105)	....

The standard errors of the beta coefficients appear in parentheses below each coefficient.

TABLE 17

Elasticity Coefficients: Per Capita Expenditures of 32 Ohio Cities in Relation to Selected Variables, 1951

Expenditure Category	*Population in 1950*	*Density of Population in 1950*	*Rate of Growth of Population 1940-1950*	*Median Family Income in 1949*	*Intergovernmental Revenue Per Capita, 1951*	*Arithmetic Mean* (dollars)
Total general operating	0.078	....	....	0.407	0.519	31.50
Common functions	0.079	....	....	0.711	....	25.99
Police	0.132	0.190	0.111	0.514	....	5.43
Fire	0.069	....	....	0.978	....	5.09
Highways (non-capital)	....	−0.140	....	0.395	....	5.03
Recreation (non-capital)	0.200	....	....	1.169	....	1.58
General control	....	....	....	0.460	....	2.71
Sanitation (non-capital)	0.106	0.355	....	1.424	....	4.03
Arithmetic mean	121.563	6.616	15.41	38.02	10.09	

quantitatively measurable characteristics and examine the hypothesis that these characteristics are not related to differences in average per capita expenditures between cities grouped in this fashion.

Relations between Expenditures and Selected Variables for Cities in California, Massachusetts, and Ohio

Analysis of the expenditures of the thirty-five cities of California, thirty in Massachusetts, and thirty-two in Ohio which had populations in 1950 of 25,000 or more produces consistently higher coefficients of multiple correlation than those obtained for the 462 cities as a whole for all functional categories except total general operating expenditure and police protection. These coefficients, together with the regression coefficients, are set forth in Tables 9 (California), 12 (Massachusetts) and 15 (Ohio). The corresponding beta and elasticity coefficients are presented in Tables 10, 11 (Calif.), 13, 14 (Mass.), 16 and 17 (Ohio).

The multiple correlation coefficients, corrected for the number of variables in each regression equation, tend to be highest for Ohio cities and lowest for cities in California, although there is no consistency in this ranking. In California they range from 0.68 for total general operating expenditure and 0.62 for police to 0.37 for recreation; in Massachusetts from 0.80 for police protection and 0.73 for recreation to 0.48 for fire control; and in Ohio from approximately 0.82 for the combined common functions, police protection and sanitation to 0.33 for general control. These coefficients suggest that within the individual states the independent variables taken into account explain as much as two-thirds of the variation among cities in per capita expenditures and, at the other extreme, as little as 10 per cent. The considerable variation from state to state in the magnitudes of the multiple correlation coefficients makes it difficult to draw broad inferences regarding the relationship between the independent variables and city expenditures in general. Moreover, comparison of the relationships between expenditures and the individual variables indicates clearly the even greater differences in the relative importance of the latter among the three states.

As in the case of all 462 cities taken together, the association between population size and per capita expenditures for California cities is negligible for all categories except police protection.[69] On the other hand, the relation between population size and all categories of expenditure except highways and sanitation in Massachusetts, and highways and general control in Ohio, is statistically significant. This result, which is in such sharp contrast to that obtained when state lines are crossed, and the

[69]The regression coefficient even in the case of police protection is not quite statistically significant at the 0.05 level of significance.

fact that the population size distribution departs so radically from normality, add substantial uncertainty to the conclusion that may be drawn with respect to the influence of population size in shaping city expenditures. However, scatter diagrams for population size and expenditures in Massachusetts reveal the rather spurious nature of the results of the regression analysis, for eliminating the city of Boston changes the picture radically. And when the multiple correlation coefficient for police protection is recomputed for the twenty-nine cities other than Boston it is reduced from 0.8 to approximately 0.4.

Within the three groups of cities density of population is clearly inversely related to highway expenditures in California and Massachusetts and positively associated with per capita expenditures for recreation in Massachusetts and sanitation in Ohio. The regression coefficients in the case of police protection are consistently positive but not statistically significant, while those relating expenditures to density of population for the remaining functional categories are neither statistically significant nor consistent in sign.

Rate of growth of population is an important variable only in California, where the average increase in population between 1940 and 1950 of 63 per cent was far higher than the 24 per cent average for all 462 cities or those for Massachusetts and Ohio of 6 and 15 per cent, respectively. In California the association between rate of growth and per capita expenditures is consistently negative. It is decidedly significant except with respect to police and fire protection and general control. In Ohio, where the rate of growth of population is comparatively low, we find a positive statistically significant association between it and police expenditures, an association for which there is no readily discernible rationale.

Differences in the level of median family income appear generally to be most important with respect to recreation and sanitation, although in Ohio the beta coefficients relating per capita expenditures on the combined common functions and fire protection to income are higher. The influence of median family income is most pronounced among Ohio cities, for which the association is in each instance positive and unquestionably significant. In the other two states only recreation and sanitation expenditures among the separate functional categories and the combined common functions in Massachusetts appear to respond markedly to differences in income.

The employment variable, for which our hypothesis is statistically supported in California for the total general operating, common functions and police expenditure categories, is apparently of no consequence for the cities of Massachusetts and Ohio. The negative association between employment and general control expenditures in Massachusetts, while statistically significant, hardly suggests a causal relationship.

Differences in intergovernmental revenue per capita within the three states are, of course, far smaller than the differences in this variable when state lines are crossed. For Massachusetts cities, all of which are responsible for the administration of schools and public welfare, this variable is not significantly associated with variation in expenditures. In Ohio some cities (generally the larger ones) include substantial sums in their municipal budgets for these optional functions which, in turn, are supported by state grants-in-aid, while others do not. In California, similarly, there is considerable variation in the extent to which cities assume responsibility for public assistance and, therefore, in the amounts received from the state. California cities also receive substantial sums from the state for fire and police protection.[70] As we should expect, therefore, total general operating expenditure and intergovernmental revenue per capita are closely related in California and Ohio. The relations between this variable and fire protection and general control in California are also positive and statistically significant.

Thus each of the six independent variables, in various combinations with one or more of the others, is statistically significant for at least one expenditure category in one, two or all three of these states. Broadly, we find that rate of growth, employment and intergovernmental revenue are most important in explaining variation in expenditures among California cities; in Massachusetts and Ohio population size, density and median family income, the other three variables, play similar roles. Inconsistencies in the results of the statistical analysis appear to be attributable in part to differences in the distribution of functional responsibilities and in the structure of state aid. However, differences among the states in the distributions of the values of the independent variables probably are far more important. Thus, for example, the standard deviation of the rate of growth variable is 60 per cent for California, compared with 6 per cent in Massachusetts and 23 per cent for Ohio cities. The standard deviation for median family income among Ohio cities is $936, compared wtih $565 and $368 for the cities of California and Massachusetts. Note, though, that for each of the three groups of cities the size of our sample, ranging from 35 to 30, is comparatively small.

Relations between Expenditures and Selected Variables for Forty Large Cities

For 1953, data recently published by the Bureau of the Census[71] enable us to combine the expenditures of the forty-one largest cities, which had 1950 populations in excess of 250,000, with expenditures of the local

[70]Bureau of the Census, *State Payments to Local Governments in 1952*, pp. 17-18 (California) and 52-53 (Ohio).

[71]Bureau of the Census, *Local Government Finances in City Areas in 1953*.

governments overlying them.[72] It is possible, therefore, to eliminate the influence of differences, both between and within states, in the distribution among local governments of functional responsibilities,[73] although differences among the states in the state-local distribution of these responsibilities remain, particularly in welfare, highways and higher and special education.

It has been possible to obtain noncapital or operating expenditure data for all of the functional categories studied.[74] Per capita expenditures for the forty cities and their overlying units of local government are presented in Table 18. We have added education and welfare to our list of functions, because each of the forty cities or their overlying governments assume some responsibility for both. On the other hand, the general control category has been dropped. Also, the "common function" category is changed; in this analysis it is the sum of per capita operating expenditures for education, police, fire protection, highways, recreation, and sanitation. Welfare is excluded from the common functions because of wide variation among the twenty-three states involved in the distribution between the state and its subdivisions of the responsibility for its financing and administration.

The varying importance of the so-called optional functions, especially welfare and hospital operation, may be seen in a city-by-city comparison of the first two columns of Table 18. For Boston and Long Beach, for example, per capita operating expenditure on the common functions is less than half of total general operating expenditure per capita, whereas for Chicago, Houston and several other cities the common functions account for well over two-thirds.

[72]Only forty cities are included in our analysis; Washington, D.C., with no overlying state or local governments, is omitted.

[73]The cities' shares of the expenditures of overlying local governments whose boundaries extend beyond city lines were allocated according to the ratios of the cities' populations in 1950 to those of their overlying local governments. This method may overstate somewhat actual expenditures by many cities, but there does not appear to be a reasonable alternative; and the amounts involved are generally small. Per capita expenditures are computed on the basis of 1950 populations, whereas expenditure totals are those reported for 1953. Since the forty cities have grown at varying rates, the relative magnitudes of per capita expenditures are subject to some overstatement for the more rapidly growing cities (according to 1940-1950 rates of growth) such as San Diego and Long Beach, California, and Houston, Fort Worth, Dallas and San Antonio, Texas. It is unlikely, however, that the distortion is serious.

[74]The unpublished breakdown between capital and operating outlays for police and fire protection was obtained from the worksheets of the Governments Division of the Bureau of the Census. The same source was used to obtain the functional distribution of the expenditures of certain special districts such as that of the New York Port Authority.

Undoubtedly a large part of the variation in this ratio is due to differences in the extent to which state governments engaged in direct expenditures[75] for health, hospitals and welfare. We should expect, however, the level of these expenditures by the state, especially in the welfare category, to be inversely related to grants-in-aid of locally administered welfare programs. The intergovernmental revenue variable, therefore, should reflect this factor to a considerable degree[76] and, in the analysis of forces affecting welfare expenditures of the cities and their overlying counties, we can take into account directly state direct expenditures in this field.

With respect to the common functions, viewed either collectively or singly, we are dealing for the most part with governmental responsibilities that are not generally widely participated in directly by the states within city boundaries. The highway function is probably the most important exception. There is, however, no association between per capita state direct operating expenditure on nontoll highways[77] and local (including city, county and special district) highway expenditure per capita in each of the forty city areas.[78] But the number and variety of factors affecting state highway expenditures is so large and the relevance of the *state* per capita data as indications of the magnitude of state expenditures within the cities is so questionable that this absence of association cannot be held to demonstrate the invalidity of the suggested exception.

Five of the independent variables used in the multiple regression analysis of the forty-city data – population size, density and rate of growth, median family income, and employment per 100 of population in manufacturing, trade and services – are simply carried over from our analysis of the 462 cities. Intergovernmental revenue per capita for 1953, rather than 1951, is used in this instance, and federal and state funds received by overlying units are allocated to the cities on the basis of population. Inter-local payments become "internal" distributions and are omitted.[79] This variable is further broken down into intergovernmental revenue for

[75]Expenditures, as distinguished from state payments to local governments, made directly to state public personnel, suppliers and private contractors, to recipients of benefits under welfare, pension and compensation programs and to bondholders.

[76]The simple correlation coefficient between state direct expenditures on welfare per capita and intergovernmental revenue per capita other than for education is –0.48 (see Table C-5).

[77]Direct state operating expenditures for "regular" highways as reported in *Compendium of State Government Finances in 1953*, p. 34, Table 22. The population figures used in computing per capita expenditures are 1950 Census populations.

[78]The simple correlation coefficient is –0.03.

[79]The source of the data for this variable is *Local Government Finances in City Areas in 1953*, pp. 21-23.

TABLE 18

Per Capita Expenditures of 40 Large Cities and Their Overlying Units of Local Government, 1953

(dollar amounts, with rank orders in parentheses)

City	*Total General*	*Common Functions*	*Education*	*Police*	*Fire*	*Highways*	*Recreation*	*Sanitation*	*Welfare*
New York	146.02(9)	74.55(18)	36.56(23)	12.26(8)	7.15(19)	7.04(17)	3.34(26)	8.20(10)	23.98(8)
Chicago	97.41(30)	68.49(24)	30.87(33)	10.82(15)	4.70(37)	5.04(32)	7.72(1)	9.34(4)	5.59(25)
Philadelphia	103.10(27)	66.78(27)	32.73(30)	10.87(14)	7.33(16)	5.86(23)	3.96(18)	6.03(19)	3.22(28)
Los Angeles	175.14(2)	100.19(1)	60.30(1)	15.15(4)	9.27(6)	7.23(15)	4.04(17)	4.20(31)	36.13(3)
Detroit	123.13(14)	80.72(11)	43.84(8)	12.94(6)	5.15(36)	5.30(28)	4.29(14)	9.20(5)	5.50(26)
Baltimore	114.41(20)	70.89(22)	34.28(25)	11.33(13)	8.12(10)	7.05(16)	3.74(22)	6.37(16)	13.38(14)
Cleveland	114.01(21)	74.45(19)	35.37(24)	12.07(9)	6.54(23)	7.58(14)	4.33(12)	8.56(9)	8.83(20)
St. Louis	83.73(36)	54.88(36)	27.54(38)	11.57(12)	5.30(33)	2.79(40)	4.33(12)	3.35(35)	0.57(37)
Boston	190.67(1)	83.48(7)	32.59(31)	17.85(2)	13.32(1)	5.91(22)	5.78(5)	8.03(11)	39.36(2)
San Francisco	146.98(8)	79.71(14)	42.07(11)	11.96(11)	11.76(3)	3.65(39)	6.60(3)	3.67(33)	28.43(6)
Pittsburgh	101.94(28)	66.32(28)	32.87(29)	10.66(16)	7.33(16)	4.55(33)	3.31(28)	7.60(12)	2.33(31)
Milwaukee	140.82(11)	81.91(9)	31.62(32)	13.76(5)	7.27(18)	9.02(8)	3.18(31)	17.06(1)	19.18(11)
Houston	96.34(31)	67.12(26)	40.02(18)	7.60(29)	6.60(22)	5.60(25)	2.33(35)	4.97(25)	1.36(33)
Buffalo	121.32(15)	83.19(8)	45.91(6)	10.57(17)	7.43(15)	5.92(21)	4.67(10)	8.69(7)	16.85(13)
New Orleans	88.89(33)	52.75(37)	24.59(40)	7.02(33)	5.24(34)	5.27(29)	3.53(24)	7.10(15)	0.61(36)
Minneapolis	117.55(16)	64.78(30)	37.77(21)	6.83(35)	5.32(32)	5.20(31)	5.05(9)	4.61(28)	23.55(9)
Cincinnati	138.16(13)	87.23(4)	49.90(3)	9.87(19)	7.84(11)	10.06(4)	3.73(23)	5.83(21)	13.10(15)
Seattle	114.61(19)	70.62(23)	38.94(19)	9.82(20)	7.75(13)	6.29(20)	4.10(16)	3.72(32)	2.30(32)
Kansas City, Mo.[a]	84.92(35)	59.06(33)	33.65(26)	8.02(27)	5.18(35)	5.41(27)	4.33(12)	2.47(38)	0.96(35)
Newark	153.63(6)	91.12(2)	46.98(5)	15.34(3)	10.18(4)	3.98(37)	3.06(32)	11.58(2)	10.82(17)
Dallas	104.38(24)	75.08(17)	41.58(12)	8.27(25)	6.85(20)	7.62(13)	3.40(25)	7.36(14)	0.46(39)
Indianapolis[b]	103.99(25)	73.43(21)	43.13(9)	8.35(24)	8.40(8)	5.56(26)	3.28(29)	4.71(27)	9.39(18)
Denver	145.75(10)	68.15(25)	41.27(13)	7.16(32)	5.92(25)	4.27(35)	5.13(8)	4.40(30)	45.72(1)
San Antonio	67.03(40)	45.34(40)	24.88(39)	4.58(40)	4.67(38)	5.84(24)	2.32(36)	3.05(36)	0.16(40)
Memphis	86.19(34)	58.02(35)	29.44(36)	5.13(39)	5.36(31)	7.66(12)	3.04(33)	7.39(13)	3.03(29)

Oakland	148.63(7)	79.31(15)	41.16(14)	12.39(7)	9.56(5)	8.19(11)	5.54(6)	2.47(38)	27.58(7)
Columbus	79.06(38)	52.45(38)	28.20(37)	7.33(30)	5.37(29)	4.17(36)	1.85(39)	5.53(23)	5.44(27)
Portland, Ore.	107.44(23)	73.77(20)	38.09(20)	12.06(10)	8.66(7)	8.39(10)	3.75(21)	2.82(37)	5.97(23)
Louisville	98.58(29)	66.26(29)	42.52(10)	7.78(28)	4.49(39)	3.86(38)	2.65(34)	4.96(26)	6.20(22)
San Diego	153.93(5)	90.95(3)	54.27(2)	9.62(21)	5.62(28)	9.66(5)	5.83(4)	5.95(20)	32.22(5)
Rochester	139.61(12)	81.03(10)	37.51(22)	8.25(26)	8.33(9)	12.38(1)	5.38(7)	9.18(6)	20.26(10)
Atlanta[c]	116.14(17)	79.91(13)	40.03(17)	9.23(23)	7.49(14)	9.64(6)	3.87(19)	9.65(3)	2.86(30)
Birmingham	69.45(39)	51.56(39)	29.85(35)	6.07(37)	5.37(29)	4.46(34)	2.21(37)	3.60(34)	0.47(38)
St. Paul	108.21(22)	64.26(31)	33.43(27)	7.22(31)	5.99(24)	8.93(9)	4.11(15)	4.58(29)	17.20(12)
Toledo	115.45(18)	80.46(12)	40.78(15)	9.35(22)	6.68(21)	11.17(2)	3.82(20)	8.66(8)	8.30(21)
Jersey City	159.32(4)	85.67(5)	40.28(16)	19.63(1)	12.19(2)	5.22(30)	3.32(27)	5.03(24)	5.75(24)
Fort Worth	80.81(37)	59.10(32)	30.14(34)	6.90(34)	5.64(27)	6.97(18)	3.25(30)	6.20(17)	1.06(34)
Akron	103.24(26)	75.70(16)	47.58(4)	5.85(38)	4.42(40)	10.16(3)	1.65(40)	6.04(18)	9.23(19)
Omaha	91.95(32)	58.64(34)	32.89(28)	6.69(36)	5.72(26)	9.16(7)	1.88(38)	2.30(40)	12.73(16)
Long Beach	169.40(3)	83.78(6)	45.83(7)	10.41(18)	7.81(12)	6.38(19)	7.72(1)	5.63(22)	36.09(4)
40-City mean	117.53	72.03	38.30	9.96	7.08	6.71	3.99	6.25	12.65
Standard deviation	29.78	12.27	7.71	3.30	2.10	2.22	1.41	2.87	12.38

[a]Data for Clay County, which serves about 3 per cent of the population of Kansas City, are not available.

[b]Does not include data for 5 townships which overlie Indianapolis.

[c]Data for DeKalb County, which serves about 10 per cent of the population of Atlanta, are not available.

Sources: (1) Bureau of the Census, *Local Government Finances in City Areas in 1953*, Tables 1 and 2.
(2) *Idem*, *Compendium of City Government Finances in 1953*, Tables 16 and 17.
(3) Unpublished worksheets of the Governments Division of the Bureau of the Census.

education[80] and intergovernmental revenue available for other purposes. In its first form (total intergovernmental revenue per capita) it is employed only in the regression analysis of total general operating expenditure and expenditure on the combined common functions, while intergovernmental revenue earmarked for education is used in the analysis of that expenditure category and the difference between the two, the third form of the variable, is employed in the analysis of each of the other expenditure categories.[81]

Three new variables were added, each of which is either not available or not relevant for the 462-city regressions. The first of these is the ratio of the population of the city to the population of its standard metropolitan area.[82] We should expect expenditures per capita, based upon the population of the city itself, to vary inversely with this ratio, for as it declines the proportion of persons who do not live within the city limits but for whom public services must be provided rises.

This hypothesis stems from two considerations. First, many persons living in the metropolitan area outside of the central city spend much of their time at work, shopping and in other activities within the central city. The ratio of these persons to the population of the central city is likely to be inversely proportionate to the ratio of the city's population to that of its metropolitan area. Second, central cities, to varying extents, provide services to outlying communities. This is commonly the case with respect to fire protection, selected police services, library, hospital, school, and sewerage facilities, among others. While the central city will typically impose charges or fees, and the additional expenditures incurred by it may not add to the taxpayers' burden, they will, nevertheless, be reported in the expenditure data.

The second of the additional variables is the number of children in the public schools per 1,000 of population.[83] This variable ranges widely

[80]From *Compendium, 1953* and *ibid.*, pp. 21-23.

[81]The data that would permit a further breakdown into intergovernmental revenue for highways, welfare, and so forth, are not available.

[82]A "standard metropolitan area," as defined by the Bureau of the Census, is "a county or group of contiguous counties which contains at least one central city of 50,000 inhabitants or more. In addition to the county, or counties, containing such a city, or cities, contiguous counties are included in a standard metropolitan area if according to certain criteria they are essentially metropolitan in character and sufficiently integrated with the central city." *County and City Data Book, 1952*, p. xi.

There is no apparent association between population size and this ratio. The simple correlation coefficient is 0.06 (see Table C-5).

[83]The data used are the averages of the reported 1952 and 1954 pupils in average daily attendance and are derived from Department of Health, Education and Welfare, *Biennial Survey of Education in the U.S., 1950-52* and *1952-54*, pp. 30-37 and 38-45, respectively.

among the forty cities, from 204 in Long Beach, California to eighty-five in Jersey City, New Jersey. It is associated with rate of growth of population[84] and probably reflects a variety of other factors that affect the level of per capita expenditures for public education, including the age distribution, cultural values and religious and ethnic backgrounds of the population. Certainly one would expect the ratio between pupils in public schools and population size to be related causatively to the level of education expenditures.[85]

Finally, in our regression analysis for welfare expenditures we take into account the per capita amounts spent directly in 1953 on welfare[86] by the state in which the city area is located. Especially since so large a part of state-local welfare outlays are now devoted to the categorical assistance programs, state direct expenditures are in large part the alternative to expenditures by the city and county. We should expect, therefore, that this variable is inversely related to city expenditures for welfare. We find that state direct expenditures are also associated with intergovernmental revenue per capita, but not so closely as to preclude the employment of both variables in the regression analysis.[87]

The results of the regression analysis for forty large cities and their overlying units of local government are set forth in Tables 19, 20 and 21 which present, respectively, regression equations and multiple correlation coefficients, beta coefficients, and elasticity coefficients.

Among the forty large cities, whose populations in 1950 ranged from close to 8 million to 251,000, neither size nor rate of growth of population is statistically associated with per capita expenditures for any of the nine functional categories. The statistically significant simple correlation coefficients of –0.38 and –0.31 for rate of growth and police and sanitation are apparently attributable in large measure to the density factor, with which rate of growth is associated, in the case of police expenditures, and both density and employment in the case of sanitation.[88]

[84]The simple correlation coefficient is 0.61 (Table C-5).

[85]Enrollment in municipal institutions of higher education is not taken into account. It is in no sense equivalent to students in average daily attendance, since "enrollment" may mean anything from full-time attendance to a one-hour course in basket-weaving. Nevertheless, it should be recognized that the role of municipal colleges and universities is a factor of disturbance in our regression analysis.

[86]Exclusive of grants to local governments administering welfare programs. Source: *Compendium of State Government Finances in 1953*, pp. 31-32.

[87]The simple correlation coefficients relating intergovernmental revenue per capita and intergovernmental revenue per capita for purposes other than education to direct state expenditures on welfare per capita are –0.39 and –0.48, respectively (Table C-5).

[88]The simple correlation coefficients relating rate of growth of population to population density and employment in manufacturing, trade and services per 100 population are, respectively, –0.60 and –0.72 (Table C-5).

TABLE 19

Regression Coefficients: Per Capita Operating Expenditures of 40 Large Cities and Their Overlying Units of Local Government in Relation to Selected Variables, 1953

Expenditure Category	*Constant Term*	*Density of Population in 1950*	*Ratio of City Population to Metropolitan Area Population in 1950*	*Median Family Income in 1949*	*Employment per 100 of Population in Manufacturing (1947), Trade and Services (1948)*
Total general operating	102.536	1.469 (0.512)	−0.568 (0.132)	....	....
Common functions	58.738	....	−0.252 (0.065)	....	0.610 (0.210)
Education	2.601	....	−0.103 (0.047)	0.804 (0.298)	....
Police	9.132	0.302 (0.065)	−0.057 (0.014)	....	....
Fire	8.093	0.092 (0.050)	−0.047 (0.013)	....	....
Highways	4.257	−0.184 (0.058)	....	....	0.131 (0.046)
Recreation	1.328	....	0.020 (0.009)	0.090 (0.061)	....
Sanitation	1.418	0.137 (0.078)	....	....	0.136 (0.063)
Welfare	9.086	....	−0.095 (0.045)	....	....

Again, as in the analysis of the 462 cities, density of population emerges as an important influence upon levels of expenditure. It accounts for a larger proportion of variation in per capita expenditures than any of the other independent variables in the cases of police protection and highways and is also of considerable importance with respect to total general

Students in Average Daily Attendance per 1,000 of 1950 Population	*State Direct Expenditures on Welfare per Capita, 1950*	*Intergovernmental Revenue per Capita, 1953*	*Intergovernmental Revenue per Capita for Education, 1953*	*Intergovernmental Revenue per Capita for Other Than Education, 1953*	*Coefficient of Multiple Correlation*[a]
n.c.	n.c.	0.982 (0.134)	n.c.	n.c.	0.862 *0.850*
n.c.	n.c.	0.353 (0.076)	n.c.	n.c.	0.734 *0.707*
0.081 (0.040)	n.c.	n.c.	0.286 (0.144)	n.c.	0.644 *0.590*
n.c.	n.c.	n.c.	n.c.	0.052 (0.021)	0.808 *0.790*
n.c.	n.c.	n.c.	n.c.	0.034 (0.016)	0.697 *0.666*
n.c.	n.c.	n.c.	n.c.	0.040 (0.020)	0.565 *0.512*
n.c.	n.c.	n.c.	n.c.	0.031 (0.013)	0.604 *0.559*
n.c.	n.c.	n.c.	n.c.	....	0.477 *0.431*
n.c.	−0.335 (0.112)	n.c.	n.c.	0.551 (0.066)	0.904 *0.895*

n.c. = not computed.
The standard errors of the regression coefficients appear in parentheses below each coefficient.
[a]"Ezekiel's Correction" (italics) has been applied to the multiple correlation coefficients to correct for the number of variables in each equation.

operating expenditure. The elasticity coefficients of 0.29 and −0.26 are highest as well for police and highways. The expected association between density of population and expenditures for fire protection and sanitation is, when the other independent variables are taken into account, not quite statistically significant at the 0.05 level of significance.

TABLE 20

Beta Coefficients: Per Capita Operating Expenditures of 40 Large Cities and Their Overlying Units of Local Government in Relation to Selected Variables, 1953

Expenditure Category	*Density of Population in 1950*	*Ratio of City Population to Metropolitan Area Population in 1950*	*Median Family Income in 1949*	*Employment per 100 of Population in Manufacturing (1947), Trade and Services (1948)*
Total general operating	0.272 (0.095)	−0.408 (0.095)	....	....
Common functions	....	−0.439 (0.114)	....	0.343 (0.118)
Education	....	−0.284 (0.131)	0.359 (0.133)	....
Police	0.506 (0.109)	−0.371 (0.092)	....	....
Fire	0.241 (0.132)	−0.478 (0.133)	....	....
Highways	0.457 (0.144)	....	....	0.407 (0.144)
Recreation	....	−0.299 (0.135)	0.219 (0.149)	....
Sanitation	0.265 (0.151)	....	....	0.328 (0.151)
Welfare	....	−0.163 (0.078)	....	....

The ratio of city to metropolitan area population (obtainable only for this group of larger cities) is associated with per capita expenditures under each of the functional categories except highways and sanitation. The beta coefficients range from −0.478 for fire protection, for which it is the most important of the independent variables, to −0.163 for welfare and −0.284 for education. The elasticity coefficients, highest for fire and police protection and welfare, suggest that a change of 1 per cent in the magnitude of this variable is associated, at the point of averages, with a change of approximately 0.3 to 0.4 per cent in per capita expenditures.

Students in Average Daily Attendance per 1,000 of 1950 Population	*State Direct Expenditures on Welfare per Capita, 1953*	*Intergovernmental Revenue per Capita, 1953*	*Intergovernmental Revenue per Capita for Education, 1953*	*Intergovernmental Revenue per Capita for Other Than Education, 1953*
n.c.	n.c.	0.632 (0.086)	n.c.	n.c.
n.c.	n.c.	0.551 (0.118)	n.c.	n.c.
0.296 (0.145)	n.c.	n.c.	0.288 (0.145)	n.c.
n.c.	n.c.	n.c.	n.c.	0.246 (0.099)
n.c.	n.c.	n.c.	n.c.	0.253 (0.120)
n.c.	n.c.	n.c.	n.c.	0.282 (0.138)
n.c.	n.c.	n.c.	n.c.	0.342 (0.148)
n.c.	n.c.	n.c.	n.c.	....
n.c.	−0.263 (0.088)	n.c.	n.c.	0.699 (0.084)

n.c. = not computed.

The standard errors of the beta coefficients appear in parentheses below each coefficient.

The most obvious and most important inference to be drawn from these findings is that the rapidly growing suburban and "exurban" communities surrounding these cities have an increasing impact upon the demand for their public services. The extent to which the central city tends to "subsidize" those living in the outlying areas depends upon the relative importance of services for which charges are levied and those (police protection, recreation, etc.) which are provided without charge to the nonresident in the course of his visits to the city. But the fact that central city expenditures are associated with the ratio of central city to metropolitan

TABLE 21

Elasticity Coefficients: Per Capita Operating Expenditures of 40 Large Cities and Their Overlying Units of Local Government in Relation to Selected Variables, 1953

Expenditure Category	*Density of Population in 1950*	*Ratio of City Population to Metropolitan Area Population in 1950*	*Median Family Income in 1949*	*Employment per 100 of Population in Manufacturing (1947), Trade and Services (1948)*
Total general operating	0.121	−0.270	....	....
Common functions	....	−0.196	....	0.218
Education	....	−0.151	0.729	....
Police	0.293	−0.322	....	....
Fire	0.125	−0.371	....	....
Highways	−0.265	....	....	0.503
Recreation	....	−0.276	0.778	....
Sanitation	0.213	....	....	0.560
Welfare	....	−0.418	....	....
Arithmetic mean	9.676	55.96	34.49	25.72

area population does not, in itself, establish the case for the view that the residents of the suburban area impose a net burden upon the central city. Conceivably the suburbanite, through his contacts with the city, contributes as much or more to the latter's tax bases as is required to finance the additional expenditures he imposes upon it.

The relationship between median family income in 1949 and the various categories of expenditure is statistically significant only with respect to education. Differences in the level of income appear, therefore, to exert a much smaller influence among the largest cities and their overlying local units of government than among all cities having populations in excess of 25,000. The most striking contrast is found in the case of sanitation. In each of the other four regression analyses the relation between income and per capita expenditure is positive and statistically significant. In this instance it is neither. The far closer positive association between income and intergovernmental revenue per capita (the simple correlation coeffi-

Students in Average Daily Attendance per 1,000 of 1950 Population	*State Direct Expenditures on Welfare per Capita, 1953*	*Intergovernmental Revenue per Capita, 1953*	*Intergovernmental Revenue per Capita for Education, 1953*	*Intergovernmental Revenue per Capita for Other Than Education, 1953*	*Arithmetic Mean* (dollars)
n.c.	n.c.	0.277	n.c.	n.c.	117.53
n.c.	n.c.	0.162	n.c.	n.c.	72.03
0.266	n.c.	n.c.	0.088	n.c.	38.03
n.c.	n.c.	n.c.	n.c.	0.112	9.96
n.c.	n.c.	n.c.	n.c.	0.103	7.08
n.c.	n.c.	n.c.	n.c.	0.128	6.71
n.c.	n.c.	n.c.	n.c.	0.165	3.99
n.c.	n.c.	n.c.	n.c.	....	6.25
n.c.	−0.237	....	n.c.	0.937	12.65
125.2	8.95	33.16	11.65	21.51	

n.c. = not computed.

cient is 0.42) for these forty cities than for the others and the narrower spread among the cities in the level of income may offer a partial statistical explanation for the much lower regression coefficients.

The importance of manufacturing, trade and service activities, as measured by the ratio of employment to population, is greatest with respect to highways and sanitation, for which it accounts for approximately 10 to 13 per cent, respectively, of variation in per capita expenditures. The regression coefficient is statistically significant for the combined common functions as well. Its influence upon the other functional categories, however, appears to be negligible.

For education expenditures, in addition to median family income and the ratio of city to metropolitan area population, we find that the number of pupils per 1,000 population and intergovernmental revenue per capita earmarked for education are significantly associated with per capita expenditures. Each of these variables accounts for about 10 per cent of variation among the forty cities in the level of expenditures. The elasticity coefficient of 0.266 for the ratio of students to population suggests that operating expenditures for education are determined only to a comparatively minor extent by the relative number of children served; the regression coefficient relating intergovernmental revenue to expenditures indicates that, on the average, each dollar of aid earmarked for public school use is accompanied by an increase of about $0.29 in per capita operating outlays for education.

Except in the case of sanitation, our regression analysis clearly supports the hypothesis that city area expenditures per capita vary directly with intergovernmental revenue per capita. The beta coefficients of 0.632, 0.551, 0.342 and 0.699 for total general operating, common function, recreation, and welfare expenditures are the highest of the coefficients for each of these expenditure categories. Intergovernmental revenue per capita for purposes other than education appears to explain close to 60 per cent of variation in per capita welfare expenditures and more than 15 per cent in the case of operating outlays for recreation. The corresponding proportions for total general operating and common function expenditures and total intergovernmental revenue per capita are 40 and 30 per cent, respectively.

We find that when the ratio of city to metropolitan area population and intergovernmental revenue variables are taken into account, per capita welfare expenditures vary inversely with the per capita amounts spent directly by the state on this function. The regression coefficient in this instance simply provides a statistical measure of the relation between state activity and variation in the city-local operating outlays per capita.

The multiple correlation coefficients presented in Table 19 range from 0.90 for welfare and 0.85 for total general operating expenditure to 0.51 for highways and 0.43 for sanitation (all corrected for the number of variables in the regression equations). The range of our coefficients of multiple determination, therefore, is from 0.81 to 0.18. As we have noted, the most consistent contributors to these values are density of population, the ratio of city to metropolitan area population, and intergovernmental revenue per capita; the employment variable is of importance with respect to the common functions, highways and sanitation; and median family income contributes appreciably only to the explanation of variation in per capita expenditures for recreation. Students per 1,000 population and per capita state direct expenditures on welfare are significantly associated with the relevant expenditure categories as well. On the other hand, population size and rate of growth contribute little or nothing to our efforts to account for differences among the forty city areas in per capita expenditures.

Examination of the residuals from the regression analysis, presented in Table E-2, fails to reveal a discernible pattern among the forty large-city areas in the extent to which their actual per capita expenditures in 1953 diverged from expenditures computed from the regression equations. Cities within individual states appear both among those in which expenditures exceeded one standard error of estimate above and below the "expected" levels. Thus, for example, for four or more categories of expenditure Akron and Columbus, Ohio, spent far less than would be indicated by the values of the relevant independent variables, whereas Toledo, under all but two functional categories, spent far more. Similar contrasts may be seen in the position of San Francisco and Long Beach, California on the one hand, and Los Angeles on the other. For some cities, Philadelphia and New York, for example, the "fit" between computed and observed values is quite consistently very close, whereas for others, like Detroit or Chicago, it is close for some functions and not for others.

Thus Table E-2 is interesting for the questions it raises rather than the answers it offers or suggests. Undoubtedly part of the unexplained variance in per capita expenditures is ascribable to deficiencies in the data,[89] but much of it must be attributed to the influence of factors that are not readily identified.

Our analysis of the forty city areas emphasizes the desirability, for comparative purposes, of being able to combine the expenditures of all local units serving each city area. The importance of this procedure, however, varies widely with the functional category being examined. It is obviously extremely important in the cases of total general operating expenditure, education, welfare and, perhaps, highways, but the ratio of county and other local government expenditure to city expenditure on police and fire protection, recreation and sanitation is typically very small.[90]

Variation in Expenditures of Cities Grouped by Type of City

The eight expenditure arrays for the 462 cities, with emphasis upon the upper and lower 5 per cent of cities, for each of the expenditure categories, and the residuals in the regression analysis suggested that there are

[89]For example, the City of Atlanta appears to have spent much more "per capita" than would be expected for total general operating, common function, highway and sanitation expenditures. But a major annexation in 1951 added approximately 100,000 to its population and roughly tripled its area, whereas our data are based on 1950 population and area estimates of the Bureau of the Census (International City Managers' Association, *The Municipal Year Book, 1952*, pp. 31-32).

[90]See *Local Government Finances in City Areas in 1953*, pp. 6-20. Chicago, with its special sanitary and park districts, is the principal exception among the larger cities.

significant differences among different kinds of cities in the amounts spent. On the basis of this, coupled with the expected influence of certain factors upon the behavior of city expenditures, a seven-fold classification was established. The seven classes of cities are: (1) core city of major metropolitan area;[91] (2) core city of minor metropolitan area; (3) high-income residential suburb or satellite city within a metropolitan area; (4) low-income residential suburb; (5) industrial suburb; (6) independent city; and (7) major resort city.

The core city of a major metropolitan area is the largest city of an area where population is over 250,000, while the core city of a minor metropolitan area is the largest where area population is under 250,000.[92]

We classify a city as a "suburb" if it is located within a standard metropolitan area but is not a core or major resort city. It is a residential suburb if the number employed per 100 population in manufacturing in 1947 and in trade and services in 1948 was equal to or less than 20.3, the median for the 137 suburbs. If the number was larger than the median, the city is classified as an industrial suburb. Similarly, a residential suburb is classified as high- or low-income according to whether or not its median family income in 1949 was higher than $4,005, the median for the sixty-nine residential suburbs.

"Independent" cities are simply those that are not located within a standard metropolitan area.

Finally, irrespective of their qualifications for classification in any of the foregoing groups, five cities, Miami Beach, Daytona Beach, Fort Lauderdale, Florida, Atlantic City, New Jersey, and Reno, Nevada, are classified as major resort cities. The criterion applied in this case is hotel receipts per capita, in 1948,[93] as reported in the 1948 Census of Business.

Table 22 presents, for each of the eight expenditure categories, the mean per capita expenditures of the seven groups of cities. The variation in the level of expenditures among the groups is quite extensive. For the combined common functions, for example, mean expenditure ranges from $56.46 per capita for the major resort cities to $25.52 for the independent cities. Moreover, there is a high degree of regularity in the rank order of

[91] See footnote 82 for the definition of a "standard metropolitan area."

[92] Where there are two or more *cities* with populations of more than 250,000 in a single metropolitan area, each is classified as a core city of a major metropolitan area. For example, in the New York–Northern New Jersey metropolitan area New York City, Newark and Jersey City are all so classified. In addition, when, as in the case of Tampa and St. Petersburg, Florida, neither of the two largest cities has a population that is either as large as 250,000 or twice the size of the smaller one, both cities have been classified as core cities of *minor* metropolitan areas. With this exception, the core city of a minor metropolitan area is the single largest city within a metropolitan area having a population of less than 250,000.

[93] Only the five cities listed had hotel receipts in 1948 of more than $60 per capita.

the seven groups for total general operating expenditure and expenditure on the combined common functions, police and fire protection. Major resort cities spent much more than each of the others, followed in order by core cities of major metropolitan areas, industrial, high-income and low-income residential suburbs, core cities of minor metropolitan areas, and, lowest in each case, independent cities.

With respect to highways, recreation, general control and sanitation, however, this pattern disappears. Major resort cities continue to lead all others, but the other groups demonstrate no discernible regularity in their rankings. This confirms the impression gained from our regression analysis that a factor which appears to explain high expenditures under one functional category may, at the same time, exert a downward influence upon another.

The appearance of substantial differences in the levels of expenditure among the seven groups of cities does not, in itself, justify the conclusion that there exists a systematic association between the type of city, as classified here, and per capita expenditure. However, it is possible to test the hypothesis that there is no such association. The results of this test are presented in Table D-1, in which we compare variance between groups with that within groups. In the case of all expenditure categories the ratio between these two variances is well in excess of 2.8, the $F_{0.99}$ value, which would occur as often as once in 100 if the differences between means were due merely to chance. The lowest ratio, or F value, is 4.7, for total general operating expenditure. For all categories of expenditure, therefore, the null hypothesis must be rejected. We may conclude that there is a systematic association between per capita expenditures and the type classification of the city.[94]

In general, the variance analysis applied to the per capita expenditures of the 462 cities grouped by type largely supports the inferences drawn from our regression analysis. It is far less complex than the latter and, for some, more meaningful. Moreover, it permits us, at least in a general way, to bring in the role of the size of the metropolitan area's population relative to that of its principal city. The core city of the major metropolitan area typically includes a smaller proportion of that area's population than does the core city of the minor metropolitan area, and the independent city lies entirely outside of such an area. With the exception of highway

[94]Because the five major resort cities contribute so large a proportion of the variance between groups, the analysis of variance was carried out separately as well for the other 457 cities and for six groups rather than seven. The F values in this instance are considerably lower than those presented in Table D-1. However, for all expenditure categories they exceed the $F_{0.99}$ value of 3.1. Thus, even without the contribution to the variance ratios of the major resort cities the conclusion drawn above remains valid.

expenditures, general control and sanitation, we find that these three groups of cities, in the order named, spend decreasing per capita amounts on each of the expenditure categories. Differences in the level of median family income are clearly highlighted in the substantially larger expenditures of high-income, compared with low-income suburbs, especially with respect to recreation and sanitation. Similarly, comparison between industrial and residential suburbs, most prominently in the cases of police and fire protection, brings out sharply the influence of the economic role of the city. And, finally, the fact that major resort cities necessarily provide public services for far more people than those enumerated in their census estimates probably goes a long way in explaining the very high level of their "per capita" expenditures.

Since important aspects of our system of classification reflect or directly represent some of the independent variables employed in the multiple regression analysis, it would seem desirable to examine the question as to whether or not the classification remains useful or informative when the analysis of variance is applied to the residuals from the regression analysis rather than to the observed per capita expenditures. When this is done we find that the variation in the residuals between types of cities is very much greater than it is within them. Actually, the ratios of variance among groups to variance within groups, the 'F' values, are higher in the analysis of the residuals for total general operating, common function, fire protection and recreation expenditures than they are in the analysis of the observed per capita expenditures. The F values, ranging from 23.6 in the case of recreation to 4.3 for general control, are all well above the $F_{.01}$ value of 2.8.

Furthermore, we find that when we rank the mean residuals for the seven groups of cities, the rank orders for core cities of minor metropolitan areas, low-income and industrial suburbs and major resort cities are, for all functional categories, identical with or only within plus or minus one of the rank orders presented in Table 22. High-income residential suburbs rank two places higher for total general operating expenditure and two places lower for fire protection, highways and general control. Independent cities rank two or three places higher for the total general operating, common function and general control categories and core cities of major metropolitan centers fall from third to seventh place in the case of total general operating expenditures.

That the results of the two analyses differ as little as they do is, of course, not surprising, in light of the fact that the relevant independent variables, income, employment, population and, perhaps, density account for considerably less than half of the total variance among the 462 cities in per capita expenditures.

TABLE 22

Mean per Capita Expenditures of 462 Cities Grouped by Type of City, 1951

(dollar amounts, with rank orders in parentheses)

Expenditure Category	*Core City of Major Metropolitan Area* (77 cities)	*Core City of Minor Metropolitan Area* (106 cities)	*High-income Residential Suburb* (34 cities)	*Low-income Residential Suburb* (35 cities)	*Industrial Suburb* (68 cities)	*Independent City* (137 cities)	*Major Resort City* (5 cities)	*462 Cities*
Total general operating	52.16 (3)	43.35 (6)	46.39 (5)	49.40 (4)	57.46 (2)	41.75 (7)	84.13 (1)	47.54
Common functions	31.21 (2)	25.98 (6)	30.70 (4)	27.08 (5)	31.32 (3)	25.52 (7)	56.46 (1)	28.26
Police	7.33 (2)	5.56 (6)	6.39 (4)	5.72 (5)	7.17 (3)	4.95 (7)	11.36 (1)	6.04
Fire	6.43 (3)	5.47 (6)	5.71 (5)	5.91 (4)	6.49 (2)	5.13 (7)	9.90 (1)	5.78
Highways (non-capital)	4.42 (7)	4.65 (6)	5.53 (2)	5.51 (3)	4.70 (5)	5.34 (4)	8.67 (1)	5.00
Recreation (non-capital)	2.88 (2)	2.23 (4)	2.68 (3)	1.84 (7)	2.17 (5)	2.07 (6)	9.13 (1)	2.36
General control	3.59 (4)	2.80 (7)	3.67 (3)	3.33 (5)	3.87 (2)	3.19 (6)	5.56 (1)	3.34
Sanitation (non-capital)	4.27 (4)	3.64 (6)	5.12 (2)	3.37 (7)	4.59 (3)	3.67 (5)	9.43 (1)	4.04

Source: Computed from data in Bureau of the Census, *Compendium of City Government Finances in 1951*, pp. 44-61. See text for bases of city classifications.