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CONSOLIDATION AND THE SUPPLY OF COMMUNITY SERVICES

by

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I. Introduction

During the last two decades considerable pressure has been placed on communities and cities for the delivery of a variety of services to citizens. The expenditures of state and local governments expanded over six-fold from 6.8 percent of GNP in 1948 to approximately 12.5 percent in 1970. During the same period both the GNP and Federal non-defense expenditures tripled. The increased pressures upon local governments seem to indicate no change in this trend is in sight.

This growth of the local public sector in the U. S. can, in large part, be attributed to population and income growth, technological progress in the private sector, and structural rigidity in the local government system. Increases in population generally require a greater supply of community services to enable consumers to remain at the same level of consumption as before the increase. A more affluent citizenry will tend to increase its demand for both public and private goods under the assumption that all goods are "normal."

Technological progress in the private sector exerts an influence on expenditures through the janitorial activities of local government. The technological revolution in food and beverage packaging is a case in point.

It has been argued that structural rigidity has played a major role in the expansion of the local public sector. The main economic criticism of local government structure stems from the alleged inability of local governments to either deal with externalities or take advantage of economies of scale in community service supply.[1/] The problem of

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1/ cf. Hirsch [5] and Tiebout [13].

externalities is generally one of the inability of one community to exclude benefits or damages from its production of public services from flowing externally to other communities. Public health and crime protection are two examples of services from which benefits may flow external to the community.

Benefit spillovers are not particularly linked to community size. However, because of the size, closer juxtaposition, and greater interdependence of economic activity in the urban community, inefficiencies due to such externalities mainly occur in urban government. Governments in large urban centers should also be able to internalize these externalities more easily because of the closer juxtaposition.

The existence of economies of scale in local government service delivery is by no means settled and remains an empirical question from the standpoint of size. For example, in cost studies of primary and secondary schools, Riew [11] analyzed senior high schools in Wisconsin and found that economies of scale existed up to an enrollment level of 1,675 students. Burkhead [2] studied high schools in Chicago and found no significant economies of scale but was analyzing high schools with an average enrollment of 2,200. In the area of hospital services Ro [12] found a negative relationship between in-patient expenditures per admission over a hospital size range of 36 to 794 beds. Cohen [3] found that over a range of hospital size from 150 to 350 beds the average unit cost function was approximately horizontal. Will [15] found in his study of fire protection in cities ranging in size from 50,000 to one million population that economies of scale were exhausted at a city size of approximately 300,000. Some weaknesses in his study included a lack of fixed management measure and the use of service level standards having scale economies already built into them. Hirsch's [5] study of fire protect

indicates the economies of scale are exhausted at a population of approximately 110,000.

It appears that benefits from economies of scale are mainly concentrated in services such as power, public health services, sewage disposal, water treatment, and delivery, and in the regulatory services such as air pollution control. Johnston [8] found economies of scale in electric power supply. Isard and Coughlin [7] studied secondary sewage treatment in Massachusetts and found benefits from economies of scale could be gained.

The Advisory Commission on Intergovernmental Relations [1] reported that it costs $58 per million gallons to provide primary sewage treatment in a million gallon facility, but less than half this amount for a ten million gallon facility. Cosgrove and Hushak [4] found benefits from unit cost reductions could be obtained by expansion of water treatment facilities in cities in Ohio. The decline in the unit cost functions of their study indicate that expanded systems should be several times larger than decentralized systems in order to realize great benefits from cost reduction. In this sense, water treatment capacity would go from a small facility of approximately 370 million gallons per year in mean flow to over 21,000 million gallons per year representing a city size difference of from 5,000-10,000 to over 50,000.

For most of these latter-mentioned services economies of scale are likely to be exhausted at populations which represent fairly large communities or cities; i.e., in the wide range of 50,000 to 300,000 population.[2/] Certain specialized services can also gain by cost reductions in expansion. Again, the populations involved are large. For example, such special

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2/ cf. Hirsch [6].

crime protection services as communications and crime laboratories can be most efficiently operated by larger government units and service several smaller communities such as exist in large urban centers.

A service such as water supply is likely to gain more from realizing scale economies in consolidation or expansion than from internalization of benefit spillovers since the service is more like a private good as viewed in the mixed public-private good spectrum. Spillovers from this service can be more easily adjusted by intergovernmental fiscal arrangements.

Given that gains from scale economies can be realized and that externalities can be internalized, major local community government reorganization is implied as the solution to the inefficiencies and increased supply of services. In fact, the reorganization should tend toward consolidation or some kind of expansion arrangement. Many inter-local and contractual agreements on financing and purchase have been made and some communities have merged. Some specialized services have been assigned to larger city or county governments to service several smaller communities within close proximity of the larger government. However, extensive consolidation in the U. S. has not taken place.[3/] Tiebout [13] has suggested the lack of consolidation may be due to the fact that the criterion of good government goes beyond the criterion of least cost supply of services. The existence of many local government units offers a variety of fiscal choices and flexibility in citizen control. If mobility is most dependent upon community service delivery this may be true; however there may be some implications of consolidation itself that combined with service production and preferences retard the rate of community consolidation.

3/ Netzer [10] points this out with respect to the formation of special metropolitan districts.

This paper, using a simple model, graphical analysis, and simplifying assumptions attempts to analyze some implications of consolidation to gain from the benefits of cost reductions due to scale economies and draw some conclusions about the supply of community services. The sections that follow develop the simple model and make use of it in analyzing community consolidation and alternatives to consolidation and their implications for service supply.

II. The Model

At the outset assume a local government system in which all citizens having the same tastes and income level are divided into two communities, A and B, each having population N. Assume also that only two goods are available, a private good, x, and a good, y, which is a public type service such as sewage disposal or water service. We will assume that no external benefits or damages spillover into the other community from the supply of y in any one of the communities. This assumption means we are specifying a particular impure public good which is very much similar in properties as the private good x.

The good, y, is assumed to be produced proportional to population and at decreasing unit cost up to a certain point, y_e, where economies of scale are exhausted, while the private good is produced at constant unit cost in the relevant range. Therefore, the production possibilities set faced by each citizen can be specified for each community as:

$$(1) \qquad G_A(y, x) = G_B(y, x) = 0, \qquad dx/dy < o, \; d^2x/dy^2 \leq o.$$

Under the above assumptions the production possibilities set for each citizen of each of the two communities is then defined on a per capita basis.

Likewise, the consumption set is a representative citizen consumption set.

Given these assumptions about the production possibilities and consumption possibilities sets for a representative citizen in any one of the two communities, each citizen maximizes the utility function,

$$(2) \qquad U = U(y, x), \qquad \partial U/\partial x > o, \ \partial^2 U/\partial x^2 < o \qquad \partial U/\partial y > o, \ \partial^2 U/\partial y^2 < o$$

subject to the production possibilities constraint. This maximization yields the optimum consumption bundle (y^*, x^*) achieving utility level $U^* = U(y^*, x^*)$ depending on the tastes of each citizen (each citizen is assumed at the outset to have equal tastes). Two polar (corner solutions) optimum consumption bundles (y^*, x^*) may exist depending on the preferences of each citizen. One such optimum bundle is $(y^* = o, x^* = x_o)$, is $(y^* = y_o, x^* = o)$. These two cases are shown along with the case for which local conditions are such that the slope of the indifference curve and production possibilities frontier are equal (point 1) in Figure 1. The production frontier is illustrated by the curve $x_o\ y_o$, assuming y is produced at declining unit cost. The bundle $(y^* = y_o, x = o)$ is the case such that the indifference curve is everywhere less steep relative to the production possibilities frontier. The more realistic polar optimum (corner solution) is such that none of the good y is consumed; i.e., $(y^* = o, x = x_o)$. This is representative of the small community where no public-type services are produced within the community.

The production possibilities frontier, $x_o y_o$, is such that as more y is produced, less and less x is given up. The curve becomes more convex as it approaches the private good axis and flatter as the community service good axis is approached. As more y is produced scale economies are

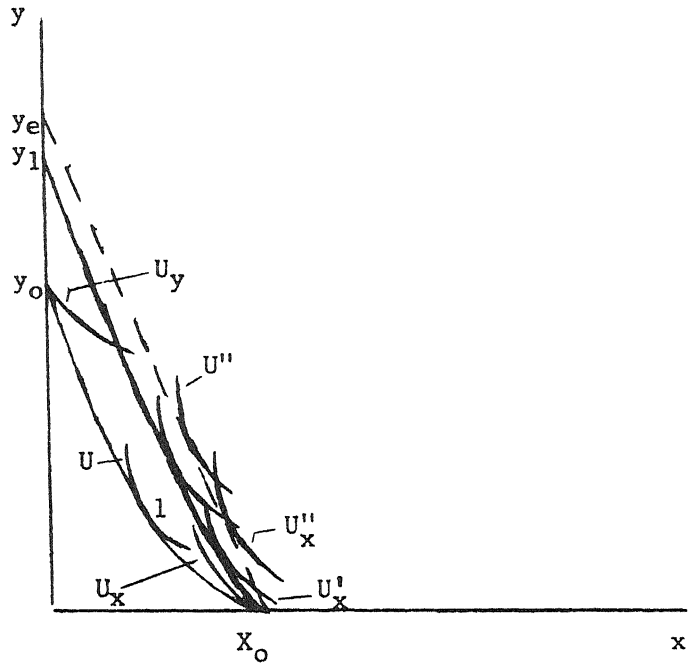

FIGURE 1

realized but at a decreasing rate. The consumption of the community service can increase either by an increase in population or by taking advantage of the economies of scale. Private good consumption can increase only by an increase in income.

Now let us analyze the gains from consolidation, if any, and attempt to outline some alternative institutional or fiscal arrangements to consolidation. The next section will deal with consolidation and analyze the implications for community service supply. The fourth section will analyze what we shall call a semi-autonomous firm arrangement and its supply implications. The fifth section will briefly outline community cooperation under our assumptions about scale economies and its relation to consolidation.

III. Consolidation

By consolidation we mean the process of community consolidation to produce the good, y. We attempt to analyze the benefits of consolidation

and cases in which it is feasible. We assume that after consolidation of communities, the new community is closed and that no spillovers occur either within the community or external to the consolidated community.

Consolidation allows cost reductions to be realized as more y is produced. The production possibilities frontier under consolidation becomes flatter and approaches linearity as more units of the service are produced. This is illustrated by the curve $x_o\ y_1$ in Figure 1.

Consolidation increases the possibility that some community service will be produced along with the private good, if the preferences are represented by U_x (increased level to U_x') as shown in Figure 1. Of course, the move to a higher indifference curve depends on preferences and the degree of exhaustion of economies of scale; i.e., the shape of the production possibilities frontier under consolidation. If preferences are represented by either U or U_x in our case, then consolidation is Pareto preferable to separate supply by any one community.

If consolidation brings about a full exhaustion of scale economies and y can be produced at constant unit cost over the relevant range of production, the production possibilities frontier will be represented by the line $x_o\ y_e$ shown in Figure 1. Again, consolidation is Pareto-preferable to decentralized supply. For the set of preferences represented by U_y, consolidation also results in a Pareto-preferred bundle as now some of the private good is added to the consumption set.

Difference in taste. Now let us relax the assumption in the simple model that tastes are equal. The citizens of the two communities, A and B, are now at different points on their production possibilities frontier. Let us refer now to Figure 2.

Consolidation will, if undertaken, result in only one level of the community service being supplied in the new community. Not all consumption

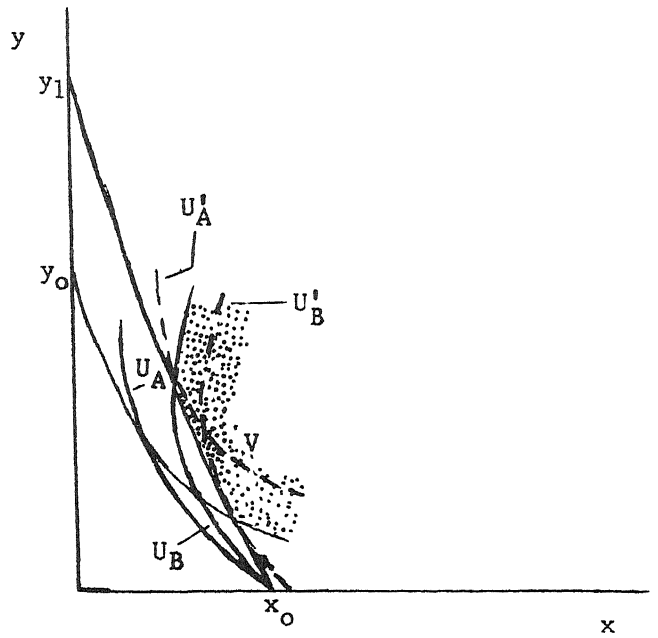

FIGURE 2

bundles in the consolidated consumption possibilities set are preferred by the citizens of A and B to the bundles consumed under separate community service supply. The level of service supply will be arrived at by the relative bargaining power of citizens of each community.

In order for consolidation to be feasible at all, the production possibilities frontier has to rotate such that the consolidated frontier $x_o\ y_1$ at least intersects with the intersection of the original indifference curves (U_A and U_B) of the two communities; i.e., sufficient cost reductions in the increased production of y have to be gained. The ~~cross-hatched~~ shaded area, V, in Figure 2, is a non-empty set such that $V = W \cap Z$, where W and Z are subsets of the consolidated production possibilities set which are preferable to the separate production possibilities sets for communities A and B respectively. Within the set, V, their will exist a consumption bundle which is preferred by all but which none lose. By relaxing the

assumption of identical tastes between communities, we conclude that taste differences imply that consolidation no longer is generally preferable to separate supply of the community service. The preferability depends on the extent of the taste differences and the degree of gain in taking advantage of economies of scale in the production of the community service.

Unequal Incomes. Next we allow income levels to differ between the two communities. Let us assume that community A is the wealthier community. Under this assumption, and as illustrated in Figure 3, the production possibilities set faced by citizens of community A (OEF) dominates the corresponding set faced by citizens of B (OCD). Under consolidation each community's production possibilities frontier expands but each in relation to the expansion path, the income difference, and the degree of cost reduction of the other community as movement down the declining unit cost function occurs as the production of y increases. The new production possibilities frontiers under consolidation are DH and FI for communities B and A respectively.

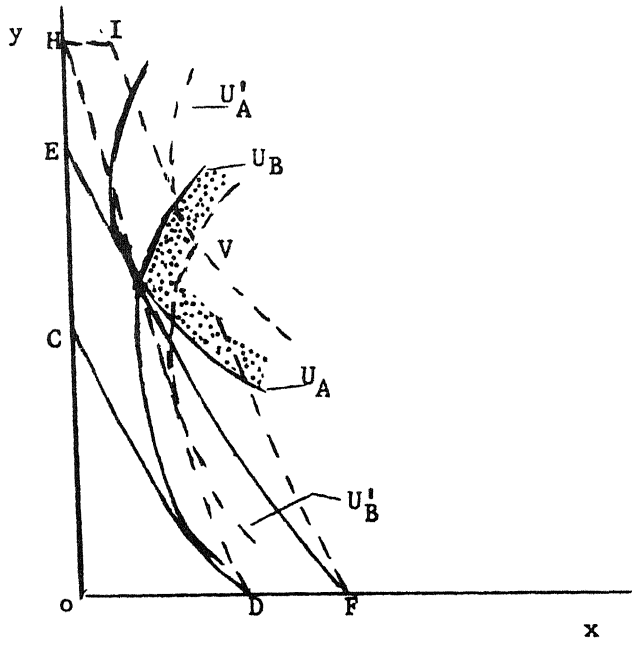

FIGURE 3

The per capita cost of y supplied above H exceeds the income level of citizens in B thus making these levels of supply infeasible under consolidation. As was the case with taste differences, the feasible set is confined to the area V. Again, if sufficient expansion of the production possibilities set is not accomplished there will be no incentive for consolidation. Likewise, if the income differences between the communities is sufficiently great, the set V will be empty and consolidation will be infeasible. It is realistic to conjecture but still depending on the relative convexity of preferences, that the set, V, is empty for two communities unequal in income and the poorer community initially producing none of the community service. However, the less wealthy community stands to gain more from consolidation both in the increase in the consumption bundle (more y) and from the gains of economies of scale realized under consolidation. No general conclusion can be made, however, about the Pareto-preferability of community consolidation to that of separate community supply of the service, y.

IV. The Semi-Autonomous Firm and Community Service Supply

Community consolidation in the supply of community services was shown to be a feasible community arrangement only if the preferences and incomes of the citizens of the communities involved were similar relative to each other. If preference and income differences are wide then substantial gains in cost reductions in the increased production of community services would have to be realized by the communities involved in order to make consolidation feasible. It is unlikely that such substantial gains are enjoyed by large communities; i.e., cities having a population over 100,000.

Communities may stand to gain from expansion in some services such as water supply and sewage disposal. However, under consolidation community autonomy has to be sacrificed and agreement reached on the supply of

services made available under such an arrangement. Again, this implies similar preference and income positions of the communities involved.

An institutional arrangement that has mainly been centered around the supply of water to communities, and to some degree, the regionalization of sewage disposal, is that of a semi-autonomous firm from which the communities can purchase the desired amount of service according to taste and income position.[4/] This type of arrangement ranges from complete control by one community to joint control by several communities in which production decisions are left to the management of the semi-autonomous firm.

Cost reductions can be realized by each community involved by setting up the semi-autonomous firm for the purpose of producing the community service most efficiently; i.e., to approach least cost production of the service. Each community can purchase the desired quantity of the service which is dictated by the preferences, income level and population of the community, but in relation to the production possibilities set of the other communities involved. For the two community model developed, the amount of y purchased by anyone of the two communities from the semi-autonomous firm is such that the equality $(dx/dy)_A = (dx/dy)_B$ holds since the price of y has to be the same to each community under the assumption that the production possibilities sets are defined on a per capita basis. The expansion path of any one community can only be defined given the expansion path of the other community. Without the assumption that output is proportional to population, then the tangency points of indifference curves with production possibilities frontiers of the two communities would

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4/ We do not attempt to cover the argument for a river basin wide firm in the case of sewage disposal in relation to water quality. That argument involves the internalization of externalities with which we do not deal. Kneese and Bower [9] analyze this type of firm.

not necessarily have to be at equal slopes.

Figure 4 illustrates the use for the semi-autonomous firm arrangement. Unequal preferences and income levels are assumed where community A initially is represented by the production possibilities frontier FE and indifference curve U_A, and community B is represented by corresponding curves DC and U_B. Under the semi-autonomous firm arrangement cost reductions are obtained by the additional production of y and the production frontiers of A and B rotate in relation to each other to the new frontiers FI and DH respectively. The new utility levels U_A' and U_B' show the expanded optimum consumption bundles of both communities. The tangency point of U_A' to the production possibilities frontier, FI, for community A must be equal to the tangency of U_B' with DH for community B.

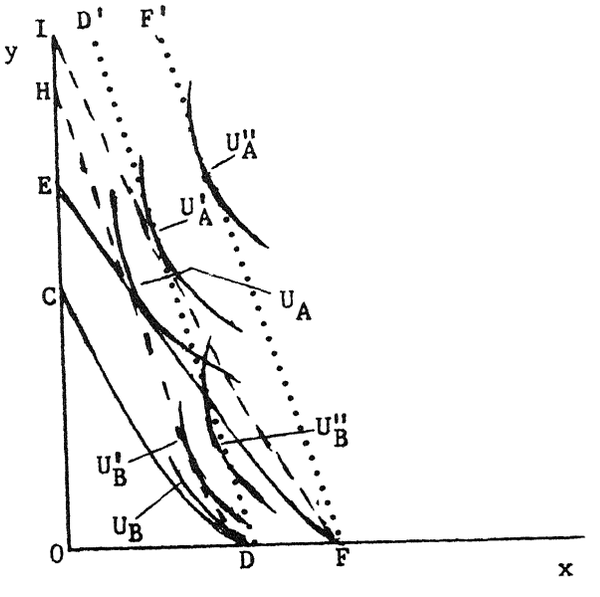

FIGURE 4

If full exhaustion of the economies of scale in the supply of y is realized by the semi-autonomous firm, then the production possibilities frontiers become linear as depicted by FF' and DD' for communities A and B respectively. The new utility levels then become U''_A and U''_B. The relative gains made by the communities in relation to each other is dependent on the differences of the communities with respect to preferences and income and the amount of y each may be supplying under complete decentralization.

Where feasible, the supply of the community service by a semi-autonomous firm will be Pareto-preferable to separate supply irrespective of community income level and preferences. Each community can purchase the desired quantity of y at the price determined by the scale of the production of y by the semi-autonomous firm. In situations where consolidation is unattractive due to wide income and preference differences, supply of community services by a semi-autonomous firm may be feasible in increasing the consumption bundles of citizens at the same time community autonomy may be maintained. Only mutual agreement on the type of firm and agreement to an outside supply source is required of any community. Obviously, factors such as conveyance costs, locational agreements and position, and the degree of close proximity of communities involved are determinants of the type of agreement communities will make in setting up such a firm for the supply of community services.

V. Community Cooperation in the Supply of Services

There is another alternative to consolidation of community service supply. This is an arrangement whereby communities cooperate in the production of services. What is understood by cooperation in public finance is that community service supply is undertaken cooperatively by communities

and, at the same time, the supply of the service can be undertaken separately by each community if desired in order to augment the supply of the service to its citizens. Let us analyze what implications our simple model has for cooperation.

Let us make the same assumptions as were imposed in the development of the original model. The communities A and B may be at different levels in the consumption of y and x as illustrated in Figure 5 by U_A and U_B. Cooperation is feasible whenever consolidation is feasible; i.e., when preferences and income levels of the communities are similar. Within the set, V, of feasible consumption bundles, each community will move to its highest indifference curve obtainable under cooperation (U_A, U_B). The cooperative production possibilities frontier becomes the segmented curve, $x_o y_c y_1$, an expansion of the separate supply frontier, $x_o y_o$. However, if one of the communities desires to augment its supply of y to its

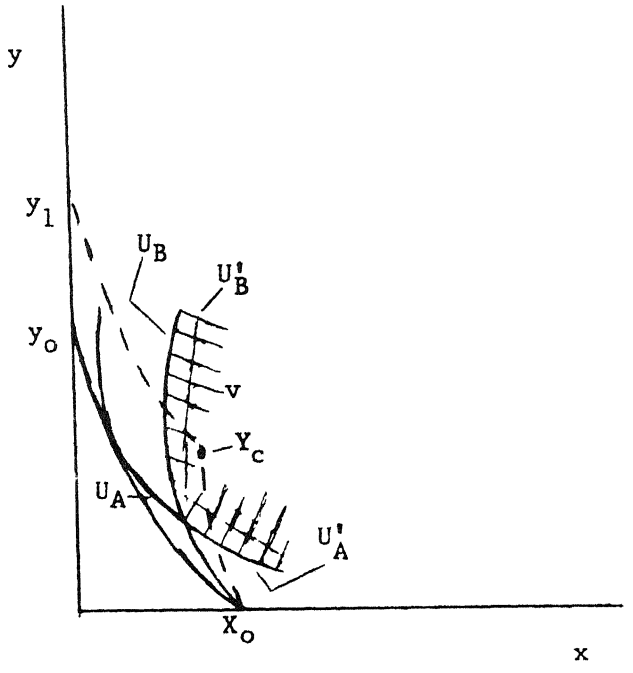

FIGURE 5

citizens beyond the level of supply under cooperation the relevant segment of the new production possibilities frontier is $y_c\ y_1$ since separate supply of y now has to be undertaken at a higher cost than under cooperation. A corner solution is derived and it is not likely that separate supply will be undertaken. The solution of cooperation is the solution of consolidation developed above. If income differences are allowed, the same conclusions that were arrived at under consolidation apply for the use of cooperation.

VI. Conclusions

The simple model developed is by no means a generalized model of consolidation and the supply of community services. It does, however, develop a framework for viewing alternative community service supply arrangements and their implications for expanding the consumption bundles of citizens which may include community services. Some of the reasons, in a welfare context, for the lack of mass consolidation in the U. S. have been pointed out by the operation of the model. The public good case; i.e., externalities and the gains from internalization, has not been incorporated into the model but the case of declining cost production of community services and gains from cost reductions has been included.

In particular, the analysis leads to the conclusion that, first, consolidation in order to take advantage of cost reductions may not result in gains to all, and further, depends on the income and taste differences of communities and the degree of cost reduction in the consolidation. Second, when consolidation is not Pareto-preferred to separate community service supply, cost reductions can be gained by agreement by communities to allow a semi-autonomous firm to supply services at least cost or at levels approaching least cost supply. Where feasible, this form of supply

is Pareto-preferable to separate supply irrespective of income and preference differences between communities. The community still maintains a degree of autonomy separate of other communities.

Community cooperation under the assumptions of the simple model developed becomes the same solution in terms of community service supply level as in the case of consolidation. Wherever consolidation is Pareto-preferable to separate supply so also is cooperation. It is highly unlikely that any one community will desire to augment its supply of community services beyond the level of cooperative or consolidated supply because of the higher cost involved and the contraction of the consumption set.

This paper has also pointed up some areas needing further analysis. Further generalization of the model is needed. Investigation of supply implications of models for particular community services needs to be done. The case of externalities and public good supply, though covered by others, needs to be analyzed further. The public investment decision and public versus mixed public-private goods delivery needs to be related to the concept of economic growth and technological advance. Further analysis of the possibilities of developing private mechanisms for the delivery of public-type services and policy directed to such delivery needs also to be done.

BIBLIOGRAPHY

1. Advisory Commission on Intergovernmental Relations, Metropolitan America: Challenge to Federalism, Washington, D. C., October, 1966.

2. Burkhead, J., Input and Output in Large City High Schools, Syracuse: Syracuse University Press, 1967.

3. Cohen, H. A.,"Variations in the Cost Among Hospitals of Different Sizes," Southern Economic Journal, Vol. 33 (January, 1967), pp. 355-366.

4. Cosgrove, M. H. and L. J. Hushak, Costs and Quality of Water in Ohio Cities, Ohio Agricultural Research and Development Center, Research Bulletin 1052, April, 1972.

5. Hirsch, W. Z., "Expenditure Implications of Metropolitan Growth and Consolidation," Review of Economics and Statistics, Vol. 41, (August, 1959), pp. 232-241.

6. _____, "Local Versus Areawide Urban Government Services," National Tax Journal, Vol. 17, (December, 1964), pp. 331-339.

7. Isard, W. and R. E. Coughlin, Municipal Costs and Revenues, Wellesley, Massachusetts: Chandler-Davis, 1957.

8. Johnston, J., Statistical Cost Analysis, New York: McGraw-Hill, 1960.

9. Kneese, A. V. and B. T. Bower, Managing Water Quality: Economics, Technology, Institutions, Baltimore: Johns Hopkins Press, 1968.

10. Netzer, D., "Federal, State, and Local Finance," in H. S. Perloff and L. Wingo (eds.), Issues in Urban Economics, Baltimore: Johns Hopkins Press, 1968.

11. Riew, J.,"Economics of Scale in High School Operation," Review of Economics and Statistics, Vol. 48, (August, 1966), pp. 280-287.

12. Ro, K. K.,"Determinants of Hospital Costs," Yale Economic Essays, Vol. 8 (Fall, 1968), pp. 241-253.

13. Tiebout, C. M., "A Pure Theory of Local Expenditures," Journal of Political Economy, Vol. 54 (October, 1956), pp. 416-424.

14. _____, "Economies of Scale and Metropolitan Governments," Review of Economics and Statistics, Vol. 42 (November, 1960), pp. 442-444.

15. Will, R. E., "Scalar Economies and Urban Service Requirements," Yale Economic Essays, Vol. 5, (Spring, 1965), pp. 1-62.