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A Model of Local Fiscal Choice

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Foreword

In this paper Shyam Nath and Brijesh C. Purohit construct and empirically test a model of local fiscal choice that includes two types of choices—the first between publicly provided and privately provided local goods and the second between the fiscal decision-makers' choice between own-source and externally financing of expenditures. The theoretical model is based on utility maximization of a community welfare function. Empirical estimates of the model are based on aggregate local expenditure and revenue data at the state-level in India for the period 1960-1984. The results support the empirical validity of the model and suggest that increases in income commonly resulted in supplemental private financing of local expenditures on "public" goods and a substitution of grants for own-source revenues.

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Larry Schroeder
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May 1990

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Introduction

Public provision of local goods confronts two types of choices which have direct bearing on their supply and in turn on social welfare, namely, citizen-voters' choice between publicly provided and privately provided local goods and local decision makers' choice between own funds and other funds to finance expenditures on local goods. Citizens may respond to public provision in three distinct ways: by increasing demand for publicly provided local goods; by substituting them by privately provided goods (e.g., by shifting away from municipal schools to private schools or from municipal tap water to own tubewell supply) or by supplementing deficient public supply with private supply. Substitution and supplementing possibilities exist because of the merit goods nature of certain local goods which essentially are private goods. Studies confirm local government expenditures on merit goods influencing their private consumption.[1] Supply responses to citizens' preferences for merit goods can occur through non-profit private organizations, voluntary organizations, private firms or citizens themselves.[2]

The second kind of choice process involves local decision makers' preference for grants as against own resources. Preference for grants originates in the contention that a part of the

[1]See, for instance, G. Cerea, "Public Expenditure and Decisions on Private Consumption," *Public Finance*, Vol. 62, No. 5 (1982): 891-901.

[2]Robert Warren, Mark S. Rosentraub, and Louis F. Weschler, "A Community Services Budget, Public, Private and Third Sector Roles in Urban Services," *Urban Affairs Quarterly*, Vol. 23, No. 3 (1988): 414-431.

additional local tax burdens may be shifted to non-residents when spending and taxing decisions are separated.[3] On the other hand, in order to minimize uncertainty in local service provision emanating from unpredictable nature of grants, local governments have tended to base their expenditure decisions on own funds.[4]

This paper attempts to incorporate the responses of local residents as well as local authorities into a model of local fiscal choice. It seeks to capture empirically the substitution possibilities between publicly and privately provided local goods and between own resources and other funds. The plan of the paper is as follows. The following section presents our model and highlights its merits in explaining citizens' response to public provision and local government preference for own funds. The details pertaining to various data sources comprise the third section. The empirical results using time-series data for selected municipal corporations and state aggregate of municipal corporations have been discussed in the fourth section. The final section summarizes the conclusions and emerging implications.

The Model of Local Fiscal Choice

We assume that a typical rational citizen-consumer derives utility from public and private provisions of local public goods and other public and private goods. A higher demand for public provision means higher citizens' preference and willingness to pay for publicly provided local services. If, because of dissatisfaction, the resident consumer wants to substitute the public

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[3]Stanley L. Winer, "Some Evidence on the Effect of the Separation of Spending and Taxing Decisions," *Journal of Political Economy*, Vol. 91, No. 1 (1983): 126-140.

[4]Larry Schroeder, "Effects of Business Cycles on City Finances—Insider's Views," Metropolitan Studies Program Occasional Paper No. 93, The Maxwell School (Syracuse, NY: Syracuse University, January 1985).

provisions of local goods by private provision, he is required to spend a higher amount on local goods. In other words, the consumer should be prepared to pay more for privately provided local services. It is also assumed that local bodies catering to the needs of the local residents can make use of any of the three resources: (1) own revenue sources comprising taxes and fees; (2) grants; and (3) borrowing. The local decision maker may in the process tend to substitute one source for the other.

We have chosen the community's welfare function to incorporate explicitly the two substitution possibilities, namely, between private and public provision of local goods and between own and other sources of funds The utility function of the community is taken to be represented by a nested CES function of the following form:[5]

$$U = \{c[a_1 Ex^{-\beta_1} + (1-a_1)\{b_1 Ad^{-\beta_1} + (1-b_1)Br^{-\beta_1}\}]^{-\beta/\beta_1} + (1-c)(Y-TNX)^{-\beta_1}\}^{-d/\beta} \qquad (1)$$

where

EX = Local government expenditures on current and capital accounts

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[5]In the literature on urban local finance, utility is usually specified as function of either goods or expenditures on the goods. The instances of former type include T.E. Borcherding and R.T. Deacon, "The Demand for the Services of Non-Federal Governments," *American Economic Review*, Vol. 62, No. 5 (1972): 891-901; D.A. Kenyon, "Preference Revelation and Supply Response in the Arena of Local Government, "*Public Choice*, Vol. 42, No. 2 (1984): 147-160; R.A. McGuire, R.L. Ohsfeldt and T.N. Van Cott, "The Determinants of the Choice between Public and Private Production of Publicly Funded Service," *Public Choice*, Vol. 54, No. 3 (1987): 211-230. The latter type of specification could be seen J.M. Henderson, "Local Government Expenditures: A Social Welfare Analysis," *Review of Economics and Statistics*, Vol. 50, No. 2 (1968): 156-163; E.M. Gramlich, "Alternative Federal Policies for Stimulating State and Local Expenditures: A Comparison of their Effects," *National Tax Journal*, Vol. xxi, No. 2 (1968): 119-123; and E.M. Gramlich. "State and Local Governments and their Budget Constraint," *International Economic Review*, Vol. x, No. 2 (1969): 163-182.

Ad	=	Grants-in-Aid
Br	=	Borrowings
Y-TNX	=	Personal disposable income after local taxes and fees (includes taxes paid to Central and State governments)

where

Y	=	Community's per capita income
TNX	=	Per capitalocal taxes and fees

a_1, b_1, c are distribution parameters; $0<a_1, b_1<1, c<1$

The distribution parameters c and (1-c) respectively depict the allocation of community's income between public provision of goods and private goods. The parameters a_1 and $(1-a_1)$ denote the distribution between own and other sources of funds. The distribution of financing of local expenditures between aid and borrowings is denoted by b_1 and $1-b_1$. β and β_1 are substitution parameters.

The budget constraint of the local decision maker is defined as:

$$Ex = TNX + Ad + Br \tag{2}$$

Using (1) and (2), and forming the Lagrange function we have:

$$L = \left[c\left(a_1 Ex^{-\beta_1} - (1-a_1)b_1 Ad^{-\beta_1} + (1-b_1)Br^{-\beta_1}\right)^{-\beta/\beta_1} + (1-c)(Y-TNX)^{-\beta}\right]^{-d/\beta} \cdot$$
$$+\lambda(TNX+Ad+Br-Ex)$$

Setting the first order partial derivatives equal to zero gives:

$$\frac{\partial L}{\partial Ex} = -\left(\frac{d}{\beta}\right)(CES)^{-d/\beta-1}(c)(CES_1)^{-\beta/\beta_1(-\beta/\beta_1)}\, a_1(-\beta_1)Ex^{-\beta_1-1} - \lambda = 0 \tag{3}$$

$$\frac{\partial L}{\partial TNX} = \left(\frac{d}{\beta}\right)(CES)^{-d/\beta-1}(1-c)(-\beta)(Y-TNX)^{-\beta-1}+\lambda = 0 \qquad (4)$$

$$\frac{\partial L}{\partial Ad} = \left[-\left(\frac{d}{\beta}\right)(CES)^{-d/\beta-1}\right](c)(-\beta/\beta_1)(CES_1)^{-\beta/\beta_1-1}(a_1-1)(-\beta_1)(b_1)Ad^{-\beta_1-1}+\lambda = 0 \qquad (5)$$

where $CES = c\left[a_1Ex^{-\beta_1} - (1-a)\left[b_1Ad^{-\beta_1} + (1-b)Br-\beta_1\right]\right]^{-\beta/\beta_1} + (1-c)(Y-TNX)^{-\beta}$

and $CES_1 = a_1Ex^{-\beta_1}-(1-a)\left[b_1Ad^{-\beta_1}+(1-b_1)Br^{-\beta_1}\right]$

Solving equations (1) to (5) and taking logs we get[6]

$$\log\, Ex = \frac{\beta(\beta+\beta_1)}{\beta_1^2(1+\beta_1)}\log\left[\frac{a_1^{1/1+\beta_1}((1-a_1)b_1)^{1/1+b}}{(b_1(1-a_1))^{\beta_1/1+\beta_1}} + (1-b_1)x^{-\beta_1}\right]$$

$$+ (1+\beta_1)\log\left(\frac{c-1}{a_1c}\right) + \frac{1+\beta}{1+\beta_1}\log\,(Y-TNX) + \frac{(-\beta)(\beta+\beta_1)}{\beta_1(1+\beta_1)}\log\, Ad$$

or

$$\log\, Ex = A_0+A_1\log\,(Y-TNX)+A_2\log\, Ad$$

where

[6]The algebraic solution of these equations is presented in Appendix A.

$$A_0 = \frac{\beta(\beta+\beta_1)}{\beta_1^2(1+\beta_1)} \log \left[\frac{a_1^{1/1+\beta_1}((1-a_1)b_1)^{1/1+b}}{(b_1(1-a_1))^{-\beta_1/1+\beta_1}} + (1-b_1)x^{-\beta_1} \right]$$

$$+ (1+\beta_1) \log \left(\frac{c-1}{a_1 c} \right)$$

$$A_1 = \frac{1+\beta}{1+\beta_1}$$

$$A_2 = \frac{(-\beta)(\beta+\beta_1)}{\beta_1(1+\beta_1)}$$

Using the above values of impact coefficients, it is possible to obtain the values of substitution parameters and respective substitution elasticities.[7] Substitution elasticity between privately provided and publicly provided local public goods (σ) denotes responsiveness of private provision to changes in public provision. Substitution elasticity between own funds and other funds (σ_1) measures responsiveness of own funds to changes in other funds.

The following features of our model are worth mentioning. The estimates of this model will throw light on the process by which the local choices are being determined on account of their sensitivity to supply constraints. For instance, if the desired level of services expected from local bodies is not available, the local residents may turn to private suppliers/contractors. This choice could, however, be exercised either by replacing goods provided by public sources or supplementing them with privately supplied goods. Conversely, a better quality of local public services may change a typical local consumer's preference in favor of goods provided by public sources. These possibilities could be captured by values of σ. The possibility of substitution by local bodies themselves of one source of finance with the other in providing services to local

[7]The formulae and derivation of these substitution parameters are presented in Appendix B.

residents can be ascertained by using values of σ_1. In fact the chances of variations in tax efforts of local bodies will be dictated, in the first instance, with the existence of a substitution possibility between own sources and other sources of finance. Thus a higher value of σ_1 should indicate a higher tax effort and vice versa.

Any movement of substitution elasticity above or below unity would determine the nature of process. In this framework any value of the elasticity coefficient exceeding unity would represent responsiveness indicating a substitution process. Conversely, any value of the elasticity coefficient less than unity indicates a lack of responsiveness and would mean a supplementing process.

Information and Data Base

Local public services in India comprise primary (sometimes middle) education, primary health care and prevention of disease, water supply, drainage, sanitation, public safety, street lighting and maintenance of parks, roads and buildings. Most of these services can also be supplied privately, if not fully, possibly partly, but only at a higher cost. Wherever private provision is not forthcoming, particularly in road and drainage maintenance, citizens suffer without better facilities. Thus in both situations citizen-voters' utility function is adversely affected. In the first event, high service costs are involved whereas in the second services deteriorate. Public provision of local goods is financed by local government own revenues and grants. The latter is awarded on a per capita basis. Matching grants which generate incentives to spend more on particular services to get more do not exist in India.

Keeping in view the nature of services provided and the mode of grant financing of local services, the analysis has been carried out in terms of aggregate local expenditures on services.

For the purpose of the empirical exercise, the data for most of the municipal corporations or their state aggregates cover the period 1960-1984. The information on the tax and non-tax revenue, grants and expenditures variables have been collected from *Statistical Abstracts* published by Central Statistical Organisation, Government of India. Because of the non-availability of data on per capita urban income, this variable is computed by using the information available from *National Accounts Statistics*. The computations have been carried out by dividing the component of national income from non-primary sector at the state level by the respective state population. This state average for per capita urban income is assumed to hold for all cities within these states. Per capita disposable income is derived by deducting per capita local taxes and fees from the per capita urban income.

Empirical Results

The empirical results pertaining to our model are presented in Table 1. Generally, statistical fits of regression equations are satisfactory.[8] Results using personal income, instead of personal disposable income, do not vary significantly (see Table 2). The substitution elasticities (derived from impact elasticity coefficients) are presented in Table 3. These provide interesting insight into the decision making process of local residents as well as of local decision makers.

[8]Excepting a very few cases, values of the DW statistic do not indicate any autocorrelation

TABLE 1
LOG LINEAR REGRESSIONS
(Dependent variable PC Total Revenue Expenditure)

Corporation/ State	Intercept	PCDPI	PCGR	R^2	R^{-2}	F	DW	DF
Trivandrum	-2.305 (-3.45)	0.672 (7.440)	0.555 (5.790)	0.896	0.894	82.723	1.716	19
Gwalior	-5.191 (-11.491)	1.160 (17.814)	-0.013 (-0.324)	0.960	0.959	245.226	1.175	20
Indore	-5.998 (-10.505)	1.340 (16.842)	0.029 (1.648)	0.954	0.953	211.985	1.454	20
Raipur	-2.784 (-2.807)	0.951 (6.172)	-0.153 (-1.397)	0.859	0.856	39.710	1.566	13
Ujjain	-3.507 (-1.786)	0.882 (3.061)	-0.015 (-0.177)	0.776	0.771	36.466	1.540	21
Ahmedabad	-3.520 (-4.018)	1.066 (7.372)	0.023 (0.228)	0.934	0.984	684.668	0.719	21
Baroda	-2.881 (-5.864)	0.934 (10.899)	0.128 (1.749)	0.982	0.981	356.603	1.260	13
Bangalore	-3.841 (-4.681)	1.088 (5.324)	-0.0001 (-0.005)	0.920	0.917	121.022	2.301	21
Dharwar	0.247 (0.523)	0.626 (7.203)	0.063 (1.134)	0.959	0.957	222.934	1.374	19
Calicut	-4.143 (-9.014)	0.964 (15.724)	-0.048 (-1.511)	0.954	0.952	208.529	1.034	20
Cochin	-7.265 (-1.906)	1.34 (2.632)	0.268 (0.862)	0.526	0.512	6.102	1.812	11
Nagpur	-0.859 (-0.954)	0.565 (3.960)	0.327 (2.968)	0.948	0.946	191.664	1.170	21
Pune	-18.681 (-1.996)	3.832 (2.488)	-3.344 (-2.671)	0.256	0.240	3.619	1.278	21
Sholapur	1.003 (1.00)	0.248 (1.528)	0.607 (4.439)	0.923	0.922	127.635	1.384	21
Agra	-1.826 (-3.299)	0.722 (9.749)	0.137 (1.406)	0.827	0.824	50.536	1.098	21
Allahabad	-3.405 (-4.059)	0.961 (8.563)	-0.094 (-1.118)	0.915	0.913	114.118	2.737	21
Bombay	-3.553 (-14.267)	1.085 (29.193)	-0.015 (-0.493)	0.993	0.993	1809.002	1.943	22

Table 1 continues....

TABLE 1
LOG LINEAR REGRESSIONS
(Dependent variable PC Total Revenue Expenditure)

Corporation/ State	Intercept	PCDPI	PCGR	R^2	R^{-2}	F	DW	DF
Lucknow	-2.469 (-6.313)	0.744 (9.700)	0.282 (1.719)	0.946	0.945	168.476	1.025	19
Varanasi	-0.520 (-1.060)	0.511 (5.890)	0.156 (1.614)	0.901	0.898	86.517	0.875	19
Calcutta	-2.612 (-4.401)	0.80 (9.029)	0.094 (1.575)	0.971	0.970	319.942	1.225	19
Chandanagore	-1.907 (4.044)	0.516 (5.968)	0.576 (9.032)	0.988	0.988	804.812	1.944	19
Simla	-0.446 (-0.615)	0.569 (6.178)	0.044 (1.058)	0.884	0.882	38.288	2.093	10
Madras	-3.661 (-8.193)	1.093 (16.441)	0.003 (0.104)	0.975	0.974	178.431	1.751	9
Gujarat	0.074 (0.097)	0.414 (3.079)	0.535 (4.432)	0.976	0.976	230.611	1.462	11
Karnataka	-3.314 (-3.833)	1.024 (8.108)	0.023 (0.564)	0.934	0.933	150.224	2.264	21
Kerala	-3.873 (-3.227)	0.893 (5.515)	0.262 (2.490)	0.910	0.908	96.232	1.790	19
Madhya Pradesh	-4.808 (-5.067)	1.117 (8.049)	0.073 (1.533)	0.960	0.959	242.457	1.144	20
Maharashtra	-3.341 (-11.466)	1.035 (22.816)	-0.019 (-0.478)	0.994	0.994	1964.876	1.900	22
West Bengal	-2.575 (-4.309)	0.832 (8.833)	0.102 (2.091)	0.971	0.971	325.742	1.216	19

Notes: PCDPI = Per capita disposable urban income. PCGR = Per capita grants.

SOURCE: Estimated.

TABLE 2
LOG LINEAR REGRESSIONS (Alternative Specification)
(Dependent variable PC Total Revenue Expenditure)

Corporation/ State	Intercept	UI	PCGR	R^2	$\bar{R}^2$	F	DW	DF
Trivandrum	-2.320 (-3.473)	0.673 (7.466)	0.552 (3.262)	0.857	0.894	83.207	1.720	19
Gwalior	-5.184 (-11.596)	1.156 (17.985)	-0.013 (-0.315)	0.961	0.960	249.869	1.184	20
Indore	-6.063 (-10.527)	1.344 (16.51)	0.032 (1.835)	0.954	0.953	211.218	1.44	20
Raipur	-2.882 (-2.945)	0.961 (6.355)	-0.153 (-1.435)	0.865	0.862	41.779	1.592	13
Ujjain	-3.593 (-1.836)	0.891 (3.115)	-0.014 (-0.174)	0.778	0.774	36.987	1.542	21
Ahmedabad	-3.697 (-4.203)	1.087 (7.543)	0.008 (0.079)	0.985	0.984	708.155	0.72	21
Baroda	-2.919 (-6.058)	0.936 (11.192)	0.123 (1.709)	0.982 8	0.982 3	374.426	1.248	13
Bangalore	-3.914 (-4.760)	1.093 (9.391)	0.001 (0.005)	0.921	0.978	122.561	2.327	21
Dharwar	0.0002 (0.0006)	0.635 (7.680)	0.060 (1.129)	0.962	0.961	246.222	1.439	13
Calicut	-4.176 (-9.150)	0.967 (15.906)	-0.048 (-1.511)	0.955	0.953	213.257	1.039	20
Cochin	-7.284 (-1.924)	1.334 (2.656)	0.266 (0.857)	0.529	0.515	6.186	1.807	11
Nagpur	-0.911 (-1.007)	0.571 (4.001)	0.323 (2.940)	0.948	0.947	133.443	1.170	21
Pune	-19.084 (-2.032)	3.879 (2.522)	-3.389 (-2.704)	0.260	0.244	3.708	1.289	21
Sholapur	0.883 (0.864)	0.267 (1.617)	0.593 (4.287)	0.924	0.923	129.296	1.372	21
Agra	-1.883 (-3.408)	0.728 (9.868)	0.135 (1.400)	0.831	0.827	51.770	1.109	21
Allahabad	-3.491 (-4.175)	0.970 (8.690)	-0.098 (-1.173)	0.917	0.915	117.032	2.752	21
Bombay	-3.560 (-14.658)	1.079 (29.961)	-0.018 (-0.582)	0.994	0.994	1903.569	1.986	22

Table 2 continues....

TABLE 2
LOG LINEAR REGRESSIONS (Alternative Specification)
(Dependent variable PC Total Revenue Expenditure)

Corporation/ State	Intercept	UI	PCGR	R^2	R^{-2}	F	DW	DF
Lucknow	-2.470 (-6.376)	0.743 (9.799)	0.276 (1.693)	0.947	0.946	171.514	1.023	19
Varanasi	-0.560. (-1.132)	0.515 (5.926)	0.154 (1.598)	0.901	0.899	87.289	0.880	19
Calcutta	-2.635 (-4.512)	0.840 (9.215)	0.095 (2.058)	0.972	0.971	331.087	1.243	19
Chandanagore	-1.922 (-4.109)	0.518 (6.050)	0.573 (9.044)	0.988	0.988	819.467	1.941	19
Simla	-0.419 (-0.581)	0.565 (6.180)	0.045 (1.067)	0.884	0.882	38.312	2.085	10
Madras	-3.718 (-8.511)	1.094 (16.949)	0.003 (0.112)	0.976	0.976	189.528	1.767	9
Gujarat	-0.056 (-0.073)	0.434 (3.184)	0.518 (4.252)	0.977	0.976	238.156	1.439	11
Karnataka	-3.407 (-3.926)	1.032 (8.184)	0.022 (0.550)	0.935	0.934	152.516	2.290	21
Madhya Pradesh	-4.808 (-5.154)	1.124 (8.049)	0.073 (1.533)	0.960	0.959	242.457	1.144	20
Maharashtra	-3.341 (-11.466)	1.037 (22.816)	-0.019 (-0.478)	0.994	0.994	1898.82	1.899	22

Notes: PCUI = Per capita urban income.

SOURCE: Estimated.

TABLE 3
SUBSTITUTION ELASTICITIES

Corporation/State	σ	σ_1
Trivandrum	1.379	0.887
Gwalior	0.862	1.000
Indore	0.746	1.000
Raipur	0.930	0.884
Ujjain	0.939	0.828
Ahmedabad	0.938	1.000
Baroda	1.037	0.969
Bangalore	0.919	1.000
Dharwar	0.928	0.581
Calicut	0.957	0.923
Cochin	0.746	1.000
Nagpur	1.183	0.668
Pune	0.261	1.000
Sholapur	2.576	0.638
Agra	0.994	0.717
Allahabad	0.932	0.895
Bombay	0.921	1.000
Lucknow	1.097	0.816
Varanasi	1.031	0.527
Calcutta	0.988	0.830
Chandanagore	1.490	0.769
Simla	0.907	0.516
Madras	0.914	1.000
Gujarat	1.633	0.676
Karnataka	0.976	1.000
Kerala	1.099	0.981
Madhya Pradesh	0.895	1.000
Maharashtra	0.966	1.000
West Bengal	0.991	0.824

SOURCE: Estimated.

Considering first the demand response of local residents associated with an income rise (which is denoted by impact elasticity coefficients of disposable income variable), we find that in 11 cases impact coefficient exceeds unity representing a stimulation of demand. However, there are 18 cases where no stimulation of demand is indicated by the impact coefficients. A comparison of these impact coefficients with substitution elasticities suggests that wherever there was a stimulation of demand, it was associated with a supplementing process (indicated by $\sigma<1$). Conversely, a similar comparison shows that wherever there was no stimulation of demand consequent upon income increase, the elasticity (of substitution) depicts a substitution process (as indicated by $\sigma>1$). The first set of results thus indicates that the supply response of public authorities toward an increased demand was inadequate and this left the people with no other option but to supplement by private means. The second set of results can be interpreted to mean that the substitution by private provisions was resorted to only where the income increase did not generate adequate collective demand for public provision of local goods. This result is plausible if income distribution of a locality is skewed toward low income strata which did not raise enough demand for public services or if the regional location of a municipality, for instance in a backward or hilly region, forbids sufficient inflow of local government investment.

Coming to the other set of results, the impact coefficient of grant does not exceed unity for any of the local bodies considered here. Apparently this denotes that because of grants, local bodies do not fully exploit their own resources.[9] A part of an increase in grants is therefore associated with a tax concession to local residents. A glance at the substitution elasticities,

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[9]Many of the impact coefficients on grant are statistically insignificant. These may be taken to indicate substitution; see George A. Bishop, "Stimulative vs. Substitutive Effects of State School Aid in New England," *National Tax Journal* Vol. xvii, No. 2 (1964): 133-143.

however, reveals by and large a tendency to supplement own resources either *pro rata* or by more than increases in grants.[10] In fact, in as many as 16 cases, the value of σ_1 just equals unity, denoting a tendency to supplement own funds *pro rata* to grants (Table 3). In another two cases, where σ_1 is less than unity, this supplementing seems to exceed increases in grants. The evidence on favoring substitution of own funds in place of grants, as reflected by σ_1 exceeding unity, emerges only for eight cases. From these results, the dampening impact of grants on local expenditures as denoted by impact coefficients is reaffirmed in nearly 60 percent of the cases by the values of substitution elasticities exceeding unity. The remaining cases—where either substitution of own resources for grants is indicated or supplementing from own funds by more than the increases in grants is depicted—are representative of a situation where institutional rigidities seem to stifle the higher willingness to tax.

Conclusions

The results of this exercise establish the empirical validity of our model which covers the local choice in regard to public and private provisions and local decision makers' choice in terms of own funds and grants. The results, in general, show both the processes, namely supplementing as well as substituting. In case of local residents, any increase in demand usually resulted in a supplementing from private means on account of inadequate response of public authorities. However, when an increase in income did not generate enough collective demand for public goods, a substitution by private means is evident. In the case of local decision makers, the

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[10] It should, however, be noted that no ambiguity creeps in to interpreting substitution elasticities as the way of interpreting them is not the same as the way in which impact coefficients are usually interpreted.

dampening impact of grants on the raising of own resources is reaffirmed in nearly 60 percent of the cases by the values of substitution elasticities. Thus, generally there is a tendency indicated on the part of local decision makers to supplement own resources *pro rata* to an increase in grants. Whenever a tendency to increase own resources for supplementing more than proportionate to an increase in grants or a tendency to substitute own funds in place of grants is visible, it is seemingly stifled by the prevalence of institutional rigidities. These interesting results, in fact, also suggest a possible extension of present analysis in quantifying the welfare implications of a decision making process generated specifically through local governmental expenditures.

Appendix A

From (3) and (5) we have:

$$-\left[\left(\frac{d}{\beta}\right)(CES)^{-d/\beta-1}\right]\cdot(c)(CES_1)^{-\beta/\beta_1-1}(-\beta/\beta_1)\cdot a_1(-\beta_1)Ex^{-\beta_1-1}$$

$$=\left[\left(\frac{d}{\beta}\right)(CES)^{-d/\beta-1}\right](c)(-\beta/\beta_1)(CES_1)^{-\beta/\beta}(a_1-1)(-\beta_1)(b_1)Ad^{-\beta_1-1}$$

or $a_1\beta_1 Ex^{-(1+\beta_1)} = (1-a_1)(b_1\beta_1)Ad$

or $a_1 Ex^{-(1+\beta_1)} = b_1(1-a_1)Ad$

or $a_1 Ad^{(1+\beta_1)} = b_1(1-a_1)Ex$

or

$$Ex = \left[\frac{a_1}{b_1(1-a_1)}\right]^{1/1+\beta_1} Ad \qquad \textbf{(6)}$$

From (3) and (4) we have:

$$-\left[\left(\frac{d}{\beta}\right)(CES)^{-d/\beta-1}\right]\cdot(c)(CES_1)^{-\beta/\beta_1-1}(-\beta/\beta_1)\cdot a_1(-\beta_1)Ex^{-\beta_1-1}$$

$$=\left[\left(\frac{d}{\beta}\right)(CES)^{-d/\beta-1}(1-c)(-\beta)(Y-TNX)^{-\beta-1}(-1)\right]$$

or $(-c)(-\beta/\beta_1)(a_1)(-\beta_1)(CES_1)^{-(1+\beta/\beta_1)}Ex^{-(1+\beta_1)} = \beta(1-c)(Y-TNX)^{-(1+\beta)}$

or $-(a_1c)(\beta)(CES_1)^{-(1+\beta/\beta_1)}Ex^{-(1+\beta_1)} = \beta(1-c)(Y-TNX)^{-(1+\beta)}$

$$\frac{-a_1c}{(CES_1)^{(1+\beta/\beta_1)}Ex^{(1+\beta_1)}} = \frac{1-c}{(Y-TNX)^{(1-\beta)}}$$

or

$$Ex = \left(\frac{a_1c}{-1+c}\right)^{(1/1+\beta_1)} (CES_1)^{(1+\beta/\beta_1)/(1+\beta_1)}(Y-TNX)^{(1+\beta)(1+\beta_1)}$$

Substituting the value of CES_1, we get

$$Ex = \left[a_1Ex^{-\beta_1}(1-a_1)\left(b_1Ad^{-\beta_1}+(1-b_1)Br^{-\beta_1}\right)\right]^{\beta(\beta+\beta_1)/\beta_1^2(1+\beta_1)}$$
$$\left(\frac{c-1}{a_1c}\right)(Y-TNX)^{(1+\beta)/(1+\beta_1)}$$

Using (6) and assuming (where x denotes some fixed percentage) Br = x Ad, we get after taking logs:

$$\log Ex = \frac{\beta(\beta+\beta_1)}{\beta_1^2(1+\beta_1)} \log \left[\left(\frac{a_1^{1/1+\beta_1}-((1-a_1)(b_1))^{1/1+b_1}}{(b_1(1-a_1))^{-\beta_1/1+\beta_1}}\right)Ad^{-\beta_1}+(1-b_1)x^{-\beta_1}Ad^{-\beta_1}\right]$$
$$+(1+\beta_1)\log\frac{(c-1)}{a_1c} + \left(\frac{1+\beta}{1+\beta_1}\right)\log\,(Y-TNX)$$

or

$$\log Ex = \frac{\beta(\beta+\beta_1)}{\beta_1^2(1+\beta_1)} \log \left[\frac{a_1^{1/1+\beta_1} - ((1-a_1)(b_1))^{1/1+b_1}}{(b_1(1-a_1))^{-\beta_1/1+\beta_1}} + (1-b_1)^{-\beta_1} x \right]$$

$$+ \frac{\beta(\beta+\beta_1)}{\beta_1^2(1+\beta_1)} \log Ad + (1+\beta_1) \log \frac{c-1}{a_1 c} + \frac{1+\beta}{1+\beta_1} \log (Y-TNX)$$

or

$$\log Ex = \frac{\beta(\beta+\beta_1)}{\beta_1^2(1+\beta_1)} \log \left[\frac{a_1^{1/1+\beta_1} - ((1-a_1)(b_1))^{1/1+b_1}}{(b_1(1-a_1))^{\beta_1/1+\beta_1}} + (1-b_1)^{-\beta_1} - x \right]$$

$$+ (1+\beta_1) \log \frac{c-1}{a_1 c} + \frac{-\beta(\beta+\beta_1)}{\beta_1(1+\beta_1)} \log Ad + \frac{1+\beta}{1+\beta_1} \log (Y-TNX)$$

or

$$\log Ex = A_0 + A_1 \log (Y-TNX) + A_2 \log Ad$$

where

$$A_0 = \frac{\beta(\beta+\beta_1)}{\beta_1^2(1+\beta_1)} \log \left[\frac{a_1^{1/1+\beta_1} - ((1-a_1)(b_1))^{1/1+b_1}}{(b_1(1-a_1))^{-\beta_1/1+\beta_1}} + (1-b_1)^{-\beta_1} x \right] + (1+\beta_1) \log \frac{c-1}{a_1 c}$$

$$A_1 = \frac{1+\beta}{1+\beta_1}$$

$$A_2 = \frac{-\beta(\beta+\beta_1)}{\beta_1(1+\beta_1)}$$

As a special case where borrowing is not permissible, i.e., if we assume $Br = 0$, we get:

$$A_0 = \frac{\beta(\beta+\beta_1)}{\beta_1^2(1+\beta_1)} \log \left[\frac{a_1^{1/1+\beta_1} + ((1-a_1)(b_1))^{1/1+\beta_1}}{(b_1(1-a_1))^{-\beta_1/1+\beta_1}} \right] + (1+\beta_1) \log \frac{c-1}{a_1 c}$$

and A^1 and A^2 as above.

Appendix B

$$A_1 = \frac{1+\beta}{1+\beta_1}$$

or

$$(1+\beta_1)A_1 = 1+\beta$$

or

$$\beta = \left[(1+\beta_1)A_1\right] - 1 \equiv R_1$$

$$A_2 = \frac{-\beta(\beta+\beta_1)}{\beta_1(1+\beta_1)}$$

or

$$A_2 = \frac{[1-(1+\beta_1)A_1][(1+\beta_1)A_1-1+\beta_1]}{\beta_1(1+\beta_1)} \equiv R_2$$

Solving R_2 we get:

$$\beta_1^2 - \frac{(1-2A_1^2+A_1-A_2)}{(A_1^2+A_1+A_2)}\beta_1 - \frac{(2A_1-A_1^2-1)}{(A_1^2+A_1+A_2)} = 0 \equiv R_3$$

The roots of R_3 yield

$$\beta_1 = \frac{(1-2A_1^2+A_1-A_2)}{(A_1^2+A_1+A_2)} \pm \sqrt{\frac{\left[\dfrac{1-2A_1^2+A_1-A_2}{A_1^2A_1+A_2}\right]^2 + 4\dfrac{(2A_1-A_1^2-1)}{(A_1^2+A_1+A_2)}}{2}}$$

Using β and β_1, σs are derived as $\sigma = \dfrac{1}{1+\beta}$ and $\sigma_1 = \dfrac{1}{1+\beta_1}$

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