PUBLIC SECTOR INEFFICIENCY IN LARGE U.S. CITIES *

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ABSTRACT

Much of the economic analysis of local governments assumes that local policymakers operate in a competitive environment where cities produce a level of local public sector output that can be considered "efficient". Efficiency can be quantified as the highest value of local property tax base possible given the endogenous and exogenous inputs available to a city government. If a city is not producing the highest attainable property value, ceteris paribus, then it could be considered inefficient. In this paper we attempt to measure the relative efficiency of large city governments in the U.S. through the technique of production frontier analysis. In a second stage of our empirical analysis we regress the derived measure of relative inefficiency against variables that have been proposed as causes of public production inefficiency. Our results show that large city governments are operating at different degrees of efficiency and that many of the causal hypotheses advanced in this regard are empirically valid.

JEL Classification Codes: H00, H72, R00, R50

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I. INTRODUCTION

As begun by Tiebout (1956), much of the economic analysis of local governments has proposed that cities, operating in a competitive environment, produce an "efficient" level of public sector output (a level that satisfies the Samuelson, 1954, conditions for allocative efficiency). Other theories advanced in this literature argue for the "inefficiency" of public sector production (see Mueller, 1989). Studies have attempted to empirically test the hypothesis that real-world public sector production levels satisfy the Samuelson conditions (for examples see Brueckner, 1979 and 1982). This paper extends the empirical analysis of local public sector efficiency an additional step. Having determined the relative inefficiency of local public sector production for a sample of 49 large central cities in the United States, we test whether sources of varying inefficiencies are as predicted in the literature.

In this paper we first propose and test a method for measuring the relative efficiency of local public sector production through the use of aggregate city property values and the concept of a frontier production function. This method is based on an extension of Brueckner's theory (1979 and 1982) where migration could conceivably equalize residential utility and business profit levels across cities. The implication is that with freely mobile citizenry and commerce, the extent to which local governments are able to maximize the welfare of their citizens and enterprises, relative to the performance of competing governments, should be reflected in property values. Holding city area and structures constant, residence in the community with the more efficient government will be more desirable to citizens and business and this will be capitalized into higher property values, ceteris paribus. Likewise, less efficient communities are less desirable locations and should exhibit lower aggregate property values.

Brueckner (1979 and 1982) tests this hypothesis by checking if municipal expenditure exerts a significant influence on aggregate property value or median home property value in cities. He tests whether or not cities are producing at the peak of a concave relationship between local aggregate property value (on the vertical axis) and public spending (on the horizontal axis). The statistical insignificance of an expenditure coefficient in a regression explaining local property value is Brueckner's necessary condition to demonstrate that cities are producing at the peak of this relationship. In this paper we test whether or not local property values are maximized for a city's chosen level of expenditure. Our regression test involves an assessment of how far away each city is producing from the frontier of this concave relationship.

We slightly modify Brueckner's theory in order that it can be applied to large cities across the United States. In large cities, dispersed over the United States, the equalization of utilities and profits could only occur in the long run. We hypothesize that large cities have previously reached such a long-run equilibrium and the action of benevolent local policymakers, seeking to maximize the utility of a representative voter, has preserved the long-run equilibrium.

The actions of local policymakers are modeled as a production process whereby city property value is produced by local policymakers using endogenous and exogenous inputs.
Applying the concept of frontier production theory, we extract in a pooled regression analysis the fixed-effect coefficients for each city. These city-specific coefficients represent a measure of local public sector choices relative to a hypothetically efficient frontier. In a second-stage regression analysis we then separately relate the city fixed-effect coefficients to various measures of government structure, competition, size, fiscal mix, and bureaucracy. These explanatory variables are chosen as proxy measures of factors, advanced by others, that encourage or allow the pursuit of inefficient policies by city officials.

The next section presents our extension of Brueckner's model of property value determination. Sections III and IV contain a discussion of the estimating techniques employed and includes the empirical evidence. In Section V we present a brief summary and our conclusions.

II. MODEL[1]

To begin, assume that consumers have identical tastes indicated by:

$$u(z, q, x; e), \tag{1}$$

where z = local public good[2], q = housing services, x = composite commodity, and e = environment.

A benevolent local policymaker would set the level of the local public good such that the value of equation (1) attains a maximum.[3] In the long run, equilibrium is obtained when utility is uniform by income group across all cities. If policymakers continue to behave in a benevolent fashion in regard to setting the local level of q, and environment remains constant, then the long-run equilibrium persists indefinitely and utility in any city is just a function of income (y):[4]

$$u = h(y); \quad h_y > 0. \tag{2}$$

Given this situation, the consumption bundle of any consumer must satisfy:

$$u(z, q, x; e) = h(y). \tag{3}$$

The rent (R) for a dwelling allowing a given level of the local public good, housing quality, and local environmental quality is expected to adjust such that equation (3) holds.

The individual budget constraint of a city resident can be written as:

$$x(1+\alpha) + R + \phi z = y(1-\gamma-\sigma) \tag{4}$$

where α = rate of local general sales tax revenue derived from resident, ϕ = percentage of public good funded through current charges, γ = rate of other/miscellaneous local nonproperty tax revenue derived from residents[5], and σ = rate of overlapping county and state taxes.[6]

Using equation (4), equation (3) can be written as:

$$u\left[z, q, \left(y(1-\gamma-\sigma)-R-\phi z\right)/(1+\alpha); e\right] = h(y). \tag{5}$$

The consumer's bid-rent function then equals:

$$R = R(z, q; e, y, \alpha, \phi, \gamma, \sigma). \tag{6}$$

Assuming that a house has an infinite life, its value (v) then equals:

$$v = (R - \iota v)/\delta \quad \text{or,} \tag{7a}$$

$$v = R(z, q; e, y, \alpha, \phi, \gamma, \sigma)/(\delta + \iota) \tag{7b}$$

where ι = property tax rate and δ = discount rate.

The aggregate value of n residential (res) rental properties in a city equals:

$$\sum_{j=1}^{n} \left\{R\left(z, q_j; e, y_j, \alpha, \phi, \gamma, \sigma\right)/(\delta+\iota)\right\} = P_{res}. \tag{8}$$

Since in equilibrium owners and renters must be indifferent between tenure choice, equation (8) necessarily applies to all residential property.[7]

In regard to nonresidential (business) property, assume that labor, fixed structural capital (including land), nonstructural capital, the public good, and the environment all enter into its production process. Also assume that firms are identical and that the rental rate of nonstructural capital is fixed across cities while the wage rate can vary. At any given time the environment, public good, and structural capital are fixed in a city. A profit maximizing firm will therefore achieve an economic profit level equivalent to:

$$\pi = \pi(s, e, z, w), \tag{9}$$

where s = structural capital and w = wage rate.

In the long run, economic profits will be eliminated in any city through the bidding up or down of rents on structural capital. The rent for a business structure of size s must also then be equivalent to equation (9). Similar to equation (7b), the value of this business structure equals:

$$\pi(s, e, z, w)/(\delta + \iota). \tag{10}$$

If the city has m firms (bus), the city's aggregate value of property (P) can be written as:

$$P = P_{res} + P_{bus} = \sum_{i=1}^{n}\{R(z, q_i, ; e, y_i, \alpha, \phi, \gamma, \sigma)/(\delta + \iota)\} + \sum_{i=1}^{m}\{\pi_i(s, e, z, w)/(\delta + \iota)\} \tag{11}$$

Finally, a city's property tax system must raise enough revenue to finance local public good provision, less the revenue received from alternate sources. This balanced budget constraint is represented as:

$$\iota P = C(z, n, m) - G - T - F, \tag{12}$$

where G = intergovernmental revenue, T = local non-property tax revenue, F = fee revenue.[8]

Multiplying (11) by (δ + ι) and then using (12) to eliminate ιP yields:

$$P = \frac{1}{\delta}\left\{\sum_{i=1}^{n} R(z, q_i; e, y_i \alpha, \varphi, \gamma, \sigma) + \Pi + G + T + F - G(z, n, m)\right\}, \tag{13}$$

where Π = aggregate business rent.

As derived in Brueckner (1982); P_q, P_Π, and P_G are expected to be positive.[9] P_z is expected to equal zero when the sum of the marginal rates of substitution between the public good and the numeraire private good equals the public good's marginal cost (Samuelson condition). This occurs because R_z equals the marginal rate of substitution (u_z/u_x). P_z is then proportional to the sum of the MRS less C_z, i.e. the Samuelson public good condition. Since (13) is a strictly concave function of z, city property value is maximized when the Samuelson condition holds. This needs to be prefaced as efficiency conditional upon a fixed housing and structural business capital stock. If P_z is greater than zero, or P_z is less than zero, then it follows that the public good is respectively under or over provided, property value is not maximized, and conditional efficiency has not occurred.

III. ESTIMATING RELATIVE INEFFICIENCY

To analyze the technical efficiency of local governments, we begin with a production function represented by the following log-linear equation:

$$Y_{it} = \alpha + X_{it}\beta + \varepsilon_{it} - \mu_i, \qquad (14)$$

where i=1,2,...,N is an index of locality, and t=1,2,...,T is an index of time. The variable Y_{it} represents output (property tax base value) for city i at time t, X_{it} is a vector of K inputs, and ε_{it} is a random disturbance term (the stochastic assumptions about the model and the estimation technique are described in the appendix) The last component, μ_i with $\mu_i>0$, represents technical inefficiency, and is assumed to be fixed over time.[10] This specification is referred to in the literature as a stochastic frontier model (Aigner, et al., 1977).

Treating the inefficiency components as city specific constants[11], the formulation fits the general framework of panel data analysis (apart from the fact that the inefficiency term is one sided). In particular the model can be written as:

$$Y_{it} = \alpha_i + X_{it}\beta + \varepsilon_{it} \qquad (15)$$

where $\alpha_i = \alpha - \mu_i$ is a separate city effect. Estimation of the parameters α_i and β is straight forward (see appendix).

If we let $\hat{\alpha}_i$ and $\hat{\beta}$ denote the estimators of α_i and β respectively, then the inefficiency component of a specific city is estimated by

$$\hat{\mu}_i = \max_j\left(\hat{\alpha}_j\right) - \hat{\alpha}_i \qquad (16)$$

where i=1,2,...,N. In other words, differences in the intercepts are interpreted as differences in efficiency levels. In principle this procedure treats the most efficient city in our sample as 100 percent efficient.

It is of further interest in this study to test alternative theories that explain the differences in the efficiency levels. For that purpose we parametrize μ_i as

$$\mu_i = Z_i \gamma + v_i \qquad (17)$$

where Z_i is a vector of city specific variables which vary across cities and v_i is a disturbance term. Notice that the inefficiency levels were estimated conditional on within city variation. Therefore, in the above parametrization it is possible to exploit variation between cities. In other words, Z_i can also include variables from the X vector that have been averaged over time. Estimation of the coefficients of Z is possible via standard least squares procedures.

Equation (13) provides the basis of the first stage of our empirical work. A complete description of the estimation procedure is given in the appendix. We estimate equation (13) for 49 large central cities in the United States for the periods 1967, 1972, 1977, and 1982. The number of cities, and years gathered for, are constrained by the availability of comparable property base data across large U.S. cities.[12] As required by equation (13), we have also gathered proxy variables to represent z, q, e, y, $\Pi(m)$, G, $T(\alpha,\gamma)$, F (ϕ), σ, and n. The explanatory variables used in this stage of our regression analysis are described in Table 1. All nominal dollar values have been placed in real terms using the national c.p.i. deflator.

insert Table 1

The choice of most proxy variables for the explanatory variables in equation (13) is straightforward. The few exceptions are that z is proxied by total municipal non-education expenditures and total education expenditures. The purpose of separating out education expenditures is to control for city governments that also fund the provision of city public schools.

The larger the percentage of local expenditure devoted to education, the less that additional school taxes have to be levied on a city's property tax base, and the greater should be the value of the base.[13] The size and quality of the local housing property base (q) is controlled by the square miles within the city and the percentage of homes built in the last decade.[14]

A city's environmental quality (e) is difficult to quantify. After considering the available variables, and checking collinearity between different measures, we settled upon the two variables listed in Table 1.[15] Employment as a percentage of population gauges the non-residential character of the city. Our second proxy for the desirability of a city's location is the percentage of population African American.

We proxy for total nonresidential rent (Π) by using the ratio of a city's employment to its population. Since fee charges do not vary across residents, the percentage of the public good funded through fees (F) can be proxied by total fee revenue. The rate of overlapping taxes in a city (σ) is measured by total state and county taxes in the state divided by the number of homes. The inclusion of sales tax revenue and other/miscellaneous tax revenue (T) along with median income (y) proxies for the reliance of these cities on these two alternatives to the local property tax.

As described in the previous theory, total municipal non-education expenditures, expenditures on education, percentage of homes built in the last decade, intergovernmental revenue, other non-property tax and sales tax revenues, and local fee revenue must all be considered to be endogenously determined. Hence, a 2SLS estimation was performed in which the appropriate instruments included the remaining exogenous variables supplemented with average number of rooms in housing, percentage of employment in manufacturing, percentage homeowners, percentage of population greater than 65, percentage high school graduates, average January temperature, number of families per population, average daily wind-speed, average daily humidity, and annual number of days with precipitation of .01 inches or more.

The property base regression initially exhibited problems of heteroskedasticity. This was corrected in the final regression results presented in Table 2. The regression was estimated in log-linear form and all coefficients represent elasticities. The results largely confirm our a priori expectations. The right hand side variables that are statistically significant in the property tax base regression are each of the 49 separate city dummy variables, each of the three time dummies, total municipal non-education expenditures, percentage of homes built in the last decade, employment as a percentage of population, median income, fee revenue, overlapping taxes, number of homes, and area.

insert Table 2

Total municipal non-education expenditure is found to exert a significant negative influence on aggregate property value in large U.S. cities. As discussed in Brueckner (1982), and in our extension, this finding is a necessary condition to show that cities are not producing an efficient amount of local government production. In terms of the concave relationship between aggregate property value and municipal expenditures, this result indicates that the average large city government in our sample was producing greater than the optimal amount. As Brueckner has asserted, the statistical insignificance of total education expenditures could indicate that in the average large city in our sample, local education is being provided at a Samuelson-efficient level.

The higher a city's employment as a percentage of a city's population, the greater its aggregate property value. Cities with high ratios are likely dynamic employment centers with a greater percentages of non-residential property base. Holding all else constant, it is no surprise that this combination drives up total aggregate property value in a city. In addition, a city's median income had a significant positive influence on local property values. The elastic response of 1.52 is a result of higher incomes encouraging ownership of larger and higher quality homes. Higher incomes also increase the demand, and consequently the price, for a given housing stock.

The regression results also indicate that greater fee collection in a city works to increase property values. If fees are used to curtail higher property tax rates, as they have been in most cities, then this result is not surprising. On the other hand, the amount of overlapping taxes (county and state) per home in a large U.S. city has a somewhat unexpected positive influence on property values. Since we are not controlling for the services provided with these taxes, this control variable might be measuring the positive capitalization of higher quality overlapping government services that may come with the higher taxes.

Naturally, as a city's number of homes increases (ceteris paribus), the city's total property value also increases. The percentage of a city's housing stock that was built in the last decade also exerts a positive influence on property value. As expected, this indicates a newer housing stock and hence one that should, ceteris paribus, have a higher value. The size of a city, measured in square miles, also has the expected positive influence of increasing aggregate property value.

Comparing our first-stage regression results with Brueckner's (1982), we found, unlike him, that total municipal expenditure exerts a significant influence on aggregate local property value. Our negative influence suggests that on average cities in our sample are producing more than a Samuelson-efficient level of output. Brueckner found that a diverse sample of Massachusetts communities are on average producing a Samuelson-efficient level of output. Since communities in Brueckner's sample are more likely to face greater competition for residents and business, the divergency in our findings is understandable.

Table 3 reports the city's inefficiency measure as defined in (16). The 49 cities are listed in descending order of efficiency. The most efficient city, Bridgeport had a fixed-effect coefficient, $\max_j\left(\hat{\alpha}_j\right)$, of -15.436.

insert table 3

IV. EXPLAINING RELATIVE EFFICIENCY

The interesting extension pursued here is an attempt to explain differences among large U.S. cities in relative efficiency attained in producing a high value of property base. To account for the observed variations in relative efficiency we consider five, broadly-defined explanations that have been advanced in the literature. The choice of proxy variables to account for explanations is based on the availability of consistent data for all cities and all years covered by the sample. Our explanations for relative inefficiency fall under the categories of rational ignorance by voters, bureaucratic inefficiency, efficiency enhancing competition, fiscal illusion, and institutional arrangements that encourage or discourage the pursuit of efficiency in public sector production. Each of these categories, and the chosen proxy explanatory variables, are discussed below.

Rational ignorance and rational abstention

Inefficiencies in performance may arise even within a model of governments run by benevolent policymakers. Government operates in a world of less than perfect information that is made worse by the fact that citizen-voters have little incentive to participate in the political process (monitoring the performance of government). Inefficiencies could arise because participation by citizen-voters is limited and uninformed.

In the large central cities comprising our sample, citizen voters face a low probability of influencing the outcomes of elections that determine policy (either directly or indirectly through the election of city officials) and hence little incentive to participate in the political process. Those who do participate (perhaps ones with strong ties to special interests) may have preferences at odds with those of the median citizen-voter. In certain instances, interest groups prefer greater government activity than the median citizen-voter (whose preferred level is assumed efficient). Furthermore, the ability to monitor a government's performance is likely to be limited as cities grow larger.[16] Ignorance, alienation, the disincentives to monitoring, and the influence of interest groups are all likely to increase with city population. Holding other factors constant, a city’s population is therefore expected to exert a positive influence on its relative inefficiency.

Bureaucratic inefficiency

If local government does not fit the model of benevolent policymakers responding to the wishes of a median voter and instead is more consistent with the bureaucratic models of Niskanen (1971) and Tullock (1977), the goals of bureaucracy make inefficiency the likely outcome. In an attempt to capture consumer surplus, Niskanen argues that bureaucrats push for a budget larger than is efficient. Migué, and Bélanger (1974) argue that bureaucrats prefer a higher labor/capital mix than is efficient, while DeAlessi (1974) suggests just the opposite (a preference for a lower labor/capital mix than is efficient). Lindsay (1976) argues that bureaucrats will reveal a preference for tangible rather than intangible inputs. Whether as a result of wasted resources, a less than optimal mix of inputs, or a tendency to produce too much, bureaucracy has been theorized to result in inefficiency. We control for the size of a city’s bureaucracy through the inclusion of variables measuring city employment as a percentage of city population and a dummy variable if the city operates the local public schools.

Efficiency enhancing competition

If city politicians, bureaucrats, and special interests advance their private interest in preference to the local public interest, inefficiency as measured by a lower aggregate local property value is expected to result. Other things equal, the ability of policymakers to advance private interest over public is expected to be a negative function of mobility and the degree of choice available to citizen-voters and business firms (Tiebout, 1956; and Brennan and Buchanan, 1980). Exploitation of citizens and firms by local governments is only possible if mobility is costly or choices are limited, either through a limited number of alternative choices or the unique characteristics of a locality (for example; weather, amenities, or location).[17]

The level of competition facing a city's decision makers is a function of not only the number of alternative location possibilities, but also the degree to which the alternatives are viewed as effective substitutes. The decision to locate in a large central city reveals a preference for the amenities such a city provides. To be an effective substitute, alternative cities must offer a similar range of amenities. In the short run this requires, other things equal, cities of similar size in the metropolitan area. In the long run it may also be reasonable to consider the availability of similar cities throughout the country. The degree of competition facing a city in this sample is positively proxied by the number of cities in the particular city's metropolitan statistical area, the average per-city population in the metropolitan statistical area, and the number of U.S. cities in the same population grouping as the city under consideration.[18]

Fiscal Illusion

The extent to which city expenditures are financed by "hidden" taxes, such as income taxes and intergovernmental grants, may create a systematic bias or "fiscal illusion" in the cost-benefit analysis of citizen voters. Such fiscal illusion can lead to a greater than optimal public sector size (see for example, Goetz, 1977, for a discussion of fiscal illusion; Hewitt, 1986; Oates, 1979; and West and Winer,1980; for evidence of its impact). The separation, or blurring, of taxing and spending powers distorts the local taxpayers' perception of the true cost of locally provided goods. The indirect tax structure results in an underestimation of the costs of locally provided goods, which results in increased demand for local government output. For example, Goetz cites evidence suggesting that the withholding system for collecting income taxes results in an underestimation of an individual's true tax burden. Likewise, grants from higher levels of government may be perceived by recipients to be partially paid for by residents of other localities despite the fact that the recipients, in turn, will be paying for part of similar grants to other localities. Therefore, grants have both an income and price effect on the local demand for public goods. The resulting size of the local public sector will be larger than would occur under a system of fiscally independent localities.

Grants may also provide city governments a means of moderating the competitive pressures inherent in a federal system (see Brennan and Buchanan, 1980). City governments may attempt to establish a cartel to bring about a more uniform tax price across all jurisdictions. A higher level of government is the logical administering body of such a cartel.[19] Brennan and Buchanan also argue that proportional, as opposed to progressive, taxes are more conducive to a "Leviathan" government's surplus maximizing. An Advisory Commission on Intergovernmental Relations (1988) study reports that the most common form of local income tax is a proportional rate on wages and salaries. Only New York City levies a progressive tax.

Considering this, we proxy for possible fiscal illusion among a city's electorate (and hence greater inefficiency in property value production) through measures of state grants as a percentage of total expenditure, federal grants as a percentage of total expenditure, and a dummy variable equal to one if a city levies a local income tax.

Institutional characteristics of government

The relative efficiency of large city U.S. governments may be partially explained by the institutional structure surrounding the governments. It has been argued that the principals in a mayor-council form of local government, as opposed to a council-manager local government, face different incentives to achieve greater efficiency in performance (Hayes and Chang, 1990). Likewise, a mayor elected by popular election may face different incentives than a mayor elected from within the ranks of the city council. Monitoring of performance may be less in cases of direct mayoral election. If the mayor is chosen from within the city council, members of the council have a stronger incentive to monitor the mayor's performance (their reelection is more directly tied to it) and greater ability to do so than the public at large.

The size of government, as measured by the number of city council members, also may influence relative efficiency. Coalition building and logrolling to achieve necessary majorities could lead to excessive government (Tullock, 1959). Also, the longer is a mayor's (or council member's) term of office, the greater may be the opportunity for rent extraction, and therefore higher relative inefficiency. If the memory of the electorate is short, officials may advance their own interests in the early years of their term and the public interest in the later years closer to reelection time -- a local version of the political business cycle.[20] Facing the citizen-voters more frequently may reduce this window of opportunity.

Finally, evidence of performance may be provided by tenure in office. Mayors who enact policies and manage governments that increase the efficiency of government performance will, other things equal, have a higher probability of being reelected. Thus a mayor with a long tenure may be an indicator of efficiency.

The characteristics of a city's governing institutions are proxied by a dummy if a mayor - council form of government, the number of years for mayor's term, a dummy if mayor chosen in a general election, the number of years sitting mayor has continually held office, and the number of council members.

An Empirical Test of Relative Inefficiency

To test the five previous hypotheses advanced in regard to possible causes of public sector inefficiency, we regressed our measure of relative inefficiency on the fourteen independent variables described above. To make the independent variables consistent with the dependent measure of average city inefficiency calculated over four different years (1967, 1972, 1977, and 1982), an observation for each independent variable was drawn for each year and an average value derived. Table 4 provides the mean value for all the variables used in the second-stage regression.

As theory tells us nothing of the functional relationship between our inefficiency measure and the independent variables, we apply the Box-Cox transformation technique to test whether a linear or log-linear functional form best fits the data.[21] The estimated Box-Cox lambda equals 0.080. Since this value is not significantly different from zero (LR test statistic of 1.07, critical value with one-degree of freedom equals 3.84), we use a log-linear functional form for our second-stage estimating equation.

The heteroskedasticity-corrected OLS regression results are recorded in Table 5. In general, the signs of the coefficients are as expected. An examination of the results indicates support for all but the bureaucratic inefficiency hypothesis. When observing the regression coefficients in Table 5, be sure to recognize that a negative sign is interpreted as exerting that influence on relative inefficiency, or greater efficiency.

Competition, principally metropolitan, is strongly associated with improved public sector efficiency. The regression coefficients derived for the number of cities in the metropolitan statistical area and the average population of these metropolitan cities indicate that while an increase in residential choice within an M.S.A. has the expected effect on inefficiency, it is important that the choices be perceived as effective substitutes for the central city. That is, the larger the average population per city in a metropolitan area, the more likely that suburban cities act as effective location substitutes to the central city, and the more likely that the central city is operating at its production frontier. An increase in the number of comparable-sized cities nationwide has only a weak effect on relative inefficiency.

An increase in city expenditures (both education and non-education) funded by state grants is positively correlated with the level of relative inefficiency exhibited by the city's government. This is consistent with both the fiscal illusion and Leviathan tax cartel hypotheses. Interestingly, federal grants to cities have no significant impact on relative inefficiency. This may be caused by differences in the nature and purpose of state and federal grants. As a percentage of total city expenditures, federal grants are more uniform across the sample. Federal grants account for, on average, 17.5 percent of total expenditures (standard deviation of 8.8) while state grants account for 48.5 percent (standard deviation of 27.4).

Among the institutional characteristics, the mayor-council form of government, mayoral term, and length of the mayor's tenure have a statistically significant impact on relative inefficiency. Contrary to earlier work (see for example, Grosskopf and Hayes (GH), 1993; Davis and Hayes (DH), 1993; and Hayes and Chang (HC), 1990) our results show that for a large U.S. city, a mayoral-council form of government performs better than a council-manager form of government. GH, HC, and DH all found no such performance differential. The comparability of these earlier studies and this study is, however, limited. HC restricted their sample to cities of population 10,000 - 150,000; GH and DH limited their samples to cities of less than 100,000. HC did not control for other determinants of inefficiency, with the exception of city size. DH controlled for only city size, tax rate, home ownership rate, and whether a city was in an urban area. GH controlled for only city size and whether a city was a central, suburban, or rural city.

The negative and significant coefficient on the variable representing the length of the current mayor's tenure in office is consistent with the argument that reelection is evidence of performance. Average tenure over the four time periods for the 49 cities was 4.9 years. A one-year increase in the average mayoral length in office would reduce relative inefficiency by 1.6 percent.

The positive and significant coefficient on the explanatory variable measuring the number of years of mayor's term of office suggests that requiring frequent validation of performance by the electorate improves government performance. Reducing the average mayoral term (of 3.5 years) by one year would improve relative efficiency by nearly 3.5 percent.

Davis and Hayes (1993) reported a quadratic relationship between city population and efficiency: as city population increased, efficiency initially increased, then fell. Economies of scale were exhausted by the time a city reached a population of 80,000. Cities in our sample were, averaged over the four time periods, at least 75 percent larger than this minimum efficient size. Our finding of a positive and significant population parameter is consistent with Davis and Hayes' conclusion. The size of the cities in our sample significantly impairs the ability of citizen-voters to monitor government performance.

Finally, our results provide no support for the bureaucratic theories of government inefficiency. Though city employment as a percentage of city population exerted a negative influence on relative inefficiency, and the operation of a school district did the same, both of these regression coefficients were statistically insignificant at the 90 percent confidence level in a one-tailed test.

IV. SUMMARY AND CONCLUSION

A primary assumption used by many public sector economists is that local government officials are best considered to be operating in a competitive environment that forces them to act to maximize the utility of a decisive voter. In this paper we proposed and tested a method by which to measure the relative efficiency of local public sector production through the use of aggregate city property values and the concept of a frontier production function. It is assumed that residence in the community with the more efficient government will be more desirable to citizens and business and this will be capitalized into higher property values, ceteris paribus. Likewise, less efficient communities are less desirable locations and should exhibit lower aggregate property values.

Our empirical technique is well grounded in Brueckner's (1979 and 1982) earlier theory. The first-stage of our regression analysis is very similar to Brueckner's and we find results easily reconcilable to his. Our sample of large U.S. cities are on average producing too much to be considered Samuelson efficient. The lack of competition, inherent to a statewide sample of cities, is the likely explanation. We, however, go beyond Brueckner's empirical method of measuring Samuelson efficiency. Applying the concept of frontier production theory, we extract in a pooled regression analysis the fixed-effect coefficients for each of 49 cities in our sample. These city-specific coefficients represent a measure of local public sector choices relative to a hypothetically efficient frontier. This empirical technique, in of itself, should be of interest to policymakers and researchers in this area.

To account for the observed variations in relative efficiency we considered five broadly-defined explanations that have been advanced in the literature. Our explanations for relative inefficiency fell under the categories of rational ignorance by voters, bureaucratic inefficiency,

efficiency enhancing competition, fiscal illusion, and institutional arrangements that encourage or discourage the pursuit of efficiency in public sector production.

In general, the explanations for public sector inefficiency are supported by our results. It appears that large U.S. cities are more likely to fit the characterization of efficient producers of local public goods the greater the degree of metropolitan competition that they face, if they use a mayor-council form of government and the mayor faces more frequent re-election challenges and wins them, and if voters are less confused by the relationship between their tax dollars and city expenditures.

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TABLE 1

Description and Mean of Variables Used in First-Stage Property Value Regression

Equation (13) Representation	**Proxy Variable Description**	**Mean**
P	Total Real Property Tax Base ($000)	17,727,549
z	Total Real Municipal Expenditure ($000) Total Real Expenditure on Education ($000)	668,548 364,548
q	Index Measure of Percentage of Homes Built in Last Decade Area in Square Miles	3.102 145
e	Employment as a Percentage of Population Percentage of Population African American	41.002 22.097
y	Median Real Income	23,353
$\Pi(m)$	Employment as a Percentage of Population	41.002
G	Intergovernmental Real Revenue ($000)	452,098
T	Other Real Non-Property Tax Revenues Plus Sales Tax Revenues ($000)	225,021
$F(\phi)$	Local Real Fee Revenue ($000)	81,101
σ	Overlapping Real State and County Taxes Paid per Home	3,138
n	Number of Homes Area in Square Miles	281,282 145

TABLE 2

First-Stage Fixed-Effect Regression of Total Property Tax Base*

Variables	Estimates
Time Dummy for 1967	0.3357 *** (0.1779)
Time Dummy for 1972	-0.2086 ** (0.0923)
Time Dummy for 1977	-0.3386 * (0.0804)
Total Municipal Non-Education Expenditure	-0.3634 ** (0.1652)
Total Education Expenditure	0.3374 (0.3725)
Percentage of Homes Built in Last Decade	0.6087 ** (0.2403)
Employment as a Percentage of Population	0.0132 * (0.0040)
Percentage of Population African American	0.0032 (0.2306)
Median Income	1.5204 ** (0.5672)
Intergovernmental Revenue	0.1347 (0.1108)
Other Local Non-Property Tax Revenue Plus Local Sales Tax Revenue	0.1161 (0.1195)
Local Fee Revenue	0.1661 *** (0.0877)
Overlapping Taxes Paid Per Home	0.3650 * (0.1145)
Number of Homes	0.7902 * (0.2537)

Standard errors are in parentheses. Level of significance: * = 1%, ** = 5%, and *** = 10%.
Note: 169 observations were used from 49 cities for the years 1967, 1972, 1977, and 1982; city fixed-effect coefficients are not recorded here.

TABLE 3

City Rankings by Relative Measure of Inefficiency

Rank	City Name	Relative Inefficiency
1	BRIDGEPORT*	0.00000
2	NORFOLK	0.09978
3	NEWARK	0.21282
4	ROCHESTER	0.39867
5	PITTSBURGH	0.41761
6	BUFFALO	0.46385
7	BIRMINGHAM	0.47566
8	SAN FRANCISCO	0.50121
9	RICHMOND	0.54777
10	ST LOUIS	0.57279
11	SALT LAKE CITY	0.62315
12	JERSEY CITY	0.68096
13	LOUISVILLE	0.75152
14	MINNEAPOLIS	0.77274
15	TUCSON	0.79765
16	NEW ORLEANS	0.79832
17	HONOLULU	0.80785
18	DAYTON	0.83864
19	LITTLE ROCK	0.85157
20	CLEVELAND	0.85404
21	MIAMI	0.93079
22	OMAHA	0.94037
23	DENVER	1.05502
24	MOBILE	1.06192
25	NASHVILLE	1.06988
26	PHOENIX	1.07290
27	BALTIMORE	1.08667
28	FRESNO	1.12021
29	SACRAMENTO	1.14341
30	PORTLAND	1.18674
31	SEATTLE	1.19353
32	DES MOINES	1.22070
33	NEW YORK CITY	1.23080
34	WICHITA	1.24964
35	MILWAUKEE	1.28161
36	TOLEDO	1.29158
37	CHICAGO	1.30544
38	MEMPHIS	1.34980
39	KANSAS CITY	1.35940
40	SAN DIEGO	1.36296
41	SAN JOSE	1.40871
42	PHILADELPHIA	1.44147
43	TULSA	1.47571
44	DETROIT	1.49721
45	JACKSONVILLE	1.50341
46	ALBUQUERQUE	1.50455
47	COLUMBUS	1.50723
48	OKLAHOMA CITY	1.63734
49	LOS ANGELES	1.86451

* - Fixed-effects coefficient = -15.436. Each fixed effect coefficient is statistically significant at the 5% significance level.

TABLE 4

Description and Mean of Variables Used in Second-Stage Relative Inefficiency Regression

Variable Description	**Mean**
Relative Inefficiency	1.00
Population (000)	706.66
Employees of the City as a Percentage of City population	1.86
Dummy = 1 if City Runs School District	0.24
Number of Cities in the City’s M.S.A.	74.41
Average Population of Cites in the City’s M.S.A. (000)	35.37
Number of U.S. Cities in the City’s Census Population Grouping	37.95
State Grants as a Percentage of Total City Expenditure*	48.48
Federal Grants as a Percentage of Total City Expenditure*	17.53
Dummy = 1 if City Levies a Local Income Tax	0.25
Dummy = 1 if Mayor-Council Form of Government	0.56
Number of Years for Mayor’s Term of Office	3.47
Dummy = 1 if Mayor Elected in a General Election	0.86
Number of Years that Sitting Mayor has Continuously Held Office	4.90
Number of City Council Members	12.26

* - Both education and non-education grants and expenditures.

TABLE 5

Second-Stage Log-Linear Regression of Relative Inefficieny[1]

Variables	**Estimates**
Constant	-0.196 (0.884)
Population	0.171 *** (0.100)
Employees of the City as a Percentage of City Population	-0.099 (0.090)
Dummy = 1 if City Runs School District	-0.080 (0.108)
Number of Cities in the City's M.S.A.	-0.014 * (0.0003)
Average Population of Cities in the City's M.S.A.	-0.080 * (0.026)
Number of U.S. Cities in the City's Census Population Grouping	-0.081 (0.089)
Funds from State Grants as a Percentage of Total City Expenditure	0.107 *** (0.052)
Funds from Federal Grants as a Percentage of Total City Expenditure	-0.004 (0.057)
Dummy = 1 if City Levies a Local Income Tax	0.009 (0.041)
Dummy = 1 if Mayor-Council Form of Government	-0.143 ** (0.061)
Number of Years for Mayor's Term of Office	0.124 *** (0.069)
Dummy = 1 if Mayor Elected in General Elections	0.034 (0.087)
Number of Years that Sitting Mayor has Continuously Held Office	-0.081 ** (0.037)
Number of City Council Members	0.049 (0.051)
R^2 - adjusted	0.565

[1] - Dependent variable equals log(relative inefficiency measure + 1). The above are the GLS estimates accounting for heteroskedasticity.
Standard errors are in parentheses. Level of significance: * = 1%, ** = 5%, and *** = 10%.

APPENDIX

Estimation Procedure:

For the i[th] cross section we have

$$Y_{1i} = \lambda_i \alpha_i + Y_{2i}\beta_1 + X_{1i}\beta_2 + \varepsilon_i \qquad i=1,2,...N, \qquad \text{(A1)}$$

where Y_{1i} is a $T_i \times 1$ vector of observations of the dependent variable, Y_{2i} is a $T_i \times K_1$ matrix of included endogenous variables, X_{1i} is a $T_i \times K_2$ matrix of included exogenous variables, and λ_i is a $T_i \times 1$ vector of ones. The unknown parameters to be estimated are α_i, i=1,2,...,N, β_1, and β_2. For the disturbance term we have that $E(\varepsilon_i)=0$ and $Var(\varepsilon_i)=\sigma_i^2 I_i$ where I_i is the $T_i \times T_i$ identity matrix, i.e. not serially correlated, but heteroskedastic across groups. In addition we assume that the error terms are not contemporaneously correlated.

Stacking the T_i observations for each city we get in matrix form

$$Y = X\beta + \varepsilon \qquad \text{(A2)}$$

where Y is the $T \times 1$ vector of the dependent variable, $X = [L, Y_2, X_1]$ is a $T \times (N + K_1 + K_2)$ matrix of observations, $T = \Sigma_i T_i$, and $\beta' = [\alpha, \beta_1, \beta_2]$ is a $1 \times (N + K_1 + K_2)$ vector of unknown parameters. L is appropriately constructed form the unit vectors λ_i. Since Y_2 is a set of endogenous variables correlated with the error term, we construct a set of instruments $\hat{Y}_2$ for Y_2 by regressing Y_2 on L, X_1, and X_2, where X_2 are other exogenous variables not included in the equation. We alternatively have $W = [L, \hat{Y}_2, X_1]$ as an instrument for X.

In addition we have that the variance-covariance matrix of ε is a heteroskedastic block diagonal matrix, Σ. Let P be the matrix such that $PP'=\Sigma^{-1}$. Then the heteroskedasticity corrected estimator $\hat{\beta}$ of the coefficient vector β, is the Generalized 2SLS estimator given by

$$\hat{\beta}_{G2SLS} = (W'PP'X)^{-1} W'PP'Y = \left(W'\Sigma^{-1}X\right)^{-1} W'\Sigma^{-1}Y \,. \tag{A3}$$

The variance-covariance matrix of the $\hat{\beta}_{G2SLS}$ is given by

$$\mathrm{Var}\left(\hat{\beta}_{G2SLS}\right) = \left(W'\Sigma^{-1}X\right)^{-1} W'\Sigma^{-1}W\left(X'\Sigma^{-1}W\right)^{-1} . \tag{A4}$$

When Σ is unknown, the above estimator is not feasible. In that case we replace Σ by $\hat{\Sigma}$, which leads to the Feasible G2SLS estimator

$$\hat{\beta}_{FG2SLS} = \left(W'\hat{\Sigma}^{-1}X\right)^{-1} W'\hat{\Sigma}^{-1}Y \tag{A5}$$

with variance-covariance matrix

$$\mathrm{Var}\left(\hat{\beta}_{FG2SLS}\right) = \left(W'\hat{\Sigma}^{-1}X\right)^{-1} W'\hat{\Sigma}^{-1}W\left(X'\hat{\Sigma}W\right)^{-1} \tag{A6}$$

where the diagonal elements of are estimated by

$$\hat{\sigma}_i^2 = \frac{\left(Y_i - X_i\hat{\beta}^*\right)'\left(Y_i - X_i\hat{\beta}^*\right)}{T_i} \tag{A7}$$

where $\hat{\beta}^* = (W'X)^{-1} W'Y$ is the 2SLS estimator. The above estimator is BLUE. With respect to efficiency, the FG2SLS estimators of β_1 and β_2 are consistent as either N or T or both go infinity. The FG2SLS estimator of α is unbiased, however it is consistent only as T goes to infinity

ENDNOTES

[1] We offer only a brief overview of Brueckner's model. For a complete discussion see Brueckner (1982).

[2] In Brueckner's (1982) theory he assumes two types of local public goods. In his empirical work he quantifies these as educational expenditures and non-educational expenditures. Brueckner finds no change in the statistical importance of the local public good variables when the two are aggregated. We also include in our empirical work both education and non-education expenditures.

[3] Given the income group that dominates a city's electoral process (assume it is the median) and the quality of the local environment.

[4] A single letter subscript indicates a partial derivative of the large letter with respect to the subscript letter.

[5] In our empirical work this will include the local selective sales tax, the local income tax, taxes classified as "other" and revenues classified as "miscellaneous" by the Census in their annual publication City Government Finances. We would have liked to separately account for local income taxes, but previous to the 1981-82 fiscal year there was no separate reporting of local income tax revenue by city.

[6] This assumes that only a portion of local general sales tax revenue and of other/miscellaneous non-property taxes is derived from city residents.

[7] Implicit assumptions made here are: (1) that local property owners bear the entire burden of a local property tax; and (2) all equilibriums are interior solutions. Furthermore, this obviously ignores the differential tax treatment of owners and renters. The determination of residential property value has been entirely demand oriented. As given in equation (6), this results in the capitalization of local public sector choices into home values. This result still holds if city land areas are fixed. However, as noted by Hamilton (1976), competition among city developers may lead to replication of desirable communities until rent is everywhere equal and fiscal choices are no longer capitalized. Considering commuting costs, economies of scale in production, and the difficulty of reproducing the amenities of a large city, Hamilton's zero-capitalization result is unlikely to occur in large U.S. cities. Complete zero capitalization would require the duplication of a central city almost next to an existing one. Thus, a demand determined value of housing stock is appropriate.

[8] The public production function, denoted by C, allows for congestion through the inclusion of n and m.

[9] The effect of an increase in n or m (number of houses or firms) on P is determined by the congestability of the local public good. If a pure public good, an increase in n or m yields higher P. If the public good is congestable, then the increase in property value from a higher n or m must be balanced against the higher public expenditures necessary to keep public good consumption constant.

[10] Implementation of a model with temporal variation in the inefficiency levels is possible (see Cornwell, Schmidt, and Sickles, 1990). Yet, in this work we are unable to account for such temporal variation in inefficiency due to the small number of periods for which data are available.

[11] Another approach would be to treat the inefficiency term mi as random (random effects) and uncorrelated with the inputs. An extension of standard panel-data techniques could be used to estimate this model and inefficiency measures could be obtained. The assumption that all mi's are uncorrelated with inputs could be formally evaluated by a Hausman-type test. Unfortunately our sample of cities was selected based on the availability of comparable property base values across the periods. Therefore it is only reasonable to assume that inferences are conditional upon the effects that are in the sample, and effects that may not be in the entire population of cities. Since the random effects model is viewed as one in which inferences are unconditional with reference to the entire population, the fixed-effects regression model is the more theoretically appropriate.

[12] Comparability of city aggregate property values is achieved by taking a city's reported assessed value and multiplying by a sales to assessment ratio that had been calculated for the quinquennial Census of Governments between 1967 and 1982. Property tax base equals reported assessed vale multiplied by {1/(assessment to sale price ratio)}. Further information on the calculation of the property tax base variable is available in Wassmer (1993). Our original goal was to gather data from the 200 most populated U.S. central cities in 1982. The unavailability of sales to assessment ratios for many of these 200 cities led to the much smaller sample of cities used here.

[13] Total education expenditures may also be positively related to the quality of education services provided. This should also have a positive influence on local property values.

[14] In some cases the current percentage of homes built in the last decade was negative. This is caused by the loss of existing housing stock over a decade that is not fully replaced by new housing stock. Because of this, and the requirement of using a log-log regression specification, we created an index for this variable where the minimum value (-15.3 percent) is set to one. Other values for new home index variable are calculated as ((percentage change in housing in last decade + 15.3 percent) / 15.3 percent) + 1. Since lot sizes could differ, it is desirable to also include city area in the regression.

[15] Since we are using a fixed-effect, pooled regression model, variables that proxy for the benefit of a city's location must vary between cities and across time. This constraint severely restricted possible choices of proxies for the desirability of city's location in the United States. In earlier regressions, hotel establishments per capita and measures of annual average daily humidity and annual precipitation were also included. These proxies for a city's environmental quality were removed due to the high degree of collinearity they exhibited with other explanatory variables. Annual average daily humidity was, however, used as an instrument.

[16] For example, Davis and Hayes (1993) argue that there may be diseconomies of scale to monitoring in large cities. Their sample included cities in Illinois with population size of less than 100,000. All cities in our sample are of population size greater than 100,000.

[17] Even in the presence of perfect mobility and sufficient range of residential choice, Brennan and Buchanan (1981) recognized that exploitation may still be possible if governments collude amongst themselves. See Grossman and West (1992) for empirical evidence of such collusion.

[18] The Bureau of Census has five (relevant) population groupings: 1,000,000 or more; 500,000 to 999,999; 250,000 to 499,999; and 100,000 to 249,999.

[19] See Grossman (1990), and Grossman and West (1994) for evidence in support of this hypothesis.

[20] Mueller (1989) reviews the theory and evidence of political business cycles. Bhattacharrya and Wassmer (1995) provide empirical evidence of the existence of political business cycles in large U.S. cities.

[21] The dependent variable in the second-stage regression is defined as the measure of relative inefficiency plus one.