THE RESPONSE OF LOCAL GOVERNMENTS TO REAGAN-BUSH FISCAL FEDERALISM

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1. Introduction

The reduction in federal grants to state and local governments during the Reagan and Bush administration was well-documented in the popular press. Official statistics detail this trend as well: federal grants as a percent of state and local government expenditures fell from 28% in 1980 to 20% in 1990.[1] State and federal aid as a percent of total local government revenue fell from 44.1% in 1980 to 33.0% by 1991.[2] Although not every government entity suffered a diminution in resources, for the most part this was a time of belt-tightening for state and local governments. Not only had a revenue source been substantially contracted, but taxpayer monitoring as well as other factors restricted local government resource allocation.

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[1]See *Budget of the United States Government, Analytical Perspectives, Fiscal Year 1994*, p.169.

[2]See *Government Finances: 1990-1991*, p.7.

Since such cutbacks appear to be the norm rather than the exception, it would be instructive to evaluate the effect of decreased intergovernmental aid on the performance of the affected governmental units. Some argue that it will lead affected governments to improve their performance. Specifically, if resources were being wasted, then a budget reduction will lead to less waste. Alternatively, one could argue that service levels and service quality will fall, and affected governments will be less likely to undertake innovative programs. Our goal is to provide some empirical evidence concerning these competing views.

In the next section, we summarize recent theoretical and empirical literature pertaining to the response of governments to changes in available resources and citizen monitoring. The empirical evidence we examine is the performance of a sample of local governments during the 1980-1990 period spanning the Reagan and Bush administrations, which included the discontinuation of revenue-sharing.

In section 3, we introduce our method of measuring performance. We employ a recently developed technique to compute productivity growth which is particularly well-suited to the analysis of public sector performance. This technique easily accommodates multiple services and does not require information on output or input prices. This is particularly important for this sector since prices (if they exist at all) do not necessarily reflect the opportunity cost of the resources used or services provided. In addition, this technique allows us to decompose productivity change into two mutually exclusive and exhaustive components: change in technology and change in technical efficiency.

Simple theoretical models suggest that reductions in budgets will lead to improved efficiency. In terms of technology change, we argue heuristically that as budgets are reduced there is less chance to experiment and be innovative and thus governments will invest less in developing a new technology or adopting one developed elsewhere. Our preliminary empirical evidence (based on results for a sample of Illinois municipalities over the 1980-1990 period) is broadly consistent with these expectations.

2. Background

Although productivity growth is of interest in its own right, particularly where market signals are lacking as they are in local governments, several strands of recent research related to public sector behavior suggest hypotheses that can be tested with respect to productivity. In this section we briefly summarize these.

Since our data cover the 1980-1990 period, we are especially interested in the effects of any changes in that period that would result in changes in productivity in the local public sector. One dramatic change over that period was the reduction in federal aid to (state and) local governments, particularly the loss of revenue sharing. As a consequence, local governments had to raise an increasing share of their expenditures. At the same time, there was growing resistance to tax increases at any level; in particular, Proposition 13 demonstrated a real resistance to raising property taxes, the traditional revenue source at the local level.

Silkman and Young (1982) focused on the effect of grants-in-aid on productivity of local governments. They argued that these grants distort prices (in the case of matching grants) and "undercut the motivation of local governments to strive for efficiency"(p. 384). The latter arises, according to their arguments from both collective incentive effects and fiscal illusion effects. Collective incentive effects arise as gains from monitoring and efficiency go increasingly to a broader constituency (state or federal taxpayers) as the share of outside funding increases. This reduces the incentives to monitor at the local level. Grants also obscure the real cost of services as they become more complex, causing fiscal illusion. Silkman and Young find evidence of such effects for libraries and school bus transportation in 1977-78. Since we have seen an increase in 1980-1990 in the share of local expenditures from own sources, their model would suggest that performance (in our case productivity) should improve over that period, *ceteris paribus.*

In a more general model, Wyckoff (1990) predicts that bureaucrats will favor maximization of organizational slack (technical inefficiency) over budget maximization as income increases over time.[3] In contrast to a traditional Niskanen-type analysis based on an agency's demand curve, Wyckoff uses a utility-based approach which allows him to include organizational slack. If we interpret the decline in funding over the 1980-1990 period as a fall in income on the part of local governments, then his model would also predict an increase in productivity over this period.

De Groot and Van der Sluis (1987) model the response of bureaucrats to the case of a declining budget. They also use a utility function to model the decisionmaker's choices. They include arguments that would allow for the standard Niskanen budget maximization goals, but argue that conflict minimization may also be a goal. In the context of their empirical application (a university department faced with a declining budget), they model conflict minimization as avoidance of layoffs. If output maximization is the only goal, however, relatively low productivity units would be reduced, implying that productivity should increase. If conflict minimization is more important than output maximization, productivity may not increase when budgets are reduced.

Thus earlier work suggests that productivity of local governments should increase as they pay a greater share of their costs out of their own sources. Next, we turn to our measure of productivity and its calculation.

3. The Productivity Index

The productivity measure we use to analyze performance of local governments during the 1980-1990 period is the Malmquist productivity index. This index was introduced by Caves, Christensen and Diewert [1982] as a theoretical index based on distance functions. They showed that this index was equivalent (under certain conditions[4]) to the Törnqvist index, which is the discrete counterpart of the Solow growth accounting model. The Törnqvist index does not require estimation of distance functions, but rather aggregates inputs and outputs by weighting them by their shares. Unlike Caves, Chris-

[3]This general prediction is also consistent with Migue and Belanger (1974).

[4]These include: technology is translog, second order terms are constant over time, firms are cost minimizers and revenue maximizers.

tensen and Diewert, we follow Färe, Grosskopf, Lindgren and Roos (hereafter FGLR) [1989] and calculate the Malmquist index directly by exploiting the fact that the distance functions on which the Malmquist index is based can be calculated as reciprocals of Farrell [1957] technical efficiency measures. As shown in FGLR, this allows the decomposition of productivity into changes in efficiency (catching up) and changes in technology (innovation).

More formally, if there are $x^t = (x_1^t, \ldots, x_N^t)$ inputs at period $t = 1, \ldots, T$ that are used to produce outputs $y^t = (y_1^t, \ldots, y_M^t)$, then the technology at t consists of all feasible (x^t, y^t), i.e.,

$$S^t = \{(x^t, y^t) : x^t \textit{ can produce } y^t\}. \tag{1}$$

The output distance function is due to Ronald Shephard [1970] and is defined[5] relative to the technology S^t as

$$D_o^t(x^t, y^t) = \min\{\theta : (x^t, y^t/\theta) \in S^t\}, t = 1, \ldots, T. \tag{2}$$

Given x^t, the distance function increases y^t as much as possible while remaining in S^t. We note that there is a close relationship between the distance function and the Farrell output based measure of technical efficiency. Specifically:

$$\begin{aligned} D_o^t(x^t, y^t) &= \min\{\theta : (x^t, y^t/\theta) \in S^t\} \\ &= [\max\{\theta : (x^t, \theta y^t) \in S^t)]^{-1} \\ &= 1/F_0^t(x^t, y^t), \end{aligned} \tag{3}$$

where $F_0^t(x^t, y^t)$ is the Farrell output based measure of technical efficiency

[5] See Färe [1988] for a detailed discussion of input and output distance functions.

[Farrell, 1957].

To illustrate the construction of the technology S^t from observed data we borrow a simple example from Färe, Grosskopf, Lindgren and Poullier [1993]. Suppose that one input is used to produce one output and that there are two observations, A and B, described by the data in the following table.

Hypothetical Data

	Observations	
	A	B
input (x)	2	5
output (y)	3	5

B uses more inputs than A to produce more output, but its average productivity (y/x) is lower, i.e., $y_A/x_A = 3/2 > y_B/x_B = 1$. The reference technology is created from both observations, but the frontier is formed by the observation with the highest average product, firm A. Thus if B is compared to A, the distance function value in this example is

$$D_0(x^B, y^B) = 2/3,$$

since

$$\frac{5/D_0(x^B, y^B)}{5} = 3/2,$$

which is the factor by which observation B's outputs would have to be scaled in order to attain maximum average product.
Also note that $D_0(x^A, y^A) = 1$.

This is illustrated in Figure 1.

The Malmquist productivity change index which we compute here is based on the simple idea illustrated above, but it allows for comparisons across time. It also allows for many outputs and many inputs and constructs the frontier from all the observations in the sample. Again, distance functions are used to provide a measure of deviations from maximum average product.

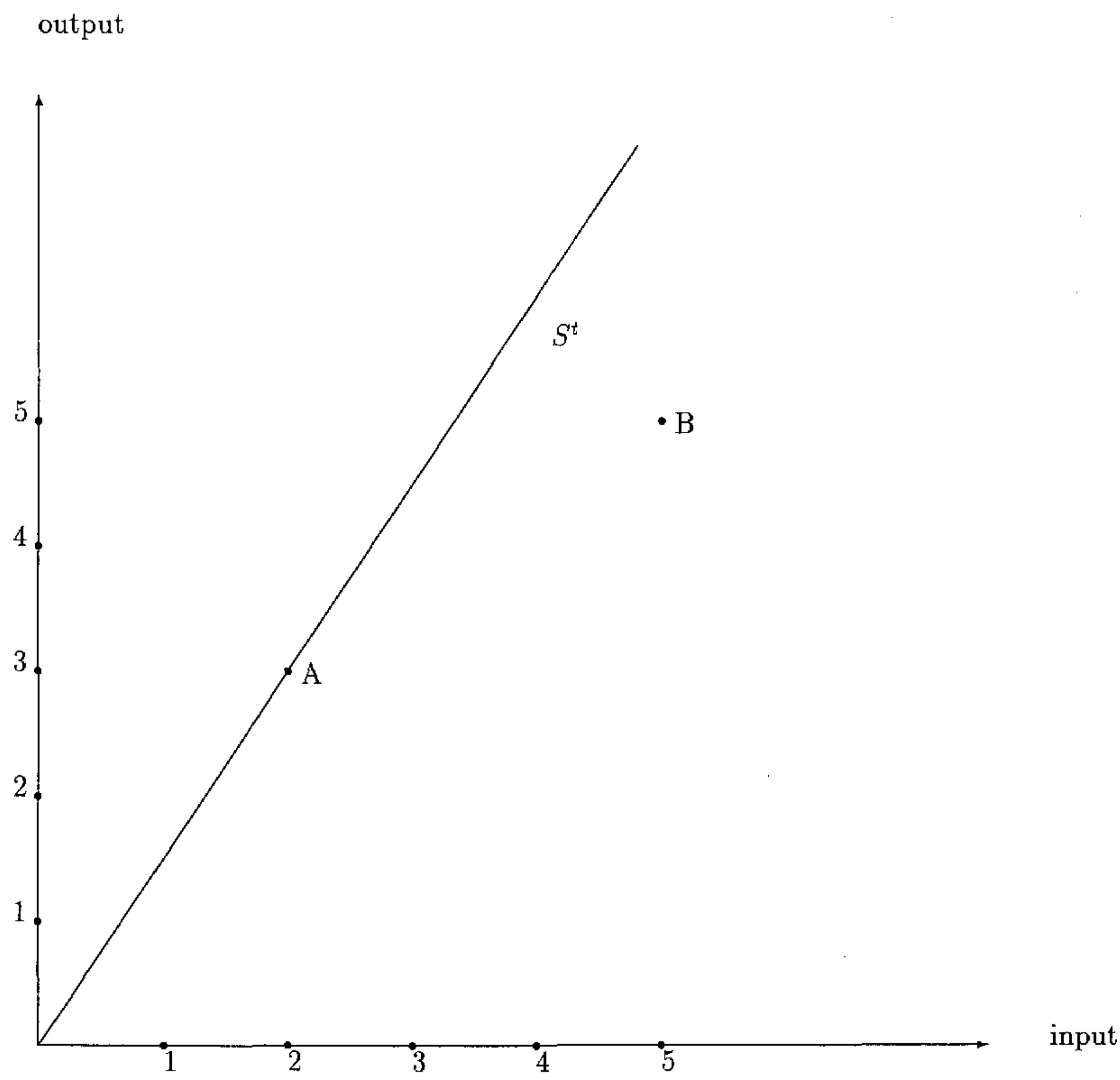

Figure 1: The Reference Technology

Specifically, we follow FGLR by defining the Malmquist index of productivity change as[6]

$$M_o^{t,t+1} = \left[\frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^t, y^t)}\right]^{1/2}, \tag{4}$$

As shown by FGLR, this index can be partitioned into two components: efficiency change and technological change. In terms of the distance functions these are defined as

$$\text{Efficiency Change (EC)} = \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)},$$

$$\text{Technological Change (TC)} = \left[\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})} \frac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)}\right]^{1/2},$$

or

$$M_0^{t,t+1} = EC \cdot TC. \tag{5}$$

If the Malmquist index takes a value greater than one, then productivitiy has improved. Values less than one reflect deterioration in performance, and values of unity are consistent with no change. The efficiency change and technical change components are interpreted similarly.

As in FGLR, we compute distance functions for the Malmquist index using the nonparametric programming methods familiar from activity analysis and data envelopment analysis (DEA).[7] This technique constructs a 'grand' frontier based on the data from all of the observations in the sample, sometimes referred to as the best practice frontier. Referring again to Figure 1, the best practice frontier is determined by the observations with the highest average product or productivity. In effect, the Malmquist index compares each observation to that frontier. How much closer an observation gets to

[6]See also Färe, Grosskopf, Norris and Zhang (1994) for a more accessible exposition of the Malmquist index and the technique we use to calculate it.

[7]See Charnes, Cooper, and Rhodes (1978).

the frontier is dubbed catching up (the efficiency change component); how much the frontier shifts at each observation's observed input mix captures innovation (the technical change component). The product of these two components yields a frontier version of productivity change. What is especially convenient for our application is that no data on output prices is required, yet specification of multiple outputs is easily accommodated. The linear programming problems used to compute the index are included in the appendix.

4. Data and Results

Our data consists of a panel of Illinois municipalities over the 1980 to 1990 period. In order to calculate our productivity index, we need to specify inputs and outputs. We have data on safety services, i.e., the police and fire functions.[8] As inputs we include police employment, fire employment, and capital outlays for the police and fire functions. Since it is not possible to directly measure the level of safety services, we use a vector of characteristics which would affect the level of safety realized by municipal citizens. These include the municipal population and (the reciprocal of) the total crimes committed.[9] We also include the percent of the population who own their homes and the percent of the population with a high school education. These last two characteristics are included as fixed or intermediate outputs over which the municipality has no discretion.

Our sample includes all municipalities which reported the variables in our model. This results in an unbalanced panel with numbers of observations ranging from 33 to 44 for this model specification.

Before turning to our results, recall that values of the productivity index and its components greater than one signal improvements; values less than one signal deterioration of performance. Since we compute productivity change, efficiency change and technical change for each municipality in

[8]In Illinois, education is not a municipal function. Thus safety services typically constitute a large share of municipal expenditures in Illinois.

[9]We include these as separate output factors rather than the reciprocal of the crime rate alone. This is to explicitly account for the different city sizes, which would be obscured by using the crime rate.

our sample for each pair of years over the 1980-1990 period, we have a large number of disaggregated results. In order to render these a bit more comprehensible, we first present the mean values of the productivity index and its components averaged across observations over time. Since the index is multiplicative, we compute the geometric means, which will preserve the integrity of the decomposition at the mean. As is evident in the Table 1, mean values fluctuate above and below one over time, with no strong apparent pattern. The grand mean for average annual productivity growth of 1.0002 suggests that there has been virtually no productivity growth on average over this period.

To better see the pattern of productivity and its components over time, Table 2 summarizes the cumulated average indexes over time.[10] This compounds the productivity changes over time. Comparing the first entry in the table with the last gives the change in overall growth in productivity and its components. These cumulated indexes show that productivity increased by about 3% in our sample on average over the 1980-1990 period. Perhaps more interesting is the composition of that productivity change: efficiency improved by about 3%, whereas technical change exhibited a decline.

Table 1
Geometric Means by Year: 1979-88

year	MALMQ	TECHCH	EFFCH	obs
1980-81	0.9827	1.0273	0.9566	44.00
1981-82	1.0537	1.0313	1.0217	38.00
1982-83	1.0899	1.0363	1.0517	36.00
1983-84	0.8984	0.9646	0.9313	44.00
1984-85	1.0483	1.0462	1.0020	43.00
1985-86	0.9133	0.9583	0.9530	37.00
1986-87	1.0051	0.9827	1.0227	33.00
1987-88	1.0013	1.0088	0.9926	36.00
1988-89	1.0134	0.9859	1.0279	36.00
1989-90	1.0126	0.9729	1.0408	35.00
grand mean	1.0002	1.0010	0.9993	38.20

[10] We cumulate the average values since we have an unbalanced panel of data.

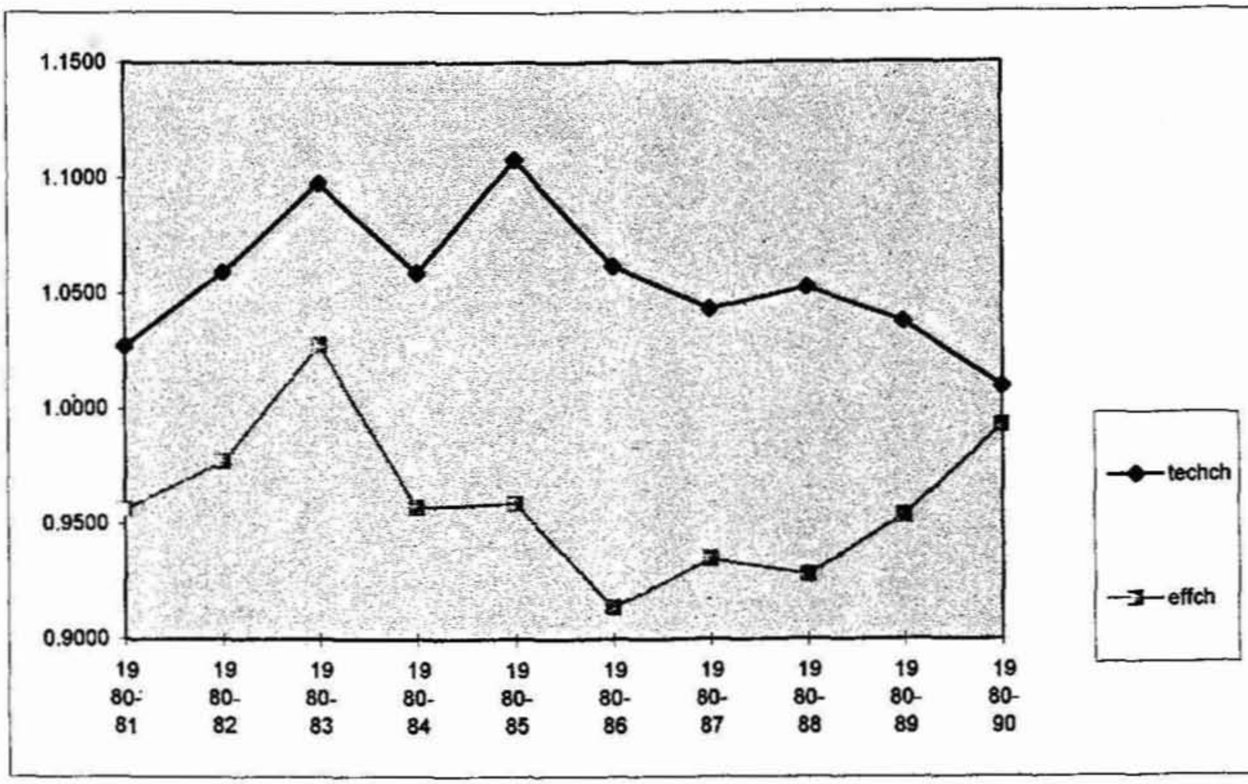

Figure 2: Cumulated efficiency change and technical change: 1980-1990

Table 2
Cumulated Means by Year: 1979-88

year	MALMQ	TECHCH	EFFCH
1980-81	0.9827	1.0273	0.9566
1980-82	1.0354	1.0594	0.9774
1980-83	1.1284	1.0979	1.0279
1980-84	1.0138	1.0590	0.9573
1980-85	1.0628	1.1080	0.9592
1980-86	0.9707	1.0618	0.9141
1980-87	0.9756	1.0435	0.9349
1980-88	0.9769	1.0527	0.9280
1980-89	0.9899	1.0378	0.9539
1980-90	1.0024	1.0097	0.9928

Figure 2 superimposes the cumulated means of the two components of our productivity index, namely efficiency change and technical change, in order to highlight the patterns observed in the tables. The difference in the trends of the two components is striking. Although not included in our figure (since data are available for only two years, 1982 and 1987), grants per capita (and grants in real terms) declined over this time period on average for our sample of municipalities. Thus declines in grants are coincident with increases in technical efficiency and declines in technical change for the municipalities in our sample. Clearly, these patterns do not provide evidence of causality. However, they provide some preliminary evidence which could be employed to further test this relationship.

In order to get some idea of whether these trends are statistically significant and can be 'explained' by other factors, we conduct a second stage analysis of the results. For each of our three productivity measures (the Malmquist index, efficiency change and technical change) we pooled the calculated results (recall that we have results for each of the municipalities in our sample for every pair of years between 1980 and 1990.) We then regress each productivity measure on variables hypothesized to influence the performance of safety providers. To avoid econometric problems we do not include as explanatory variables the factors incorporated in the specification of the distance functions.

Based on available data, the second stage regression takes into account the capital labor ratios for police and fire services in each period, per capita safety service expenditure in each period, a time trend, and dummy variables for the counties bordering Chicago and for urban areas. The capital labor ratios are a measure of capital intensity, which traditionally is expected to be positively related to technical change. The time trend is included to determine whether the patterns we observed in the graphical summary are statistically significant. Unfortunately, we do not have disaggregated annual information for grants or the percent of expenditures from local sources. Instead we include the per capita expenditures on safety services, which gives us a rough proxy of the size of the budget. We would expect the size of the budget to be correlated with lower efficiency.

The dummy variable for municipalities in the Chicago area is intended to capture any effects of the largest metropolitan area in our sample. For example, one might expect that these municipalities constitute a large competitive area in the sense of Tiebout. Citizen-voters in the Chicago area have a wide selection of communities in which to live, which may serve to improve the performance of those municipalities. The dummy variable for urban areas

Table 3: Regression Results

	Dependent Variable		
	Malmquist	Efficiency Change	Technical Change
Variable	Coefficient (prob > t)	Coefficient (prob > t)	Coefficient (prob > t)
Intercept	1.034	0.976	1.048
	(0.0001)	(0.0001)	(0.0001)
Time Trend	-0.009	0.003	-0.011
	(0.140)	(0.414)	(0.009)
K/L Police	-0.215	0.019	-0.192
	(0.527)	(0.915)	(0.400)
K/L Fire	0.105	0.002	0.101
	(0.277)	(0.974)	(0.121)
Safety Exp/pop	1.006	0.125	0.831
	(0.131)	(0.715)	(0.063)
Chicago	0.002	-0.015	0.011
	(0.961)	(0.439)	(0.646)
Urban	-0.041	0.010	-0.043
	(0.390)	(0.689)	(0.182)
Observations	337	337	337

might also capture such Tiebout effects.

The regression results are displayed in Table 3. Based on this preliminary evidence, we cannot reject the hypothesis that performance, as measured by the productivity index, has remained constant over the 1980-90 period for the municipalities in our sample. Our results suggest, however, that this is due to the fact that the two components of productivity, namely efficiency change and technical change, are moving in opposite directions. In fact we reject the hypothesis that there has been no change in innovation: we observe a significant decline in innovation as measured by our technical change component of productivity over this time period. We do not have direct evidence concerning the relationship between productivity and local share of financing; that is obviously one direction of future research. The only other variable which is marginally significant at conventional levels is the per capita expenditure variable in the technical change equation: higher per capita expenditure is associated with greater innovation.

Given the relatively small number of observations in any given year, we also computed productivity indexes in which the only inputs were police related (most of our missing values were due to incomplete information on fire services). This increased the observations to a range between 45 and 61. The regression results for this variation confirm those of the other model. In this case, however, we find that more of the coefficients are significant. As before, the time trend for the Malmquist productivity index is insignificant, due again to opposing trends in the two component measures, see Table 4. Again, the time trend in the technical change equation is negative and sstatistically significant. This time, however, the time trend in the efficiency change equation is significant as well. Thus, as before, we find evidence that during this period of budgetary pressures, innovation in the local public sector was adversely affected. At the same time, we see that the efficiency component of productivity actually improved.[11] Budgetary pressure appears to be consistent with improved efficiency, but diminished innovation.

[11]To some extent, this follows from the reduced innovation result. If the frontier is not advancing, then municipalities that 'stand still' could actually end up being closer to the frontier.

Interestingly, the per capita expenditure variable is also significant: negative in the efficiency change equation and positive in the technical change equation. If the per capita expenditure variable is thought of as a proxy for budget size, then these coefficients are consistent with our hypotheses: relatively large budgets are associated with inefficiency, but allow municipalities to be relatively innovative. What would be even more informative would be information on expenditure share from own sources instead of expenditures per capita. That data was not available from published sources on an annual basis for the municipalities in our sample.

Table 4: Regression Results
Model with Police Only

	Dependent Variable		
	Malmquist	Efficiency Change	Technical Change
Variable	Coefficient (prob > t)	Coefficient (prob > t)	Coefficient (prob > t)
Int	1.016	0.866	1.189
	(0.0001)	(0.0001)	(0.0001)
T	-0.003	0.017	-0.028
	(0.455)	(0.0001)	(0.0001)
K/L	0.072	0.156	-0.193
	(0.548)	(0.132)	(0.149)
Exp/pop	0.203	-0.615	1.362
	(0.564)	(0.043)	(0.001)
Chicago	0.016	-0.015	-0.033
	(0.974)	(0.404)	(0.198)
Urban	-0.012	-0.013	0.015
	(0.696)	(0.619)	(0.668)
Observations	463	463	463

5. Summary

The purpose of this paper is to provide some empirical evidence as to performance in the local public sector during a period in which intergovernmental aid was reduced. Our application covers Illinois municipalities during the 1980-1990 period. Perhaps our major contribution is to employ a technique for measuring performance that is especially well-suited to the public sector. We compute Malmquist productivity indexes which allow for specification of many outputs without requiring information on output prices. In addition, this productivity index can also be decomposed into indexes of efficiency change (or catching up) and technical change (innovation). This provides insight into the sources of productivity change.

Earlier theoretical and empirical work suggest that decreases in grants should improve performance. We find that during the 1980-1990 time period, our sample of Illinois municipalities had on average no real discernible pattern of productivity change. On the other hand, the two components of productivity suggest that there are some patterns: we found evidence of a general tendency toward improvement in efficiency, which was apparently offset by a decline in innovation over this period.

We consider our results to be only suggestive. We are unable to disaggregate annual information on grants and therefore could not directly test the hypothesis that grants had a significant impact on productivity. However, we feel that further work in this area would be useful in providing some insight into the potential impacts of the proposed changes in responsibility and financing of public services in the future.

Appendix

For each municipality, $k' = 1, \ldots K$ and $t = 1, \ldots, T$, we calculate

$$\left[D_o^t(x^{k',t}, y^{k',t})\right]^{-1} = \max \theta$$
$$\text{s.t.} \quad \theta y_m^{k',t} \leqq \sum_{k=1}^{K} z^{k,t} y_m^{k,t}, \quad m = 1, \ldots, M, \qquad (6)$$
$$\sum_{k=1}^{K} z^{k,t} x_n^{k,t} \leqq x_n^{k',t}, \quad n = 1, \ldots, N,$$

$$z^{k,t} \geqq 0, \qquad k = 1, \ldots, K.$$

The other three components are calculated similarly, substituting the appropriate period data (i.e., t or $t+1$).

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