NON-FEDERAL GOVERNMENT SERVICES
AND SMSA PER CAPITA INCOME

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Introduction

Growth center theory has focused a considerable amount of attention on the role of public investment in infrastructure on regional economic development, e.g., [10, 14, 15]. This has created an imbalance in both the literatures in regional economics and in public finance since there has been very little theoretical or empirical work on the development impacts of public services, as noted in Polinsky and Rubin feld [13]. This paper contributes to this work by analyzing non-federal public employment, which is indicative of services, as a determinant of regional per capita income. Per capita income is used because it is one of the most comprehensive measures of economic development employed in empirical studies. The paper provides evidence on the usefulness of public employment programs as an instrument of regional development policy.

The success of the Jarvis-Gann constitutional amendment in California in 1978 inspired initiatives for state and local fiscal constraint throughout the United States [11]. A number of states and localities introduced legislation designed to reduce, or at least limit the growth of, public sector expenditures in an effort to ease the burden of state and local taxation. Few of these proposals were accompanied by careful assessments of their potential effects on the level of regional economic activity. While tax reductions would increase disposable income, resulting reductions in public services would decrease benefits enjoyed by private firms and residents. This would make locations within the affected areas less valuable. The model presented in this paper provides a means for deriving first approximations of development impacts of such reductions in public services.

Our analysis excludes federal services (employment) in regions because their spatial impacts are likely to be broader (e.g., a Veteran's Administration Office that serves a three state area, or a military supply facility that contributes to national security) and less well-defined than that of state and local government services.[1] The regions covered by the analysis are the 243 Standard Metropolitan Statistical Areas, as delineated in 1972. SMSA's were used for two reasons. First, they collectively contain most of the population of the nation. Second, they are functionally integrated economic entities that are less dependent on external trade than areas outside SMSA's. This implies that a very large proportion of the benefits of public services can be expected to be

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[1]The cost of non-Federal public services is borne largely by the region within which impacts are greatest. Some funds may be received from the Federal goverment in the cases of matching-grant or revenue sharing programs. By contrast, benefits (for example, payrolls) from federal installations are likely to be much larger than the locality's contribution to their costs. From the standpoint of regional development planning, the use of federal services as means of promoting local economic development may be viewed as a "beggar-thy-neighbor" policy that can only be enjoyed by a relatively small number of regions,

captured by the region in which the services are performed. For example, the graduate of a public high school or community college within an SMSA is more likely to remain in the SMSA, because of the variety of opportunities available there, than the graduate of a public school in a rural area. Growth center literature contains evidence that public investments in metropolitan areas with good linkages to "hinterlands" are also likely to create far more positive "spillovers" to surrounding regions than public investments placed elsewhere. The same is likely to be true of public services [6]. Thus, any national regional development programs would more likely concentrate public employment programs in SMSA's.

The paper is organized as follows. In the second section we present a model in which the relationship between public employment and income is derived from a regional production function. One of the structural equations of the model explains variations in per capita income with government employment as one of its arguments. Another structural equation explains the demand for government employment. The parameters of these two interdependent equations were estimated using the SMSA data. The empirical results are given in section 3. Section 4 investigates the constancy of the parameter relating government employment to income. Estimates of two structural equations of the model, for sub-samples of SMSA's, show that increments in public services increase per capita income but that the income effects tend to be somewhat smaller in areas where there is a relatively high concentration of government employment. The final section summarizes results and draws some policy implications of our findings.

Non-Federal Government Services and Income:

The Model. Output and income of the private sector in a region are a function of private sector labor and capital resources and, in addition, various services of the public sector. Stated more formally,

$$(1) \qquad Q_j^{(p)} = f(L_j^{(p)}, K_j^{(p)}, SVC_j),$$

where $Q_j(p)$ is region j private sector output, $L_j(p)$ is labor employed in the private sector in region j, $K_j(p)$ is private sector capital in region j, and SVC_j represents non-federal government services available in region j. In the discussion which follows, private employment and public services (and the public employments these services require), and their relationship with personal income in each region are developed. Private sector employment is given by the following derived demand for labor equation,

$$(2) \qquad L_j^{(p)} = f(Q_j, W_j^{(p)} / P_j) \,,$$

where $L_j(p)$ is the quantity of labor employed in the private economy in region j, $W_j(p)$ is the private sector money wage in region j, and P_j is region j's price level. This function is similar to ones used in a large number of regional econometric models, such as that for the state of Mississippi by Adams *et al* [1]. Aggregate real personal income earned in the private sector in region j, $PI_j^{(p)}$ is given by

$$(3) \qquad PI_j^{(p)} = f(L_j^{(p)}, W_j^{(p)} / P_j)$$

The real wage in region j, which enters as an argument in equations (2) and (3), is a function of the quality of the region's labor force, or its "human capital," E_j, the level of surplus labor in the region, and the national average wage level. The equation representing the regional real wage in the private sector is thus specified as,

(4) $W_j^{(p)} / P_j = f(E_j, U_j, W_n^{(p)})$,

where U_j represents the level of surplus labor in region j, and $W_n^{(p)}$ is the national average wage for all private sector employees. By substituting equation (4) into equation (3), we derive an aggregate real personal income equation for the region's private employees.

(5) $PI_j^{(p)} = f(L_j^{(p)}, E_j, U_j, W_n^{(p)})$

We turn now to the set of employment, income, and wage equations for the government sector. Government services themselves require the input of labor and of capital (infrastructure). Our focus in the present work is on the labor component in government services. Government employment is viewed as a direct indicator of the level of public sector services produced.

It is clear that differences exist in the various functions of non-federal governments (e.g., traffic control vs. highway operations vs. recreation services); differences also exist in the extent to which locally produced services benefit local firms and households only, as opposed to providing spillover benefits to firms and households in other regions. Such variations suggest that not all government services are homogeneous in their impact on a region's output. In what follows we abstract from these differences and treat state and local government employment in aggregate form, independent of functional type, and we ignore jurisdictional spillovers.[2] Our concern in this paper is with the own-region impact of variations in the absolute size of non-federal government services, not with the mix of functions, or spillovers enjoyed by other regions. Finally, we ignore any differences among regions in effects on output that might arise from differentials in rates or levels of taxation.

Several recent works have studied the demand for government services [2, 4, 8, 9, Ch. 2]. In general, they develop demand relationships for specific state and local services, such as police, fire, education, and so forth. All have identified a region's income level as an important determinant of its levels of various public services. Our model also specifies regional income PI_j in the government services (government employment) function. By substituting equation (1) into (2), and substituting (2) into (5), we find that regional income is also a function of government services. Thus, between income and government employment there exists mutual causation, or simultaneity. We incorporate this simultaneity by treating government services as an endogenous variable that is a function of regional income, and other variables. The additional variables are intergovernmental transfers TR_j, demographic characteristics of the region D_j, institutional factors I_j, and structure of the region's economy ES_j.

[2]Frequently such spillovers, or "externalities," are significant. This is very evident in the case of education. Owing to the significant rate of mobility of the U.S. population, education and skills acquired in one school district in many instances benefit other areas as individuals migrate and change places of employment. Our concern in this paper is with the realization of such benefits locally only.

The government employment demand equation thus is given by,

$$(6) \qquad G_j = f(PI_j, TR_j, D_j, I_j, ES_j)$$

Intergovernmental transfer payments reduce the net cost of government services that must be borne by the benefitted area. Most transfers are received either through a matching grants program or through an outright revenue sharing scheme. Matching grants are designed to stimulate the demand for specific public services and investments. Revenue sharing funds, not tied to specific items, raise the demand for a broad range of public services and investments. In either form, we expect that the amount of transfers received by a unit of government is positively related to the level of services it provides. Demographic characteristics determine the relative desirability of public services within a region, i.e., the attractiveness of governmental services relative to private goods and services. By institutional factors we mean the set of historical and political determinants of the location of government agencies, particularly those state facilities that need not be near all the people they serve. Finally, the composition of a region's economic activity is related to the amount of government services needed to complement that activity.

Real personal income generated directly in the non-federal public sector is a function of employment and the wage rate in the sector,

$$(7) \qquad PI_j^{(g)} = f(G_j, W_j^{(g)} / P_j)$$

The wage in this sector is a function of investment in human capital and surplus labor supply. Analogous to equation (4), the wage rate equation is,

$$(8) \qquad W_j^{(g)} / P_j = f(E_j, U_j, W_n^{(g)})$$

where $W_n(g)$ is the national average wage for state and local government workers. Since the national wage rates $W_n^{(p)}$ and $W_n^{(g)}$ are constant over regions in cross-section analysis, they can be omitted from equations (4) and (8) respectively, without concern for specification error.

Finally, aggregate personal income in the Jth region may be expressed as a function of personal income in the government sector and personal income generated in the private sector. Equation (9) is a stochastic relationship, rather than an identity, because of the omission of income from federal employment, and the omission of property income (interest, dividends, and other non-labor income).

$$(9) \qquad PI_j = f(PI_j^{(p)}, PI_j^{(g)})$$

Substituting equations (5) and (7) into (9) gives us,

$$(10) \qquad PI_j = f(L_j^{(p)}, G_j, E_j, U_j)$$

The two principal structural equations are equations (6) and (10), which are interdependent. The empirical analyses in Sections 3 and 4 focus on the parameters of these equations.

TSLS Estimates of the Government Employment and Income Equations for the Full Sample

Regional economic policy is aimed at affecting levels of economic well-being [5]. The indicators of well-being most frequently used for evaluating policies are averages rather than aggregates. To give the two structural equations of the model more of a policy orientation, most of the variables in equations (6) and (10) were replaced by their corresponding means. For simplicity of presentation, we will drop the regional subscript j from the remainder of the paper. Total regional personal income PI was replaced by per capita income (PCI). Percentage of the labor force unemployed (U) was substituted for aggregate unemployment. Economic structure was represented by the percentage of workers employed in manufacturing (MFGPCT). The skill level of workers is primarily determined by their levels of educational attainment, measured here by the median number of years of schooling completed (SCHOOL) and by the percentage of persons with four or more years of college-level education (COLLEGE). Both of these educational variables relate to persons over age 25. The only direct measure of the wage rate used in the income equation was the mean wage of production workers in manufacturing (MFGWAGE). Demographic characteristics were represented by two variables: total population of the area (POP), and the percentage of persons under age 18 (YOUTH). These measured, respectively, the size and age distribution of the population being served by government. The institutional variable related to the location of government employment is a dummy variable (CAP) equal to 1 if the SMSA contains the state capital and 0 otherwise. Finally, a per capita measure of governmental transfers received in the area (TR) was included in the governmental employment equation.

The revised government employment equation can be written as,

(11) $G = f(PCI, TR, MFGPCT, POP, CAP, YOUTH)$,

while the revised income equation was,

(12) $PCI = f(G, MFGPCT, MFGWAGE, U, SCHOOL, COLLEGE)$

The three monetary variables in these two equations, PCI, MFGWAGE, and TR, have been adjusted by a price index to allow for price differentials among SMSA's. Thus, all three were expressed in real terms. The metropolitan "cost-of-living" index used for this purpose was that reported by Liu [12, Tables A-5, B-6, C-5].

Since the objective of the regression analysis of equations (11) and (12) was to derive a reliable estimate of the effect of G on PCI, and G is itself dependent of PCI [as implied by equation (11)], PCI is likely to be significantly correlated with the error term of the income equation, and this would result in a biased parameter estimate in the regression of PCI on G. The same problem occurs in estimating the government employment equation, since there is interaction between PCI and G. To correct this problem, the regression coefficients of both equations were calculated with the two-stage least squares (TSLS) estimator.[3] See, for example, Dutta [7, pp. 298-309].

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[3]The TSLS estimates were derived by first regressing PCI and G on all of the other variables in equations (11) and (12). These first stage regressions were then used to calculate conditional expected values of these two variables to replace the original observations. The conditional expected values of PCI and G for each SMSA were then used in the second stage to estimate equations (11) and (12) individually. The parameter estimates obtained in the second stage are reported here. The TSLS estimator produces estimates that have been shown to be consistent for large samples such as ours. This consistency reduces the size of the bias due to simultaneity.

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As explained above in the second section, income levels will change as a result of location decisions of firms and residents, and these decisions depend partly on the quantities of public services offered in each area. In other words, public services affect the level and composition of economic activity and this, in turn, results in new levels of income. Our analysis is not concerned with the dynamics of the response of income to government services, but rather with the change in equilibrium income resulting from all adjustments motivated by a new amount of services. In econometric analysis, cross-section observations over regions constitute the appropriate data set for such an investigation of comparative statics. Of course, we can never be certain that all regions in the cross-section sample are realizing their equilibrium incomes with respect to their current level of public services. In reality, most will probably be either above or below their equilibria, but over the entire range of observations we assume that negative and positive divergences balance out. Fortunately, appropriate cross-section data are available and were used for this analysis.

The regressions were estimated from SMSA data contained in the COUNTY AND CITY DATA BOOK 1972 [16]. This volume reports information on social, economic, and demographic variables compiled from various government enumerations. While a later edition was available, it did not provide detailed information on government employment suitable for our analysis. There are some limitations of the data utilized that might have introduced biases in the regressions of unknown size. First, observations on all of the variables were not collected contemporaneously. The enumerations were made over a period of four years (1967-1970). Second, cross-section data may not be truly representative of general conditions if observations were distorted by any spurious events that might have occurred when the census was made. In addition, no adjustments were made for seasonal variation. This may have caused significant distortions in the observations of employment. Third, employment is recorded by place of residence of workers and not on the basis of where work is peformed. This may cause bias where there is substantial commuting across the boundaries of SMSA's. However, since SMSA's are large geographical entities and have been delineated on the basis of functional integration of residential and place-of-work areas, the bias is likely to be minimal.

The TSLS estimate of the government employment equation (11) is,[4]

(13) $G = 24{,}839 + 0.276\ PCI + 61.9\ TR + 0.047\ POP + 7808\ CAP$
$$\phantom{G = 24{,}839 + }(0.102)\quad\ (4.220)\quad\ (74.812)\quad\ \ (4.634)$$

$-863\ YOUTH - 141\ MFGPCT$
$$(3.386)\qquad\quad (2.237)$$

The TSLS estimate of the income equation (12) is,

(14) $PCI = -95.5 + 168\ SCHOOL + 24.7\ COLLEGE - 41.4\ U$
$$(5.057)\qquad\quad (4.144)\qquad\quad (2.774)$$

$+ 7.035\ MFGPCT + 270\ MFGWAGE + 0.0013\ G$
$$(3.505)\qquad\qquad (6.941)\qquad\qquad (3.964)$$

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[4]The regressions reported here were actually derived from slightly less than the full sample of 243 SMSA's. Four observations were lost due to missing data.

Figures in parentheses below each coefficient are t-ratios that relate to the level of significance of each estimate. This level is the probability that the true parameter is zero, i.e., that the regressor is not related to the dependent variable in the equation.[5] All of the coefficients are significant at the 0.05 level or lower, except the coefficient of PCI in equation (13).

We discuss first equation (13), the government employment function. Somewhat suprisingly, per capita income has no significant impact on the number of non-federal workers in the SMSA. Stated another way, relative to per capita income, the aggregate of non-federal services exhibits neither normal nor inferior good status. As noted, previous research which has demonstrated significant positive income effects on non-federal services, has been confined to specific service types, such as education, highways, recreation and so forth [2, 4, 8]. The positive sign on transfers indicates that the availability of intergovernmental funds does indeed promote more government employment. As expected, population exerts a positive influence, reflecting the fact that larger areas require larger numbers of public employees. Also as expected, SMSA's containing a state capital had a significantly larger number of government workers (on average 7808 more) than SMSA's without a state capital. Given the average government work force across all SMSA's of some 27,000, this means that the public sector workforce is 29 pecent greater for the average state capital SMSA than regions without state capitals. Surprisingly, a negative sign appears on the variable YOUTH. This indicates that a larger percentage of the population under 18 leads to a smaller public sector workforce. Even though education most often is the largest segment of local government budgets (including both labor and capital expenditures), it is the share of the population over 18 that tends to pull up the number of non-federal employees.

We turn now to the estimate of the per capita income function, equation (14). The variables SCHOOL and COLLEGE are positively related to income, as expected. Education increases skill levels and the higher marginal product of labor that results is reflected in higher earned incomes. The unemployment rate in the region (U) is negatively related to income. This is consistent with our expectation that the existence of surplus labor in an area tends to reduce per capita incomes, through its downward influence on wages. This is reinforced by the income effect of unemployed workers: those unemployed, while not contributing to aggregate SMSA income (numerator of PCI), are still included in the population (denominator of PCI), and hence cause average income in an area to fall. The variable MFGPCT, having a positive sign, corresponds with the traditional notion that industrialized areas tend to have higher incomes. As anticipated, MFGWAGE also exhibits a positive effect on regional per capita income. There may be some overlap between the explanatory effect of this variable and SCHOOL and COLLEGE (representing skill levels of workers), but each makes a strong enough independent contribution to be statistically significant.

The coefficient of non-federal workers G, 0.0013, is positive and highly significant. Additional non-federal employees tend to increase per capita incomes in SMSA's. The value of this coefficient indicates that each 100 additional workers in government raises per capita income by $1.30. The average

[5]The coefficients of determination for the first stage regressions of G and PCI were 0.97 and 0.50, respectively. Since the second stage involves use of instrumental variables in place of original variables, the R-squared statistic is not an appropriate indicator and is not calculated.

size of non-federal employment for all SMSA's is some 27,000. A hypothetical 10 percent increase in government employment, clearly a substantial magnitude, would be expected to boost area incomes by only $3.50 per person. In short, the development impact of such a program appears to be rather minor. Conversely, these results also suggest that reductions in government employment (occasioned by tax revolt, economy in goverment, reduced inter-governmental transfers, etc.) will have but a small negative effect on average incomes in affected areas. Whatever else their merits (or demerits) in terms of efficiency and equity in taxation, the recent initiatives for state and local fiscal constraint thus appear to hold little threat for areas in the form of losses in per capita income.

The estimated impact of government employment on income is the net outcome of a change in government employment (services), and the corresponding change in per capita taxes which are required to fund this activity. Most of these, presumably, are non-federal taxes. Thus, the additional government employment which serves to raise area income will carry with it some additional tax burden on the SMSA which simultaneously may act to reduce average income through possibly disincentive effects. The *net* impact of these is reflected in the coefficient of .0013. If increments in the non-federal workforce are funded fully or very largely by revenues raised outside the SMSA (whether from federal or state sources), the development potential could become more favorable. This is because any negative effects from additional taxation on SMSA residents and firms are avoided or are very small.

An interesting and important question is whether the impact of G on PCI is uniform across all SMSA's. Differences in the size or scale of the government sector might alter the size of the impact coefficient. This question is addressed in the next section.

Sub-Sample Estimates

The main objective of the preceding section was to develop an estimate of the parameter relating non-federal government employment to per capita income. The purpose of this section is to test the stability of that parameter. Specifically, we wish to determine whether the impact of G on PCI is related to the relative size of the public sector in each SMSA. As the government sector becomes larger, *ceteris paribus*, the ratio of public sector inputs to private sector inputs grows. A simple rearrangement of equation (1) gives.

$$(15) \qquad Q_j = f(SVC_j, L_j^{(p)}, K_j^{(p)})$$

Economic theory suggests that as the quantity of the variable input SVC is increased relative to the quantities of fixed private sector inputs, L and K, government services will make a diminishing marginal contribution to regional output, after some point. Simultaneously, and for the same reason, the incremental contributions to per capita income will decline. The task of this section involves testing this proposition.

Statistically, this test can be accomplished by partitioning the observations according to the size of the non-federal government sector. A comparison can then be made of the coefficients of G in the sub-sample income equations. However, the major determinant of the absolute size of government employment is the size of the population being served. [See equation (13)]. Thus, segmenting the sample by the size of G alone would make it difficult to

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determine whether any variation in parameter values would be due to the size of the government sector, to population, or some combination of these two. We filtered out the effect of population by segmenting the sample according to the ratio of government employment to population. Two groups of SMSA's were formulated. Group one consisted of all SMSA's with a government employment to population ratio below the mean national value (for SMSA's) of 50.5 employees per 1000 population. Group two included all SMSA's whose ratios were above this value. Group one had 159 observations, while the second contained 84 SMSA's. In order to obtain efficient estimates of the G parameter, a TSLS estimator was employed on both structural equations of the model.

The estimates of the two pairs of equations are shown in the Appendix. For Group 1, consisting of areas with relatively small non-federal government sectors, the coefficient of G was + 0.0014, which was slightly larger than the same coefficient for the full-sample model reported in section 3. The coefficient for Group 2 (large government) was + 0.0010. The differences in the slopes of the two regression lines are significantly different at the .02 level.[6] This result indicates that the government employment parameter is a function of relative public sector size. Specifically, regions with large public sectors would benefit less from a given absolute increment in G than would other regions. This implies that there are diminishing returns to government services.

Our method of partitioning the sample assumed that high levels of government employment per capita corresponds with relatively large public sector shares of the total labor force. Some analysts may feel that a more appropriate control factor would be the ratio of government employment to total employment, or the ratio of public sector employment to private sector employment. In our sample, the simple correlation between total employment and population was 0.96, implying there was very little variation in labor participation rates among SMSA's. Consequently our results should not be very different from those that would be obtained from a partitioning based on the number of government workers relative to total employment.

Summary and Conclusions

The preceding analysis has served to demonstrate that within metropolitan areas increments in non-federal public services make a positive contribution to the level of economic development, as represented by per capita income. Conversely, reductions in public services seem to be associated with lower levels of per capita income. However, the magnitude of the impact is rather small: a change of 1000 workers is associated with a change of only $1.33 in average SMSA income. Thus, regional economic development policy should not rely heavily on additions to state and local public employment. And, reductions in government employment, occasioned by tax revolt or government economy, should have very little effect on average income. We might note that average income is but one indicator of economic well-being, and that changes in public employment may be effective in realizing other objectives.

The following limitations of our analysis should be recognized. This re-

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[6]We used an analysis of covariance test of the null hypothesis that the regression coefficients of G in the income equation were homogeneous for the two sub-samples. The null hypotheses were rejected because the coefficients were significant at less than the 0.05 level. The test is explained in Beals [3, pp. 326-330].

search investigates only the effect of non-federal employment on average, money income within a region. We have not investigated any attendant effects on the distribution of income in the region, on unemployment levels, or on the degree of regional economic stability. Also, no attempt was made to account for the benefits of the many government services to individuals that raise real, but not monetary income.

APPENDIX
Two-Stage Least Squares Estimates
For Sub-Samples Of SMSA's

			Government Employment (G)				
Group	INTERCEPT	PCI	MFGPCT	POP	CAP	YOUTH	TR
1	2132.659	1.503	-75.938	0.041	3766.662	-217.614	26.488
		[1.05]	[1.85]	[88.32]	[2.63]	[1.34]	[2.70]
2	16981.660	3.453	-79.124	0.054	5733.941	-812.310	30.047
		[1.02]	[1.21]	[106.25]	[4.06]	[2.71]	[2.05].

			Per Capita Income (PCI)				
GROUP	INTERCEPT	G	MFGPCT	U	SCHOOL	COLLEGE	MFGWAGE
1	158.658	0.0014	8.324	-66.631	141.992	48.795	239.641
		[2.56]	[3.42]	[3.459]	[3.77]	[5.68]	[4.92]
2	520.581	0.0010	1.034	- 9.899	115.912	8.912	333.967
		[2.79]	[0.33]	[0.51]	[1.54]	[1.18]	[6.20]

NOTE: Group 1 consists of 159 SMSA's with government employment below the mean of 50.50 per thousand persons; 156 were used in the regression.

Group 2 consists of 84 SMSA's with government employment above the mean of 50.50 per thousand persons; 82 were used in the regression.

The bracketed terms are t-ratios.

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