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Application of BEA Economic Areas in the Development of the Great Basin Fiscal Impact Model

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Abstract. With changing revenue and service responsibilities between federal, state and local governments, the need for local decision-makers to accurately assess fiscal impacts of new economic developments or federal government programs has become increasingly important. In this paper we explore the use of cross-sectional data and procedures to derive a fiscal impact model that crosses state boundaries. This study uses BEA Economic Areas to select counties to be included in the Great Basin fiscal impact model. Fixed effects are specified to incorporate institutional differences between states and metropolitan counties. Results of this analysis indicate that model derivation is not statistically impacted by use of place of work employment rather than place of residence employment. An example analysis for a rural Nevada county shows how the Great Basin fiscal model can be applied to measure changes in county fiscal balances.

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1. Introduction

During the 1980's and 1990's many states and counties in the mountain states of the United States experienced rapid population and economic growth. With this rapid growth, however, many communities realized strains on their community services and budgets. Unlike many metropolitan areas, rural counties of the mountain states do not have the personnel to assist rural decision-makers that analyze and predict future economic growth and consequential demand on local community services. In fact, many rural policy-makers, such as county commissioners, are part-time public officials with little background or experience in public administration. Yet their decisions pertaining to the future must be based on many complex relationships.

Rural decision-makers have requested assistance in analyzing current and potential economic trends and their impacts on local government fiscal balances. To assist rural decision-makers, various socio-economic/fiscal models have been developed and used by cooperative extension. The IMPLAN input-output microcomputer software (Minnesota IMPLAN Group 1997) has been used by numerous researchers and extension personnel to assist rural decision makers in estimating economic impacts of exogenous changes to a local community. Other models have been developed to incorporate estimates of economic change and derive consequential fiscal impact to local governments (Swallow and Johnson 1987; Beemiller 1989; Deller et al. 1996; Shields 1998; Johnson et al. 1996; Swenson 1996.)

For this analysis, the cross-sectional model developed by Johnson et al. (1996) will be used to derive fiscal impacts for the Great Basin area. The primary impetus for development of a Great Basin Area model was the statistical problem of the state of Nevada having only seventeen counties. To address the problem of insufficient observations for statistical estimation, application of BEA Economic Areas will be employed. Through the use of BEA Economic Areas, a Great Basin fiscal impact model will be developed for this applied research. In pursuance of this objective, the paper will be divided into three parts. First, a discussion of BEA Economic Areas and the area used in this model will be presented. Second, development of a fiscal impact model will be discussed. Finally, results of the cross-sectional Great Basin fiscal impact model will be presented and applied to a rural county in the state of Nevada.

2. BEA Economic Areas

In order to develop procedures for estimation of fiscal impact modeling for the state of Nevada, the region was expanded to include counties in California, Idaho, Utah and Arizona. The area of analysis was designated as the Great Basin, which includes Bureau of Economic Analysis (BEA) areas of 149, 150, 151, 152 and 153 (Figure 1). The BEA divides geographic areas of the United States into economic areas along county boundaries. Each BEA economic area consists of a metropolitan statistical area, or a similar area, as a core trading center. The surrounding counties within the economic area are related to the core area (U.S. Department of Commerce, 1995.) An unusual characteristic of BEA economic areas is that they may cross state lines. [1]

The state of Nevada has only 17 counties, so employing cross-sectional procedures developed by Johnson et al. (1996) would be problematic. The problem centers on obtaining statistical significance for the estimated variables given the limited sample size. By aggregating the five BEA economic areas, however, there should be enough observations to develop a meaningful cross-sectional fiscal impact model. Because of the multi-state nature of this model, the fiscal impact model developed for this applied research will be referred to as the Great Basin fiscal impact model.

Population growth in the counties of the Great Basin Area has been fairly rapid throughout the 1990's. For example, the Great Basin Area grew by 18.87 percent between 1990 and 1995 with the state of Nevada realizing a 27.33 percent growth rate. The nation grew by only 5.35 percent during this five-year period. Clark County, Nevada, which includes the city of Las Vegas, realized the highest growth rate of all Great Basin counties with an increase in population of 33.89 percent from 1990 to 1995. Non-metropolitan counties of the Great Basin Study Area realized a population increase of 18.27 percent from 1990 to 1995. This growth

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[1] **BEA Economic Area 149:** Blaine, Idaho; Camas, Idaho; Cassia, Idaho; Gooding, Idaho; Jerome, Idaho; Lincoln, Idaho; Minidaka, Idaho; Twin Falls, Idaho. **BEA Economic Area 150:** Ada, Idaho; Adams, Idaho; Boise, Idaho; Canyon, Idaho; Elmore, Idaho; Gem, Idaho; Owyhee, Idaho; Payette, Idaho; Valley, Idaho; Harney, Oregon; Malheur, Oregon. **BEA Economic Area 151:** Alpine, California; Inyo, California; Lassen, California; Mono, California; Plumas, California; Churchill, Nevada; Douglas, Nevada; Elko, Nevada; Eureka, Nevada; Humboldt, Nevada; Lander, Nevada; Lyon, Nevada; Pershing, Nevada; Storey, Nevada; White, Pine, Nevada; Carson City, Nevada; Washoe, Nevada. **BEA Economic Area 152:** Davis, Utah; Franklin, Utah; Oneida, Utah; Box Elder, Utah; Cache, Utah; Carbon, Utah; Emery, Utah; Grand, Utah; Juab, Utah; Millard, Utah; Morgan, Utah; Salt Lake, Utah; Sanpete, Utah; Sevier, Utah; Summit, Utah; Toole, Utah; Uintah, Utah; Utah, Utah; Wasatch, Utah; Wayne, Utah; Weber, Utah. **BEA Economic Area 153:** Clark, Nevada; Esmeralda, Nevada; Lincoln, Nevada; Mineral, Nevada; Nye, Nevada; Beaver, Utah; Garfield, Utah; Iron, Utah; Paiute, Utah; Washington, Utah; Mohave, Arizona.

rate lagged Great Basin area metropolitan county growth of 19.15 percent but exceeded national non-metropolitan growth of approximately 4.85 percent during this five-year period.

Even with rapid population growth rates during the 1990's, the non-metropolitan counties of the Great Basin continue to be sparsely populated. Population density for the Great Basin counties ranges from 323.66 persons per square mile in Carson City County, Nevada to 0.33 persons per square mile in Esmeralda County, Nevada. Per capita income in 1995 for non-metropolitan counties in the Great Basin was $17,577 while 1995 metropolitan county per capita income for the Great Basin Area was $20,861.

Given the rapid population growth that has occurred in the Great Basin Area as well as the new governance relationship between federal, state and local government levels caused by devolution, rural decision makers may find their demand for timely data and analyses increasing.

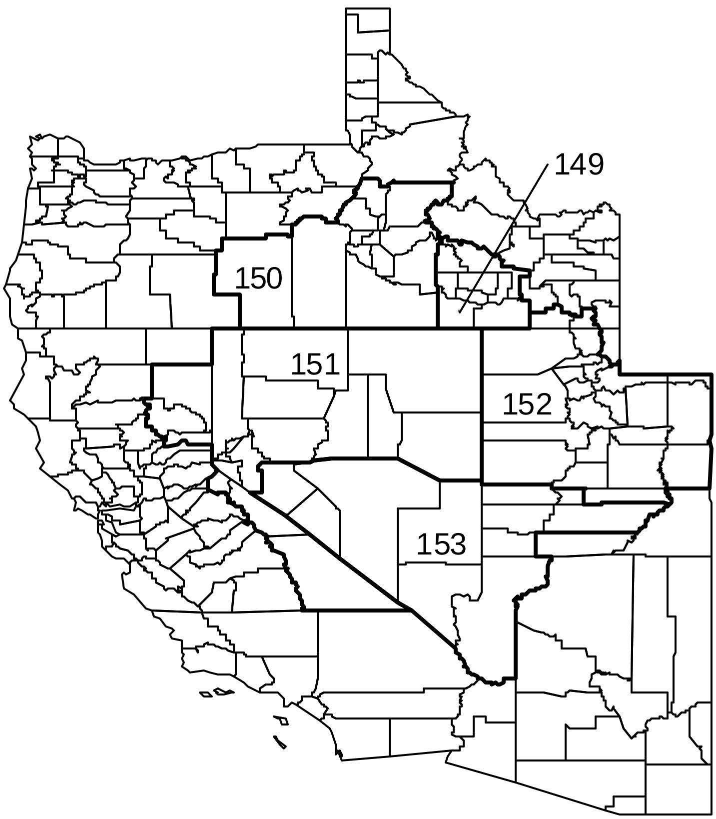

Figure 1. Great Basin Study Area

In order to facilitate and meet the demands of rural decision-makers, a fiscal impact model should be useful to predict potential impacts of new economic developments or changes in natural resource management policies.

3. Model Development

The model for this applied research explicitly recognizes the interrelationships between economic and demographic characteristics, local government expenditures and revenues, and level of taxes. The model clearly follows the fiscal impact models developed by Johnson et al. (1996), Swenson (1996), and Beemiller (1989). This fiscal impact model crosses state boundaries by employing state-specific dummy variables and investigates the potential of using place of work employment rather than place of residence employment for fiscal impact modeling.

For the Great Basin fiscal impact model, county revenue and expenditure data for California, Idaho, Nevada and Utah counties within the five BEA Economic Areas of the Great Basin Area were used. Since there was only one Arizona county, and two Oregon counties in the five BEA Economic Areas, their observations were excluded from the analysis. Expenditure and revenue equations are allowed to have differential slope and intercept dummy variables for each state. Fixed effects were used to capture differential institutional constraints for each state regarding revenues and expenditures and to account for factors not represented by socio-economic variables. Fixed effects were also considered to account for factors unique to metropolitan counties.

In the study by Beemiller (1989) a fiscal impact model was developed that crossed state boundaries. Employing dummy variables and step-wise regression techniques, appropriate variables for each state's fiscal impact model were derived. Step-wise regression, however, has been criticized as a technique for determining model specification. The criticism of step-wise regression is that as a mechanical procedure it strives to maximize the number of statistically significant regressors, and the true significance of regressors tend to be overstated due to sequential test bias. One result of this problem is that small changes in the sample can have pronounced effects on the magnitudes and significance of the models' estimated parameters (Draper and Smith, 1998; Pindyck and Rubinfeld, 1981).

In the fiscal impact models developed by Johnson et al. (1996) and Swenson (1996), a labor module is developed to derive county labor force estimates. The labor module is very helpful in estimating changes in county in-commuters, out-commuters and unemployment due to changes in economic activity. Development of a labor module can be quite intensive and time consuming. Also, county estimates of in-commuters and out-commuters for estimation in the labor module are only available from journey to work analysis conducted on a decennial basis (U.S. Department of Commerce, 1997).

If one does not require a labor module in the analysis, however, it might be advantageous to investigate the relative contributions of county place of work and county place of resident employment in the estimation of county expenditures and revenues. Of these two employment measures, place of work employment would be preferred, since models such as input-output and export-base forecast place of work employment. A statistical test of the informational value of the place of residence employment variable in the estimation of county level fiscal relationships was employed for this analysis.

Additionally, the fiscal model developed in this applied research and those developed by Johnson et al (1996) and Swenson (1996) are cross-sectional models. These cross-sectional models represent average relationships across a large number of jurisdictions. For the Great Basin fiscal impact models, the average relationships cover four states except for the use of dummy variables. For an individual county, county specific factors may need to be incorporated in the analysis when appropriate.

4. Expenditure and Revenue Module

Following Hirsch (1970, 1977); Beaton (1979); Stinson (1978); and Stinson and Lubov (1982), cost of public services is hypothesized to be a function of the level and quality of services. Using Census of Government data (1992), public service expenditures are broken down into eleven categories: capital outlay, education, welfare, hospitals, health, highways, police protection, correction, natural resources and parks and recreation, sewage and solid waste management, and interest on general debt. For some counties, there were no responses on any cost category and for some counties separation of costs among the eleven categories was not made. Therefore, for this analysis, total county expenditures were used for the regression model.

For revenues, county data from the Census of Government (1992) were used. County revenue data were compiled in detail for those counties that reported. County revenue categories were non-local federal government; intergovernmental revenues, non-local state government; intergovernment revenues, local government general fund tax revenues, and local government general fund non-tax revenues.

County place of work employment estimates were derived from the Regional Economic Information System (U.S. Department of Commerce 1998). Labor force, unemployment, population, county acreage, and public lands data were derived from "USA Counties 1996" (U.S. Department of Commerce 1998).

For the total government expenditure equation, total government expenditures were specified as a function of employment by place of work, the unemployment rate and population density. Given that Nevada rural counties are sparsely populated, distance increases the cost of providing some government services at satellite locations, even though the population base is insufficient to fully utilize the capacity. These service costs may make government expenditures less sensitive to population changes in low-density rural areas. Also areas of higher unemployment may mean higher government costs due to welfare demands.

For the local government revenue models, the following regression models were developed. Non-local federal intergovernmental revenue was specified as a function of employment by place of work and percentage of total county land area under federal ownership. This latter variable is included because a characteristic of the Great Basin Study Area is the presence of federal lands. For the four states in this analysis, the percentage of federal lands ranges from 61.6 percent in the state of Idaho to 82.9 percent in the state of Nevada. For five of Nevada's seventeen counties, the federal government administers over ninety percent of total land acreage.

For non-local state intergovernmental revenues, local employment by place of work, the rate of unemployment and percentage of non-white population were found to be significant factors in explaining these revenues. Local unemployment rate and percentage of non-white population are important factors in allocating state government funds to county governments. Also the level of county government economic activity and / or the local employment by place of work influence intergovernmental revenue to county government from the state government.

As for county government tax revenues, the primary factor for local tax revenue is the level of local economic activity that is represented by the employment by place of work variable. Other county revenues except for tax revenues are found to be a function of local employment by place of work and unemployment rate. Local employment by place of work reflects economic activity of the local economy.

5. Results

A Box-Cox estimator was employed and results suggested that the data supported a logarithmic functional form; hence all equations employed logarithmic transformations of the continuous variables. Madalla (1998) suggests transforming the data into logarithmic form in order to reduce heteroskedasticity in error variance. The importance of fixed effects was investigated by including dummy variables for intercepts and slopes to account for metropolitan effects, state of Nevada effects and state of Idaho effects. Using joint test procedures, the F-test results found these fixed effects were statistically significant regressors, except for the population model (Table 1). Therefore, dummy variables will be used for county expenditures and revenue functions while the population equation will not employ dummy variables.

Using the county expenditures, revenue and population equations as a system, place of work employment and place of residence regressors were tested for differences using seemingly unrelated regression procedures. If regressors do not differ, place of work employment is preferred, since most employment is reported by place of work and results of export-base and input-output models are reported by place of work employment.

In the previous section, a discussion was presented on the use of either place of work employment or place of residence employment in the estimation of county expenditures, revenue and population. For many impact models, such as input-output or export-base models, place of work employment is often derived from model results. Therefore, using seemingly unrelated regression system procedures and given the model specification for the system of equations, a test was completed to determine if place of residence employment improves model fit. That is, the null hypothesis is that the coefficient on place of residence variables is zero.

Table 1. Joint Test of Dummy Variable Regression Coefficient for County Expenditure, Revenue and Population Equations

Model	Unrestricted Model[1] R^2	Restricted Model[2] R^2	Calculated F-Statistic	Degrees of Freedom
County Expenditure	0.8831	0.7036	4.4725*	(16, 47)
Federal Gov't Intergovernmental Revenue	0.7380	0.6232	1.9940*	(12, 52)
State Gov't Intergovernmental Revenue	0.7778	0.4564	4.2749*	(16, 47)
Local Government Tax Revenues	0.8413	0.6771	6.9636*	(8, 57)
Local Government Non-Tax Revenues	0.7699	0.6258	2.7137*	(12, 52)
Population	0.9950	0.9945	0.7125	(8, 57)

* denotes calculated F-statistic is greater than the tabled F-statistics at the five percent significance level.
[1] Unrestricted model denotes the model with all variables included.
[2] Restricted model denotes the model where no dummy variables are allowed.

Using Lagrangian multiplier (LM) test for adding variables (Gujarati 1995) for a system of equations and correcting for degrees of freedom, the calculated chi-square value was 34.64. At the 0.05 level of significance, this chi-squared value signifies that as a group the place of residence employment variable in the fiscal system may be omitted when place of work variables are present. Therefore, place of work employment will be used for this analysis.

Total County Expenditures

The dependent variable is the sum of the eleven county expenditure categories.

$$
\begin{aligned}
LTOTX = \; & \underset{(0.9945)}{6.8861} + \underset{(0.0953)}{0.8243}\, LW9 + \underset{(0.2636)}{0.6219}\, LUE - \underset{(0.0638)}{0.1259}\, LPD + \underset{(0.2892)}{0.1384}\, LMETW9 + \underset{(0.8357)}{0.3521}\, LMETUE \\
& + \underset{(0.1174)}{0.0958}\, LMETPD + \underset{(0.1285)}{0.0029}\, NVW9 - \underset{(0.1611)}{0.0940}\, IDW9 - \underset{(0.2353)}{0.1613}\, CAW9 - \underset{(0.4932)}{0.2775}\, NVUE \\
& - \underset{(0.3762)}{0.6487}\, IDUE + \underset{(1.6050)}{0.5498}\, CAUE + \underset{(0.0758)}{0.0919}\, NVPD + \underset{(0.0872)}{0.0940}\, IDPD - \underset{(0.2288)}{0.0400}\, CAPD \\
& - \underset{(4.2310)}{2.2851}\, MET + \underset{(1.4410)}{1.3509}\, ND + \underset{(1.6700)}{1.8606}\, ID + \underset{(5.0320)}{1.2351}\, CD
\end{aligned}
\qquad (1)
$$

Standard errors are in parenthesis $R^2 = 0.8831$

Where:

LTOTX is the log total county government expenditures;
LW9 is the log county place of work employment;
LUE is the log county unemployment rate;
LPD is the log county population density;
LMETW9 is the log metropolitan county place of work slope dummy variable;
LMETUE is the log metropolitan county unemployment rate slope dummy variable;
LMETPD is the log metropolitan county population density slope dummy variable;
NVW9 is the log Nevada county place of work slope dummy variable;
IDW9 is the log Idaho county place of work slope dummy variable;
CAW9 is the log California county place of work slope dummy variable;
NVUE is the log Nevada county unemployment rate slope dummy variable;
IDUE is the log Utah county unemployment rate slope dummy variable;
CAUE is the log California county unemployment rate slope dummy variable;
NVPD is the log Nevada county population density slope dummy variable;
IDPD is the log Idaho county population density slope dummy variable;
CAPD is the log California population density slope dummy variable;
MET is the intercept dummy Metropolitan county variable;
NV is the intercept dummy Nevada variable;
ID is the intercept dummy Idaho variable; and
CD is the intercept dummy California variable.

For equation 1, Utah is the reference state. Therefore for the state of Utah, a one percent increase in place of work employment increases total non-metropolitan county government expenditures in Utah by 0.8243%. For the state of Nevada, a 1% increase in place of work employment increases total non-metropolitan county expenditures in Nevada by 0.8272% (0.8243 + 0.0029). For the state of Idaho, a 1% increase in place of work employment increases non-metropolitan county total expenditures in Idaho by 0.7303% (0.8243 - 0.0940). For the six northern California counties, a 1% increase in place of work employment increases non-metropolitan county total expenditures for the six northern counties in California by 0.6630% (0.8243 - 0.1613).

As for population density, the negative sign for the coefficients yields information about economies of size. Using Utah as the reference state, a 1% increase in population density decreases non-metropolitan total county expenditures in Utah by 0.1259%. For Nevada, a 1% increase in population density decreases total non-metropolitan Nevada county expenditures by 0.0340% (-0.1259 + 0.0919). For Idaho, 1% increase in population density decreases total non-metropolitan county expenditures by 0.0319% (-0.1259 + 0.940) while for the six northern California counties a 1% increase in population density would decrease total non-metropolitan Northern California county expenditures by 0.1659. Results show that non-metropolitan total county expenditures for Nevada and Idaho counties are less responsive to changes in population than Utah and the six northern California counties. This may be due to overall low population densities and required mandated service levels for community services by federal and state governments.

Federal Government – Intergovernmental Revenues

This equation will be used with three other revenue equations to derive changes in county government revenues from changes in local employment by place of work.

$$\begin{aligned} LFG = \; & \underset{(2.5550)}{-2.9171} + \underset{(0.1887)}{0.7901}\, LW9 + \underset{(0.3965)}{2.0812}\, LPL + \underset{(0.6428)}{0.1352}\, LMETW9 - \underset{(0.6953)}{1.0932}\, LMETPL \\ & + \underset{(0.2461)}{0.1512}\, NVW9 + \underset{(0.3423)}{0.0724}\, IDW9 - \underset{0.4916)}{0.6443}\, CAW9 - \underset{(0.6721)}{0.8804}\, NVPL + \underset{(0.5484)}{0.3273}\, IDPL \\ & - \underset{(2.9390)}{1.1357}\, CAPL + \underset{(7.2980)}{2.0800}\, MET + \underset{(3.6490)}{2.8822}\, NV - \underset{(4.4810)}{2.9562}\, ID + \underset{(13.9100)}{10.1210}\, CD \end{aligned} \qquad (2)$$

Standard errors are in parenthesis $R^2 = 0.7380$

Where:

LFG is the log federal intergovernmental revenues to county governments;
LPL is the log value of the percentage of county total acreage under federal ownership;
LMETPL is the log value of the percentage of metropolitan county total acreage under federal ownership;
NVPL is the log value of the percentage of county total acreage under federal ownership for the state of Nevada slope dummy;
IDPL is the log value of the percentage of county total acreage under federal ownership for the state of Idaho slope dummy;
CAPL is the log value of the percentage of county total acreage under federal ownership for the state of California slope dummy; and other variables were defined earlier.

For equation 2, the reference state is Utah. Therefore for the state of Utah, a 1% increase in place of work in Utah increases total non-metropolitan federal government intergovernmental revenues by 0.7901%. In the state of Nevada, a one percent in place of work employment would increase non-metropolitan county federal government intergovernmental revenues by 0.9413% (0.7901 + 0.1512). For the state of Idaho, a 1% increase in place of work employment would increase non-metropolitan revenues by 0.8625% (0.7901 + 0.0724). For the six northern California counties, a 1% increase in place of work employment would increase non-metropolitan revenues by 0.1458% (0.7901 - 0.6443).

Also of interest is the elasticity of non-metropolitan federal government intergovernmental revenues from a 1% change in proportionate share of public lands to total county land acreage. For the states of California, Utah, Nevada and Idaho, the respective elasticities are 0.9455, 2.0812, 1.2008 and 2.4085. The state of Nevada, which has the largest proportionate share of federal land ownership surprisingly, has the second lowest elasticity coefficient among these states. The low elasticity for the six northern California counties is due to their population and public land acreage. A primary source of federal funds from public lands is payment in lieu of taxes (PILT). However, PILT payments are capped by population, which often restricts PILT payments to many rural Nevada counties and the six northern California counties in the study. Therefore, any change in the proportionate share of public lands in a county will have somewhat limited impacts in the state of Nevada and/or the six northern California counties compared to Idaho and Utah.

Also of interest, is the impact of increased public land acreage on metropolitan areas. The negative value for the metropolitan variable indicates lower elasticity for metropolitan areas from changes in public land acreage. This is due to procedures employed in calculating PILT payments.

For equation 3, the reference state is Utah. For the state of Utah, a 1% increase in place of work employment in Utah increases state government intergovernmental revenues to non-metropolitan county general funds in Utah by 0.4105%. For the state of Nevada, a 1% increase in the place of work in Nevada increases state government intergovernmental revenues to non-metropolitan county governments in Nevada by 0.4815% (0.4105 + 0.0710). For the state of Idaho, a 1% increase in place of work employment increases state government intergovernmental revenues to non-metropolitan counties in Idaho by 0.4727% (0.4105 + 0.0622). For the six northern California counties, a 1% increase in place of work employment increases state government intergovernmental revenues to the six northern California non-metropolitan counties by 0.0857% (0.4105 - 0.3248).

State Government-Intergovernmental Revenues

This equation will be used with three other revenue equations to derive changes in the detailed revenue categories from changes in local employment by place of work.

$$\begin{aligned}
LSG = \; & \underset{(1.8580)}{7.9391} + \underset{(0.1423)}{0.4105}\,LW9 + \underset{(0.5697)}{0.8617}\,LUMR + \underset{(0.1852)}{0.3409}\,LPNW + \underset{(0.6753)}{0.5053}\,LMETW9 - \underset{(2.8090)}{0.5232}\,LMETUE \\
& + \underset{(0.9990)}{0.7565}\,LMETNW + \underset{(0.1965)}{0.0710}\,NVW9 + \underset{(0.2271)}{0.06224}\,IDW9 - \underset{(0.3843)}{0.3248}\,CAW9 - \underset{(1.0550)}{0.2674}\,NVUE \\
& - \underset{(0.7974)}{1.1934}\,IDUE - \underset{(3.5830)}{5.1284}\,CAUE - \underset{(0.5025)}{0.6618}\,NVNW - \underset{(0.2856)}{0.6036}\,IDNW - \underset{(0.6528)}{0.6639}\,CANW \\
& - \underset{(10.9600)}{5.7387}\,MET + \underset{(2.7630)}{2.4566}\,NV + \underset{(3.0090)}{2.3279}\,ID + \underset{(10.0400)}{18.7470}\,CA
\end{aligned}$$

Standard errors are in parenthesis $R^2 = 0.7778$

Where:

LSG is log state government intergovernmental revenues to county government; (3)
LPNW is log county percentage of total population that is non-white;
LMETNW is log metropolitan county percentage of total population that is non-white;
NVPNW is log county percentage of total county population in the state of Nevada that is non-white dummy slope variable;
IDPNW is log county percentage of total county population in the state of Idaho that is non-white dummy slope variable;
CAPNW is log county percentage of total county population in the state of California that is non-white dummy slope variable, and other variables were defined earlier.

County Government Funds from Taxable Sources

This equation will be used with three other revenue equations to derive changes in detailed revenues from exogenous changes in the local economy.

$$\begin{aligned}
LLTX = \; & \underset{(0.8602)}{7.1527} + \underset{(0.0927)}{0.7814}\,LW9 + \underset{(0.3003)}{0.6847}\,LMETW9 - \underset{(0.1144)}{0.1453}\,NVW9 + \underset{(0.1554)}{0.2065}\,IDW9 - \underset{(0.2425)}{0.2841}\,CAW9 \\
& - \underset{(3.6220)}{8.3718}\,MET + \underset{(1.1030)}{1.9899}\,NV - \underset{(1.4830)}{2.0321}\,ID + \underset{(2.1420)}{4.0188}\,CA
\end{aligned}$$

Standard errors are in parenthesis $R^2 = 0.8413$

Where: (4)

LLTX is log county government revenues from taxes; and other variables were defined earlier.

For equation 4, the reference state is the state of Utah. Therefore, for the state of Utah, a 1% increase in place of work employment in Utah increases county government revenues to non-metropolitan county general funds by 0.7814%. For the state of Nevada, a 1% increase in place of work employment increases county revenues from taxes for Nevada non-metropolitan counties by 0.6361% (0.7814 – 0.1453). For the state of Idaho, a 1% increase in place of work employment increases county revenues from taxes for non-metropolitan counties for the state of Idaho by 0.9879% (0.7814 + 0.2065). For the six northern California counties, a

1% increase in place of work employment increases county revenues from taxes for these six northern California non-metropolitan counties by 0.4973% (0.7814 - 0.2841).

County Government Funds from Non-Taxable Sources

This equation will be used with three other revenue equations to derive changes in detailed revenue from exogenous changes in the local economy.

$$\begin{aligned} LOCR = {} & \underset{(1.9070)}{3.8143} + \underset{(0.1448)}{0.8310}\,NVW9 + \underset{(0.5793)}{1.3760}\,LUE - \underset{(0.5362)}{0.4455}\,LMETW9 - \underset{(1.8250)}{1.4759}\,LMETUE + \underset{(0.2027)}{0.3882}\,NVW9 \\ & - \underset{(0.2453)}{0.0431}\,IDW9 - \underset{(0.4013)}{0.4262}\,CAW9 - \underset{(1.0980)}{1.7356}\,NVUE - \underset{(0.8148)}{0.8112}\,IDUE - \underset{(3.4820)}{3.0822}\,CAUE + \underset{(8.5720)}{8.1871}\,MET \\ & + \underset{(2.7900)}{0.8317}\,NV + \underset{(3.1760)}{1.8356}\,ID + \underset{(10.5400)}{11.8540}\,CA \end{aligned} \tag{5}$$

Standard errors are in parenthesis $R^2 = 0.7699$

Where:

LOCR is log county government revenues other than taxes, and other variables were discussed earlier.

For equation 5, the reference state is Utah. Therefore, for the state of Utah, a 1% increase in place of work employment in Utah increases county government revenues from non-taxes for non-metropolitan county general funds by 0.8310 percent. For the state of Nevada, a 1% increase in place of work employment increases county revenues other than taxes for Nevada non-metropolitan counties by 1.2192% (0.8310 + 0.3882). For the state of Idaho, a 1% increase in place of work employment increases county revenues from non-tax sources for non-metropolitan counties in the state of Idaho by 0.7879% (0.8310 - 0.0431). For the state of California, a 1% increase in the place of work employment increases county revenues from non-tax sources for non-metropolitan counties in the state of California by 0.4048% (0.8310 - 0.4262).

Population Estimation

From the place of work data, estimation of county employment was derived from the following equation:

$$LPOP = \underset{(0.0887)}{0.10261} + \underset{(0.0092)}{0.9977}\,LW9 \tag{6}$$

Standard errors in parenthesis $R^2 = 0.9945$

Because of the findings reported in Table 1, dummy variables were not used for equation 6. From equation 6, a 1% increase in place of work employment increases county population by 0.997%.

6. Example Application

For this section an example application of the Great Basin fiscal impact model will be presented for the state of Nevada. For this example, assume that new business development occurs in Lincoln County, Nevada and that this development yields a total place of work employment increase of 300 employees. Using equations 1 through 6, the expected Lincoln County, Nevada expenditures and revenues are calculated.

Nevada County Expected Total Expenditures:

Using equation 1, expected Lincoln County total expenditures can be stated as:

$$E(NVTOTX) = 8.2370 + 0.8533\ NVW9 + 0.3444\ NVUE - 0.0340\ NVPD \qquad (7)$$

Where:

E(NVTOTX) is expected log county total expenditures;
NVW9 is log Nevada county place of work employment;
NVUE is log Nevada county unemployment rate; and
NVPD is log Nevada county population density

For estimation of expected county expenditure impacts for Lincoln County, the place of work employment in 1992 was 2,210 with a 1992 unemployment rate of 9.49% and 1992 population density value of 0.353 persons per square mile. Also assume there was an increase of 300 place of work employees in Lincoln County from a given development. The calculated expected increase in county expenditures for Lincoln County is estimated to be $808,357. [2]

Nevada County Expected Federal Government-Intergovernmental Revenues:

Using equation 2, expected Lincoln County federal government-intergovernmental revenues can be stated as:

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[2] To derive the impacts to county expenditures and revenues, the logarithmic formula is given as: $\ln y = a_0 + b_1 \ln x + b_2 \ln z + \varepsilon$

Where y is the dependent variable and x and z are the independent variables. To derive the estimate of y, the logarithmic formula can be in exponential form to derive the dependent variable y as represented by y_1 as follows: $y_1 = e^{(a_0 + b_1 \ln x + b_2 \ln z + ½ \sigma)}$

If the variable x was increased by 300, the value of dependent variable y is represented by y_2 as follows: $y_2 = e^{[a_0 + b_1 \ln (x+300) + b_2 \ln z + ½ \sigma]}$

After deriving y_1 and y_2, the increase in county expenditures or revenues from a 300 unit increase in variable x is derived for variable y_3 or as shown below:

$y_3 = y_2 - y_1$

$$E(NVLFG) = -0.0349 + 0.9413\ NVW9 + 1.2017\ NVPL \tag{8}$$

Where:

E(NVLFG) is expected log Nevada federal government-intergovernmental revenues;
NVPL is log Nevada percentage of county land under federal administration; and
NVW9 was defined earlier.

For estimation of expected federal government-intergovernmental revenues for Lincoln County, the place of work employment in 1992 was 2,210 with the percentage of Lincoln County land under federal administration being 98.29%. Also assume there is a total increase in 300 place of work employees in Lincoln County as a result of a given development. The calculated expected increase in federal government-intergovern-mental revenues for Lincoln County is $88,542.

Nevada County Expected State Government-Intergovernment Revenue:

Using equation 3, expected Lincoln County state government-intergovernmental revenue can be stated as:

$$E(NVLSG) = 10.3957 + 0.4815\ NVW9 + 0.5943\ NVUE - 0.3209\ NVNW \tag{9}$$

Where:

E(NVLSG) is expected log Nevada state government-intergovernmental revenues;
NVNW is log Nevada county percent of non-white population to total population; and
NVUE and NVW9 were defined earlier.

For estimation of expected state government-intergovernmental revenues for Lincoln County, the place of work employment in 1992 was 2,210 with county unemployment rate of 9.49% and non-white population of 8.03%. Also, assume there is a total increase of 300 place of work employees in Lincoln County as a result of a given development. The calculated expected increase in state government-intergovernmental revenues for Lincoln County was $234,471.

Nevada County Government Funds from Taxable Sources:

Using equation 4, expected Lincoln County government funds from taxable sources can be estimated as:

$$E(LLTX) = 9.1426 + 0.6361\ NVW9 \tag{10}$$

Where:

E(LLTX) is expected log Nevada funds from taxable sources; and
NVW9 was defined earlier.

For estimation of expected county funds from taxable sources for Lincoln County, the place of work employment in 1992 was 2,210. Also assume there is a total increase of 300 place of work employees in Lincoln County as a result of a given development. The calculated expected increase in county government funds from taxable sources in Lincoln County is $124,999.

Nevada County Government Funds from Non-Taxable Sources:

Using equation 5, expected Lincoln County government funds from non-taxable sources can be estimated as:

$$E(NVLOCR) = 4.6460 + 1.2192\ NVW9 - 0.3596\ NVUE \tag{11}$$

Where:

E(NVLOCR) is expected log Nevada funds from non-taxable sources; and
NVW9 and NVUE were defined earlier.

For estimation of expected county funds from non-taxable sources for Lincoln County, the place of work employment in 1992 was 2,210 with an unemployment rate of 9.49%. Also assume there is a total increase of 300 place of work employees in Lincoln County as a result of a given development. The calculated expected increase in county government funds from non-taxable sources for Lincoln County is $139,620.

Nevada County Population:

Using equation 6, expected county population can be estimated as:

$$E(LPOP) = 0.1026 + 0.997\ NVW9 \tag{12}$$

Where:

E(LPOP) is expected log Nevada population and LW9 was defined earlier.

For estimation of population impacts for Lincoln County, the place of work employment in 1992 was 2,210. Assuming a development in Lincoln County has total place of work employment impacts of 300 employees in Lincoln County, the place of work employment yields a population increase of 557 people.

It is of interest that the forecast county expenditures from the 300 job increase are approximately $220,000 higher than expected revenues. With this example, only place of work employment was used while all other variables remained constant. For a complete analysis with the 300 place of work employment increase, other exogenous variables, such as the unemployment rate or population density would change. This would lower expected county total expenditures. In addition, other independent variables, such as county unemployment rate and percentage non-whites in county labor force would change. This would increase county government revenues. If there were no changes to exogenous variables with a 300 employee increase, the marginal impact to county fiscal balances is negative from our example analysis in Lincoln County, Nevada.

7. Conclusion

In this applied research we investigated procedures to develop a cross-sectional fiscal model using data for more than one state. BEA economic areas were used to collect observation numbers for statistical analysis. Employing seemingly unrelated regression techniques, LM tests were employed and found no statistical difference in regression coefficients in the estimation of county revenues and expenditure equations between place of work employment and place of residence employment. Also F-test was used to derive significance of dummy variables to derive differential impacts of metropolitan counties and counties in the states of Idaho, Nevada and Utah.

In using the Great Basin fiscal models, certain precautions should be kept in mind. First, cross-section regressions represent average relationships across a large number of jurisdictions. Local factors, such as excess capacity in the county's infrastructure can be incorporated in a case-by-case basis, based on local conditions. Second, fiscal impacts are assumed to occur the same year as the exogenous impacts. It is likely that expenditures for a given exogenous change will be needed before the change occurs and revenue increases may occur some time later. Third, county expenditures are measured as a linear function of place of work employment and population. Therefore, in times of decreased employment, the amount of county government expenditures may not decline as rapidly because of federal and state community service mandates and those unemployed being on unemployment insurance. In summation, the fiscal components may be less appropriate for economic declines than expansions.

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