

Measuring State Tax Capacity and Effort*

William D. Berry, *Florida State University*

Richard C. Fording, *University of Kentucky*

Many political scientists and economists have used the American states as units of analysis to test theories of the determinants of economic conditions and public sector policy choices. In the models developed in this research, *tax capacity* and *tax effort* appear quite frequently as independent variables. Tax capacity can be defined as the "capability of a governmental entity to finance its public services" (Advisory Commission on Intergovernmental Relations [ACIR], 1982:2). In turn, a government's tax effort can be understood as the extent to which it utilizes its tax capacity (ACIR, 1990:13). Both tax capacity and tax effort are often measured with indicators constructed by the Advisory Commission on Intergovernmental Relations (ACIR) (ACIR, 1982). Although the ACIR measures have been criticized and alternative indicators have been proposed (Akin, 1973; Office of State and Local Finance, 1985; Wildasin, 1987:481-483), none have challenged the dominance of the ACIR measures in social science research. The ACIR tax-capacity index has been used as an explanatory variable in models of state social welfare spending (Schinnar et al., 1992; Hill, Leighly, and Hinton-Andersson, 1995), economic development policy (Ambrosius, 1989), interest-group regulation (Opheim, 1991), and tax equity (Morgan, 1994). ACIR's tax-effort index—or measures of change in the index—have been employed in models of state economic and industrial growth (Romans and Subrahmanyam, 1979; Plaut and Pluta, 1983), borrowing costs (Marks and Raman, 1987), and lottery adoptions (Filer, Moak, and Uze, 1988; Wohlenberg, 1992), as well as other state economic conditions (Benson, Marks, and Raman 1988; Clapp, Fields, and Ghosh, 1990) and policy outcomes (Ambrosius, 1989;

*Direct all correspondence to William D. Berry, Department of Political Science, Florida State University, Tallahassee, FL 32306-2049, or e-mail at wberry@garnet.acns.fsu.edu. We wish to thank Evan Ringquist and the *Quarterly's* referees for their helpful comments on an earlier version of this paper. All data analyzed in this paper (and associated documentation) are available from ICPSR (#S1124) and from the State Politics and Policy Data Archive in the Policy Sciences Center at Florida State University. The research presented in this paper was partially funded by Berry's National Science Foundation grant (SBR-9320849). Editor's Note: Reviewers were David Morgan and John Due.

Schinnar et al., 1992; Morgan, 1994; Hill, Leighly, and Hinton-Andersson, 1995).¹

Numerous studies of state policymaking have argued that the level of state economic resources is among the principal determinants of policy choices. Such resources are conceived as placing economic constraints on the behavior of government elites (Plotnick and Winters, 1985; Berry and Berry, 1992). Various socioeconomic variables, including per capita income, urbanization, and level of industrialization, have been used to reflect economic resources (Dye, 1966; Fry and Winters, 1970; Tweedie, 1994). All these variables have significant weaknesses as measures of state resources. Urbanization and industrialization, while partly indicative of resources, also reflect the demand for government services (Dawson and Robinson, 1963; Hofferbert, 1966; Berry and Berry, 1992), a concept distinct from resources available. Personal income certainly reflects one tax base that state governments can tap for revenues, but states rely on a wide variety of other tax bases, including corporate income, consumption, and property (ACIR, 1982: 7–10; Wildasin, 1987:481). Many scholars who have sought a measure of state resources that reflects the presence of the wide range of resource bases that states tap for revenue have chosen the ACIR index of tax capacity as the best alternative.

While the ACIR indicators have become the standard measures of tax capacity and effort since their introduction in 1967, unfortunately, neither measure is available for all years. Even in very recent years, measurement has been infrequent; since 1986, the variables have been observed only in 1986, 1988, and 1991. While they were measured annually for the period 1980–1986, prior to 1980, there are only four years of observation: 1979, 1977, 1975, and 1967. This scattered measurement pattern precludes the use of either measure in cross-sectional analyses in many years and seems to have forced some analysts to measure tax capacity or effort in a year other than that preferred.² Moreover, social scientists studying the states increasingly have been relying on pooled cross-sectional time-series analysis, realizing that they can better test their theories by supplementing cross-sectional variation with annual variation within states.³

Currently, the longest continuous period of annual ACIR observations is 1979–1986; there are no other periods with even two years in a row.

¹Policy analysts have also taken the normative position that states' values on ACIR's tax-capacity and tax-effort indexes should be used to determine the allocation of federal grant-in-aid assistance to states (e.g., Dommel, 1983; Buck and Kamlet, 1993).

²For example, Romans and Subrahmanyam (1979) study the determinants of state economic growth over the 1964–1974 period and measure most independent variables in 1964. Presumably, they would prefer a 1964 tax effort measure to the 1967 observation they use. We also speculate that Marks and Raman (1987) would not have observed the change in tax effort from 1967 to 1975 if data were available for other years.

³Pooled analyses employing the ACIR indexes of tax capacity and/or effort include pieces by Plaut and Pluta (1983), Ambrosius (1989), and Hill, Leighly, and Hinton-Andersson (1995).

Measuring these variables for missing years using the ACIR methodology would be an arduous and expensive task. Thus, the best practical hope is to construct good estimates of the missing observations.⁴ This paper calculates estimates of the ACIR's tax-capacity and tax-effort indexes for all missing years between 1960 and 1991, thereby creating a data set that will be useful in a wide range of cross-sectional and pooled analyses.

The ACIR's Measurement Methodology

The first step used by ACIR in computing its tax-capacity index is to calculate "representative" tax rates by determining the national-average state (and local) tax rate for each of twenty-seven commonly used tax bases (e.g., major ones such as personal income and general sales, and more minor tax bases such as beer consumption and hunting licenses).⁵ ACIR then defines a state's *tax capacity* as the amount of revenue the state would collect if it applied this set of national-average tax rates to each of its own tax bases. Finally, a state's tax-capacity *index* is defined as its *per capita* tax capacity divided by the average value of this variable across the states (multiplied by 100). Thus, if a state with an index value of 115 in 1990 taxed all twenty-seven tax bases at nationally representative rates, it would collect 15 percent more revenue per capita than the national average.

ACIR defines a state's *tax effort* as the ratio of its tax collections to its absolute tax capacity. The tax-effort *index* is calculated by dividing each state's tax effort by the average value of effort across states, and then multiplying by 100, so that scores above 100 indicate above-average tax efforts while those below 100 indicate below-average efforts.

The structure of the tax-capacity and tax-effort indexes implies a weakness in the measures for longitudinal analysis that should be recognized. For example, tax-capacity index values are not comparable across time to assess the *absolute* amount by which a state's tax base has changed, because ACIR's representative tax rates change each year to conform to national-average rates for that year. If a state's index value increases from one year to the next, we cannot know how much of the change is due to an increase in the state's tax base and how much is due to an increase in the tax rates that are deemed "representative." Thus, index values are comparable over time only to the extent that a change in the index between two years indicates that a state's tax capacity *relative to the national average* has changed between those years. The same qualification applies to the tax-effort index. As we have seen, this characteristic of ACIR's indexes has not

⁴ Indeed, Ambrosius (1989)—in her pooled analysis for the period 1969–1982—interpolates all missing-year observations for tax capacity and tax effort; however, she provides no evidence of the quality of the estimated observations.

⁵ This section presents a simplified description of ACIR's operational definitions. Further details are available in ACIR (1990).

prevented scholars from using them in research relying on pooled designs, nor has it prevented researchers from measuring change over time in tax effort by examining change in the ACIR index (e.g., Marks et al., 1988).⁶

Estimating Missing Values of the Tax-Capacity and Tax-Effort Indexes

Both the tax-capacity index (TCI) and the tax-effort index (TEI) have been measured for all fifty states and the District of Columbia for 1967, 1975, 1977, 1979–1986, 1988, and 1991.⁷ We seek to supplement these data with estimates for missing years to create a complete data set for 1960–1991.⁸

We implemented several methodologies for estimating missing observations. The simplest methods rely on *trends* in the values of these indexes in a given state over the years for which data are available: linear *interpolation*—in which we assume steady change between known observations in two years—and linear *extrapolation*—in which we assume steady change in an index throughout some period at the same rate that change is observed in a later period. Another alternative is to utilize information about the relationship between an ACIR index and other variables during years for which all the variables have been observed (in the form of a regression of the index on one or more independent variables) to “predict” values of the index in years for which only the values of the other variables can be observed. Our general strategy is to rely on estimates produced by “trend analysis” when there is evidence that this method will yield good estimates, but to use the “regression approach” when trend analysis will produce weaker estimates and there is evidence that the regression method performs better.

The “Trend” Approach to Estimation. For both the TCI and the TEI, there is empirical evidence that linear interpolation works very well for the post-1975 period. During this period, there are at most two missing years between observations. We tested the accuracy of linear interpolation over two missing years by interpolating over years in which actual observations were available so that the estimates could be compared with the known values. For both the TCI and the TEI, for each state, we interpolated between 1979 and 1982, and between 1983 and 1986. Then, for each year estimated (1980, 1981, 1984, and 1985), we examined the cross-sectional

⁶Indeed, ACIR (1982:46–49) makes clear that it believes it is appropriate to make longitudinal comparisons of its tax-effort index by developing a measure of state “fiscal blood pressure” based on the ratio of a state’s tax-effort index in one year to its index value in a previous year.

⁷Data for 1991 were obtained directly from ACIR; other data are from ACIR (1993:186–187). A mistake was found for Iowa in 1967; the correct value is taken from ACIR (1982).

⁸As of April 1996, ACIR reports that, because of budgetary cutbacks, there are no definite plans to construct measures for more recent years.

relationship between actual and estimated index values. If estimation were perfect, for each state the estimated and actual index values would be identical, so that a graph of the estimates against actual values would have all fifty-one observations on a 45° line through the origin.⁹ Thus, the correlation between the two variables would be 1.00, and if actual values were regressed on estimated values, the intercept would be zero, and the slope coefficient would be one. For the TCI, for all four years, the correlation exceeds .98. The correlations for the TEI are only slightly weaker, with all greater than .94. Also, all eight intercept estimates are small, ranging between -20 and 18,¹⁰ and all slope estimates are near one (between .81 and 1.21). Thus, we are confident that interpolated estimates of the TCI and the TEI are of high quality in the post-1975 period. We will refer to the actual values of the indexes supplemented with interpolated values for missing years between 1975 and 1991 as TCI-TREND and TEI-TREND.

The more complex task was to estimate index values for 1960 to 1974, a period during which there is only one year of observed data: 1967. The most obvious approach when relying on "trend analysis" is to interpolate between 1967 and 1975, and to extrapolate from observed change between 1967 and 1975 to estimate values for 1960-1966.

To test the strategy of interpolating indexes between 1967 and 1975, we interpolated over a different eight-year period for which we had actual observations in intervening years to compare to the estimated values. In particular, we interpolated between 1977 and 1985, and then regressed actual on estimated values for all intervening years for which actual values were known: 1979-1984. For both the TCI and the TEI, as might be expected, the correlation between estimated and actual index values is lowest in the year midway between 1977 and 1985, 1981 (.93 for tax capacity and .91 for tax effort). For both indexes, as well, the estimated regression line deviates most from a 45° angle through the origin for 1981 data. For the TEI, the fit is still good, with an intercept estimate of -23 and a slope coefficient of 1.26. But for tax capacity, the fit is much weaker; the intercept is -57 and the slope is 1.60.

To test the strategy of extrapolating values for 1960-1966 based on change between 1967 and 1975, we extrapolated values for 1976-1982, assuming the same rate of change as between 1983 and 1991, and compared estimated to actual index values for 1977 and for each year between 1979 and 1982. Consistent with our expectations, extrapolation proved to (1) be less effective overall than interpolation in generating accurate estimates, and (2) be less effective as the year of estimation got farther away from the period for which actual data were available. For example, for 1982, the correlation between estimated and actual values of the index

⁹We will refer to fifty-one "states" (including the District of Columbia).

¹⁰Recall that the average value of both indexes across states in each year is 100.

exceeds .97 (and the corresponding regression line approximates a 45° angle through the origin) for both the TCI and the TEI. But for 1977, the same correlation drops to .77 for tax capacity and .74 for tax effort.

The Regression Approach to Estimation. In sum, the results of the “trend” approach to estimation for the period 1960–1974 are good (especially for tax effort), but not great. Can we do better using a regression approach? It is not obvious what variables would be suitable predictors of tax effort, but there are two strong candidates for predictors of tax capacity: personal income and gross state product (GSP). We tried two regression approaches for estimating the TCI. The first involved (1) conducting time-series regressions of tax capacity on the predictor variables, for each state separately, using data from the post-1975 period, (2) using the regression estimates to “predict” values of tax capacity from values of the predictor variables for years before 1975, and (3) from these estimates of capacity, calculating values of the TCI using data on state population to “per capitate.”¹¹

While this approach achieved some success, a second strategy produced higher-quality estimates. Here, we calculated a per capita GSP *index* and a per capita income *index* with forms similar to the TCI by dividing each state’s value of per capita income or per capita GSP by the average value of the variable across all fifty-one states. Then, for each state, we ran time-series regressions of the TCI on the two predictor indexes using data from years after 1975.¹²

In these regressions, we restricted the predicted value of the dependent variable to be equal to the actual value in 1975.¹³ The average R-square value for the fifty-one regressions was a healthy .70. But there were two outlier states for which the regressions produced a weak fit: Hawaii (R-square = .07) and Arizona (R-square = .09). (All other states had R-squares greater than .28.) For these two states, we concluded that the “trend” approach to estimating pre-1975 TCI index values was superior. But for the remaining states, we used the time-series regression coefficient estimates to “predict” values of the TCI from observed values of the predictor variables for the 1960–1974 period.¹⁴ We will refer to these regression-based estimates of the TCI between 1960 and 1974 as TCI-REGRESS.¹⁵

¹¹ Tax-capacity data are from ACIR (1987: App. C).

¹² Based on the foregoing evidence about the high quality of interpolated TCI estimates for the post-1975 period, we included these estimates in the regressions.

¹³ We used this procedure, instead of an *unrestricted* regression, to eliminate the possibility of pre-1975 estimates that would be characterized by a large “jump” between 1974 and 1975 values.

¹⁴ Since GSP data are available beginning only in 1962, we needed to estimate 1960 and 1961 values. Details on our estimation procedure are available in our archive data set.

¹⁵ Recall that for Hawaii and Arizona, these estimates are trend-based.

Very strong support for the quality of the TCI-REGRESS estimates comes from two quarters. First, if the estimation strategy is successful, the average value of the TCI estimates across states should be approximately one for each year. Remarkably, for *every* year between 1960 and 1974, the average index estimate is in the extremely narrow range between 99.9 and 101.6. Second, the fit between actual and estimated values of the TCI for 1967 is striking. The correlation between the two variables is .92, and a regression of actual on estimated values yields a line almost perfectly through the origin at 45°—*with an intercept of -2.7 and a slope of .998*. This indicates the almost complete absence of any systematic bias in the estimates, despite the fact that the 1967 estimates are based on relationships among variables a full eight years and more into the future. Based on this evidence, our final recommended measure of the TCI relies on interpolation after 1975 (TCI-TREND), but a regression approach for prior years (TCI-REGRESS).¹⁶

What remains is to see whether we can construct better tax-effort index estimates for 1960–1974 than those computed earlier using the “trend” approach. As noted earlier, we were not able to identify plausible predictors that could be used in a regression estimation strategy to estimate TEI values directly. However, an alternative is to take the estimates of tax capacity we produced using the regression approach (see earlier discussion), divide these into total tax collections, and then “norm” the resulting tax-effort variable by dividing observations by the mean value across states to produce an estimate of the TEI. The cross-sectional correlation between the actual TEI and these estimates for 1967 is .46. Since we saw earlier that an extrapolation strategy produced 1977 estimates (based on data from 1983 to 1991, and thus six or more years into the future) correlating at .74 with actual TEI values, and since interpolation is even more effective than extrapolation, we concluded that the trend-based estimates of the TEI are superior to those constructed from the regression approach. Thus, we recommend a final measure of the TEI that is based on interpolation after 1967 and extrapolation in prior years.

Conclusion

We have constructed estimates of ACIR’s tax-capacity index and tax-effort index for each missing year between 1960 and 1991, thereby creating a complete data set that can be used for cross-sectional analysis in any year after 1960, or for pooled cross-sectional time-series analysis over a period

¹⁶Note that the 1967 values for this measure are the regression-based estimates rather than the actual ACIR values. Clearly, analysts doing cross-sectional analysis relying on 1967 data should use actual 1967 index values. But researchers doing pooled analysis based on a continuous set of years including 1967 should use our estimated values for 1967 to avoid deceptive “jumps” in index values from 1966 to 1967, and from 1967 to 1968.

in excess of thirty years. The estimates are based on a combination of interpolation, extrapolation, and regression-based strategies. The quality of the estimates produced by each strategy is assessed empirically, and the results of these tests drive our decisions about which strategy to use for which years of missing data.

Our main points are as follows:

- Analysts relying on longitudinal variation in ACIR's tax-capacity index or tax-effort index must recognize that index values are comparable over time only in the sense that a change in the index means that a state's tax capacity or effort *relative to the national average* has changed.
- Our recommended strategy for estimating the tax-*capacity* index relies on interpolation after 1975 and the relationship of tax capacity to per capita income and GSP to "predict" pre-1975 values.
- Our recommended strategy for estimating the tax-*effort* index relies on interpolation after 1967, and on extrapolation before that.
- Analysts employing pre-1975 measures of the TCI or the TEI might wish to supplement empirical results using our recommended measure with results using pre-1975 estimates based on one of our alternative estimation approaches (i.e., TCI estimates based on the "trend" approach, or TEI estimates based on the "regression" approach) and conduct a sensitivity analysis of the impact of the change in estimation strategy on substantive conclusions. If results are highly consistent using two estimation strategies of quite different character, researchers can have a great degree of confidence that substantive conclusions are not a function of error in the measurement of tax capacity or effort. **SSQ**

REFERENCES

- Advisory Commission on Intergovernmental Relations (ACIR). 1982. *Tax Capacity of the Fifty States: Methodology and Estimates*. Washington, D.C.: U.S. Government Printing Office.
- . 1987. *Measuring State Fiscal Capacity*. Washington, D.C.: U.S. Government Printing Office.
- . 1990. *State Fiscal Capacity and Effort, 1988*. Washington, D.C.: U.S. Government Printing Office.
- . 1993. *Significant Features of Fiscal Federalism*. 1990, vol. 2. Washington, D.C.: U.S. Government Printing Office.
- Akin, John S. 1973. "Fiscal Capacity and the Estimation Method of the Advisory Commission on Intergovernmental Relations." *National Tax Journal* 26:275–294.
- Ambrosius, Margery Marzahn. 1989. "The Role of Occupational Interests in State Economic Development Policy." *Western Political Quarterly* 41:53–68.
- Benson, Earl D., Barry R. Marks, and K. K. Raman. 1988. "Tax Effort as an Indicator of Fiscal Stress." *Public Finance Quarterly* 16:203–218.
- Berry, Frances Stokes, and William D. Berry. 1992. "Tax Innovation in the States: Capitalizing on Political Opportunity." *American Journal of Political Science* 36:715–742.

- Buck, Jeffrey A., and Mark S. Kamlet. 1993. "Problems with Expanding Medicaid for the Uninsured." *Journal of Health Politics, Policy and Law* 18:1-26.
- Clapp, John M., Joseph A. Fields, and Chonmoy Ghosh. 1990. "An Examination of Profitability in Spatial Markets: The Case of Life Insurance Agency Locations." *Journal of Risk and Insurance* 57:431-454.
- Dawson, Richard E., and James Robinson. 1963. "Inter-Party Competition, Economic Variables, and Welfare Policies in the American States." *Journal of Politics* 25:265-289.
- Dommel, P. R. 1983. "Decentralization and Fiscal Disparities in the United States of America." *Environment and Planning C: Government and Policy* 1:259-272.
- Dye, Thomas R. 1966. *Politics, Economics, and the Public*. Chicago: Rand McNally.
- Filer, John E., Donald L. Moak, and Barry Ze. 1988. "Why Some States Adopt Lotteries and Others Don't." *Public Finance Quarterly* 16:259-283.
- Fry, Brian, and Richard Winters. 1970. "The Politics of Redistribution." *American Political Science Review* 64:508-522.
- Hill, Kim Quaile, Jan E. Leighly, and Angela Hinton-Andersson. 1995. "Lower-Class Mobilization and Policy Linkage in the U.S. States." *American Journal of Political Science* 39:75-86.
- Hofferbert, Richard I. 1966. "The Relation between Public Policy and Some Structural and Environmental Variables in the American States." *American Political Science Review* 60:73-82.
- Marks, Barry R., and Krishnamurthy K. Raman. 1987. "Fiscal Determinants of State Borrowing Costs." *International Journal of Public Administration* 9:115-126.
- Marks, Barry R., K. M. Raman, and Earl R. Wilson. 1988. "Toward Understanding the Determinants of Pension Underfunding in the Public Sector." *Journal of Accounting and Public Policy* 7:157-183.
- Morgan, David R. 1994. "Tax Equity in the American States: A Multivariate Analysis." *Social Science Quarterly* 75:510-523.
- Office of State and Local Finance, Department of the Treasury. 1985. *Federal-State-Local Fiscal Relations*. Washington, D.C.: U.S. Government Printing Office.
- Opheim, Cynthia. 1991. "Explaining the Differences in State Lobby Regulation." *Western Political Quarterly* 44:405-421.
- Plaut, Thomas R., and Joseph E. Pluta. 1983. "Business Climate, Taxes and Expenditures, and State Industrial Growth in the United States." *Southern Economic Journal* 50:99-119.
- Plotnick, Robert D., and Richard F. Winters. 1985. "A Politico-Economic Theory of Income Redistribution." *American Political Science Review* 79:458-473.
- Romans, Thomas, and Ganti Subrahmanyam. 1979. "State and Local Taxes, Transfers and Regional Economic Growth." *Southern Economic Journal* 16:435-452.
- Schinhar, A. P., A. B. Rothbard, D. Yin, and T. Lutterman. 1992. "Public Choice and Organizational Determinants of State Mental Health Expenditure Patterns." *Administration and Policy in Mental Health* 19:235-250.
- Tweedie, Jack. 1994. "Resources Rather Than Needs: A State-Centered Model of Welfare Policy-Making." *American Journal of Political Science* 38:651-672.
- Wildasin, David E. 1987. "Federal-State-Local Fiscal Relations: A Review of the Treasury Report." *Public Finance Quarterly* 15:472-499.
- Wohlenberg, Ernest H. 1992. "Recent U.S. Gambling Legislation: A Study of Lotteries." *Social Science Journal* 29:167-183.

Copyright of Social Science Quarterly (University of Texas Press) is the property of University of Texas Press and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.