An Annual Cost of Living Index for the American States, 1960-1995

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RESEARCH NOTES

*An Annual Cost of Living Index for the American States, 1960–1995**

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An enormous amount of research on state politics and policy relies on monetary variables. Such variables are affected by differences in the purchasing power of a dollar over time and across states, but a lack of information about geographic variation in the costs of goods and services has kept social scientists from taking these differences into account. We remove this obstacle by constructing an annual cost of living index for each continental American state from 1960 to 1995. The index constitutes a deflator suitable for cross-sectional, time-series, and pooled research. After establishing the reliability and validity of our index using a battery of diagnostic tests, we illustrate the importance of deflating monetary variables by examining two variables that are often used in state politics research.

Monetary variables figure prominently in studies of American state politics. They are used to analyze government expenditures in such diverse areas as welfare (Brown 1995; Hill, Leighley, and Hinton-Andersson 1995), regulation (Teske 1991; Williams and Matheny 1984), and the arts (Hofferbert and Urice 1985). Campaign spending (Caldeira and Patterson 1982), wage levels (Peterson and Rom 1990), and personal income (Holbrook 1991) are measured monetarily, too.

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Research using such variables must contend not only with changes in a dollar's value resulting from inflation but with variation in the rate of inflation across states and cross-state differences in the purchasing power of a dollar at any given time. What scholars need is a valid state-level cost of living index that can be used to adjust for both longitudinal and cross-state variation in the value of a dollar.

Indeed, a few studies have used state-level price indexes to deflate monetary variables. Unfortunately, nearly all the indexes are unpublished and inadequately documented. Hill, Leighley, and Hinton-Andersson (1995) deflate welfare benefits with "state-specific Consumer Price Index data," but provide no details. Tweedie (1994) measures state cost of living using a procedure (described in a brief footnote) that relies on both metropolitan-area and regional Consumer Price Indexes. These state price indexes may be satisfactory, but since the methodologies are not clarified and tests of reliability and validity are not reported, there is no empirical evidence that the measures are acceptable.

So far as we are aware, the only *published* state-level cost of living index available annually for a period of years is McMahon's (1991), which is presented for 1981–90. We detect substantial measurement error in this index, however, so we modify McMahon's approach to construct a state cost of living (COL) index for all years from 1960 to 1995 in each continental American state.[1] We then offer extensive empirical evidence that our deflator is both reliable and valid.

The need for a deflator like ours is evident. Multivariate analysis involving monetary variables is undermined when these variables fail to take into account both longitudinal and cross-state variation in the value of a dollar. In some cases, measurement error may be so great that it yields coefficient estimates with incorrect signs. But even when distortion is not this severe, analysts inevitably lose important information when they fail to deflate monetary variables. For example, the apparent precision of a regression interpretation that a given increase in an independent variable prompts a change of so many dollars in a dependent variable is illusory because a *dollar* is not a fixed unit when an undeflated dependent variable (or one incompletely deflated using a national price index) is used. However, once we deflate and thereby establish a fixed measurement unit—e.g., 1995 Illinois dollars—we can interpret the magnitude of effects meaningfully.

A Previous Measure of State Cost of Living

The most widely used COL index—the Bureau of Labor Statistics (BLS) Consumer Price Index (CPI)—has been measured annually since 1967 for various subnational geographical units.[2] However, subnational CPIs are intended for

[1] We are unable to compute good COL estimates for Hawaii and Alaska; see note 11.

[2] Only the national CPI is available for years before 1967.

longitudinal comparisons and are not comparable cross-sectionally.[3] Fortunately, *family budgets* for an intermediate standard of living, also calculated by the BLS, are comparable across space and time. These family budgets tally the costs of food, housing, transportation, clothing, personal items, medical care, and taxes for an urban family of four.[4] Family budgets were computed for as many as 40 Standard Metropolitan Statistical Areas (SMSAs) during the period 1967–81 and for nonmetropolitan urban areas (cities, towns, villages, and unincorporated areas with at least 2,500 residents) in four Census regions for the same period.

McMahon and Melton (1978) used BLS intermediate family budgets to measure COL at the state level. They proceeded in two stages. First, they specified COL as a function of three predictors: per capita personal income, median housing value, and population.[5] Per capita income was assumed to have a positive impact on the COL because greater income boosts demand for goods and services, and increased demand leads to higher prices, especially for goods—like land—with an inelastic supply. Housing value was also assumed to be positively associated with the cost of living because housing is a major category of consumer spending. In addition, housing represents a significant portion of consumer assets, and larger assets fuel the demand for goods and services, putting upward pressure on prices. The effect of population on cost of living was held to be ambiguous; McMahon and Melton noted that rapid population increases can boost consumer demand, and hence prices, in a locale. They also recognized that population growth leads to economies of scale that reduce the costs of goods and services. The authors estimated their COL equation—separately for the four Census regions—using SMSAs and one nonmetropolitan urban region (NMUR) as cases and the 1973 family budget as dependent variable.[6]

In the second stage of their analysis, McMahon and Melton used the coefficient estimates for their regression equations to predict the COL in the states, on the assumption that the effects of the independent variables remained the same when the unit of analysis is the state. Specifically, they inserted values for state-level per capita income, median housing value, and population into the estimated regression equation for each region and predicted state-level values of the dependent variable.[7] McMahon (1991) subsequently constructed COL estimates

[3] This is because the BLS fixed all subnational CPIs at 100 in 1967, even though the COL was not uniform across the nation in that year.

[4] For details on the assumed composition and lifestyle of the family, see BLS (1976, 82–83).

[5] To be precise, McMahon and Melton use *change in population over a 10-year period* in their final model, after experimenting with *population* and *population squared* and determining that *change in population* yields the largest R-square. However, McMahon and Melton's (1978, 326; see also McMahon 1991, 432) stated justification for including a population variable in their model suggests that population *level* (rather than *change*) influences the COL.

[6] In effect, McMahon and Melton measure per capita income, housing value, and their population variable with a three-year lag because they rely on decennial Census data.

[7] A similar strategy was used by Fournier and Rasmussen (1986) to estimate 1980 state COL values, and by Nelson (1991) to measure 1988 values.

for the states for each year between 1981 and 1990, applying a similar methodology. We find evidence of considerable measurement error in McMahon's index, but his general approach is appealing and forms the basis for our measurement strategy.

Constructing Our State Cost of Living Index

We modify and refine McMahon's (1991) approach in several important ways. First, we rely on a much broader base of information. McMahon analyzed data for other years, but all of his COL estimates for the 1980s are based on regression analysis of 1981 data. This is as unnecessary as it is unsatisfactory. All variables in the original McMahon/Melton model have been measured in a sample of SMSAs and NMURs over the 1970–81 period. Furthermore, by taking into account not only family budgets but CPI data as well, we can extend the base of information to include years through 1996.

The CPI is available for selected SMSAs and NMURs beginning in 1967. Although the CPI yields information about change in the COL within these units, it is useless for comparing the COL across units, since it is fixed at 100 in all units in 1967. However, all that is required to make the CPI comparable across units is information about the relative COL in the units for any single year. Family budgets provide just this kind of information. In particular, we use intermediate family budgets of SMSAs and NMURs in 1977 to adjust units' 1977 CPI values so that they are in the same relation to one another as the units' family budgets. Then each unit's CPI values in all other years are rescaled to conform to the new 1977 value, creating a new index that we call the *cross-sectionally adjusted CPI* (CSA-CPI).[8]

If family budgets and the CPI were perfectly equivalent measures of the COL, the CSA-CPI would be fully comparable both cross-sectionally and longitudinally. In fact, family budgets track a smaller market basket of goods than the CPI and treat changes in taxes differently. Yet, there is strong empirical evidence that the CPI and family budgets convey very similar information about the COL. There are 348 SMSAs and NMURs between 1967 and 1981 for which both an annual family budget and a CPI value are available; when we pool these observations, the correlation between family budget and CSA-CPI values is greater than .99.

In theory, any year's family budgets are equally suitable for adjusting CPI values, but practical considerations favor 1977. Before 1977, CPIs were not available for NMURs, and beginning in 1979, there was a decrease in the number of SMSAs for which family budgets were reported. Thus, the use of 1977 family budgets maximizes the number of units for which we can calculate cross-

[8] The sources for data are: BLS **family budgets** from *Monthly Labor Review*, and **CPI** from http://www.stats.bls.gov. For NMURs, the CPI value is for Class D cities (fewer than 75,000 inhabitants), when available. However, for the Northeast and West, CPI values for Class D cities were unavailable, and Class C values were substituted.

sectionally adjusted CPI values.[9] (To test whether the choice of the "adjustment year" is consequential, we replicated the computation of the CSA-CPI, changing only the year of adjustment—to 1967. The correlation between the two versions of the CSA-CPI across all SMSA-years for which both versions are available ($n = 621$) exceeds .99, confirming that the specific adjustment year is unimportant.)

Our second refinement of McMahon's approach is to add dummy variables for regions to the regression equation to account for variables excluded from his model.[10] For example, the COL varies across regions for a host of reasons: Differences in climate affect utility costs and food prices; differences in weather and exposure to geologic upheavals affect construction costs; and differences in the availability of water and suitable land affect settlement patterns and real estate prices. Similarly, the cost of living changes over time because of momentous events (e.g., the huge increase in oil prices in 1974), the effects of which are not specified in McMahon's model. In theory, dummy variables for each year could be included to account for these effects. However, there are no cases before 1970 that can be included in the regression. Thus, a regression involving year dummies would not permit predictions about dependent variable values for years before 1970, thereby precluding the computation of our state COL index for the 1960s. To overcome this problem, we include the national CPI as a regressor to reflect factors influencing the COL that vary longitudinally but are not captured by the other independent variables in our model. Moreover, to permit the effect of the national CPI to vary across regions, we specify interaction between the regional dummy variables and the CPI using a set of multiplicative terms.

Our regression model is:

$$\begin{aligned}\text{CSA-CPI}_{i,t} = {} & \beta_0 + \beta_1 \text{VALHOUSE}_{i,t} + \beta_2 \text{PCINC}_{i,t} + \beta_3 \text{POPUL}_{i,t} \\ & + \beta_4 \text{NORTHEAST}_i + \beta_5 \text{MIDWEST}_i + \beta_6 \text{WEST}_i \\ & + \beta_7 (\text{CPINATL}_t * \text{NORTHEAST}_i) \\ & + \beta_8 (\text{CPINATL}_t * \text{MIDWEST}_i) \\ & + \beta_9 (\text{CPINATL}_t * \text{WEST}_i) \\ & + \beta_{10} (\text{CPINATL}_t * \text{SOUTH}_i) + \epsilon_{\text{i,t}} \end{aligned} \qquad \textbf{[1]}$$

where the i and t subscripts denote the geographic unit (SMSA or NMUR) and year observed, respectively.[11] The dependent variable is the cross-sectionally

[9] Throughout our analysis we rely on CPI-W (for urban wage earners and clerical workers) rather than CPI-U (for all urban consumers) because the BLS used CPI-W to construct family budgets.

[10] Although McMahon and Melton (1978) do separate regressions within regions, McMahon (1991) inexplicably drops region from the analysis.

[11] Alaska and Hawaii's great physical distance from the lower 48 adds to their prevailing costs for goods and services in ways that are not reflected in equation [1]. Furthermore, Alaska's extremely low population density makes for unusual cost structures, while Hawaii's atypical climate creates a

adjusted CPI. The variables on the second line of the equation are three regional dummies scored one if the SMSA or NMUR is in the region and zero otherwise; observations in the South are scored zero on all three dummies, making that region the frame of reference.[12] CPINATL denotes the national CPI; the hypothesis that its effect on the dependent variable is positive in all four regions implies that the coefficients for all multiplicative terms should be positive. *Median housing value* in dollars (VALHOUSE) and *per capita personal income* in thousands of dollars (PCINC) are also expected to have positive effects. We make no prediction about the sign of the coefficient for population (POPUL, measured in thousands) since McMahon contends that its impact is "ambiguous."[13]

Like McMahon, we proceed in two stages. First, we estimate regression model 1 using data for SMSAs and nonmetropolitan regions. We include all cases for which data are available for all variables in the equation. This consists of 191 SMSAs observed in 1970 and 1974–96, plus 36 NMURs observed in selected years from 1977–95, for a total sample of 227.[14] The regression results are presented in column 1 of Table 1. The overall fit of the model is excellent (R^2 = .98). More important, the coefficient estimates for housing value, per capita income, and all product terms involving the national CPI are positive as predicted and statistically significant at the .001 level.

Turning to the second stage of our analysis, we assume that the regression coefficient estimates based on data from SMSAs and NMURs also apply when

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special demand for housing. Consequently, we exclude six Honolulu SMSA observations (for 1970, 1976, 1979, 1980, 1983, and 1990) and one Anchorage SMSA case from the estimation sample and do not report state-level COL estimates for either Alaska or Hawaii. Our choice is supported by the fact that predicted CSA-CPI values for Honolulu and Anchorage based on the coefficients for equation [1] underestimate true values by an average of 11.4% (and as much as 18%) across the seven excluded cases.

[12] It is tempting to use differences across regions in the observed value of the CSA-CPI to guide predictions about coefficients for the regional dummies. For example, since we can observe that CSA-CPI values, on average, are highest in Northeastern SMSA/NMURs, the dummy coefficient for NORTHEAST should be greatest. But to the extent that the observed COL in the Northeast is highest *because* of its income levels, housing values, and population amounts, there is no reason to expect the COL to be greatest in the Northeast when holding income, housing value, and population constant. Thus, we make no predictions about the coefficients for the regional dummies.

[13] For reasons specified in note 5, we use *population* rather than *change in population*. Yet, this makes little difference in our final state COL measure. When all state-years from 1960 to 1995 are pooled, the correlation between our state COL index and a measure identical except that it is constructed using five-year population change rather than population in the regression, is .999. (The corresponding value of ρ_c is also .999 [see p. 557 for a definition of ρ_c].)

[14] The sources for the independent variables are: **per capita income** from the Census Bureau's *Local Area Personal Income* series, **population** from the Census Bureau's *Local Area Personal Income* and *Current Population Reports* (P-25 series), and Census Bureau **housing values** from the *Census of Housing* (1970) and *Annual Housing Survey* (various years). More detailed information on data for nonmetropolitan regions is provided in the unpublished supplement to this paper (see Appendix S-2).

TABLE 1

Coefficient Estimates for Regressions of SMSA and NMUR Cross-Sectionally Adjusted CPIs on Various Predictors (with *t*-ratios in parentheses)

	Regression Coefficients		
	(1) Full Sample (SMSAs & NMURs)	(2) SMSAs Only	(3) NMURs Only
housing value	0.000538**	0.000563**	0.000369
	(9.21)	(8.59)	(1.24)
per capita income	0.00255**	0.00130	0.00031
	(3.54)	(1.51)	(0.26)
population	−0.000828**	−0.000941	0.000157
	(−3.22)	(−1.37)	(0.03)
national CPI* NORTHEAST	0.734**	0.820**	0.850**
	(17.72)	(15.15)	(11.08)
national CPI* MIDWEST	0.760**	0.844**	0.806**
	(18.56)	(16.35)	(13.96)
national CPI* WEST	0.644**	0.716**	0.785**
	(16.18)	(13.21)	(11.74)
national CPI* SOUTH	0.683**	0.756**	0.801**
	(15.77)	(13.71)	(11.12)
NORTHEAST	14.1	14.2	21.1
MIDWEST	0.6	0.0	15.5
WEST	8.9	12.8	11.7
Intercept	17.5	12.5	−4.9
R^2	.98	.98	>.99
N	227	191	36

$*p = .05$; $**p = .01$. Significance tests are one-tail for housing value, per capita income, and all terms involving the national CPI; and two-tail for population. Tests are not conducted for intercepts or for regional dummy variables.

the unit of analysis is the state in any year between 1960 and 1995 (a claim for which we present empirical support below). This permits us to use the coefficient estimates in Table 1, along with state-level values of the independent variables, to predict state-level CSA-CPI values.[15] Finally, the predicted CSA-CPI

[15] Annual state-level observations are available during our period of analysis for per capita income and population. (The population data are from *Current Population Reports* and the decennial Census; income data are from the *Statistical Abstract* [various years] for 1960–68, and for later years, from *Local Area Personal Income and Per Capita Personal Income, 1969–96* [U.S. Department of Commerce, Economics and Statistics Administration, Bureau of Economic Analysis, http://www.bea.doc.gov/bea/dr1.htm].) However, state median housing values are observed only in decennial Census years, so we must estimate values in intervening years. (The unpublished supplement presents our methodology for constructing these estimates [see Appendix S-1].) Although we used data through

values are adjusted to form a deflator arbitrarily fixed at 100 in the state-year with the lowest predicted COL: Texas in 1960.

Table 2 reports index values for the 48 continental states in 1960, 1980, and 1995 (see columns 1, 2, and 3). In each year there is substantial variation across states. For each state there is a large increase over time, reflecting the effects of inflation. However, the effect of inflation is uneven since the rate varies substantially across states (see column 4).

Assessing the Quality of the State Cost of Living Index

We subjected our state COL index to a variety of reliability and validity tests, each of which assesses the degree to which two COL indicators yield similar values. Lin (1989) has developed a measure of the correspondence between two indicators presumed to measure the same concept on the same scale, called the *concordance correlation* and denoted ρ_c. The concordance correlation can be conceived as the product of the Pearson correlation between the two indicators (which reflects the precision of fit) and a measure of the extent to which the line best fitting the observations for the two measures deviates from a 45° line through the origin. The concordance correlation takes on the same sign as the Pearson correlation and ranges in absolute value between zero (indicating a Pearson correlation of zero) and one (indicating that the two indicators have the same value for every case).

COL measures tend to have within-unit time series that are integrated; they trend up over time and hence do not have a constant mean. For two such variables, a high correlation may be spurious (Granger and Newbold 1977). Thus, the concordance correlation between two COL indicators is an insufficient test of similarity. A stronger test is whether annual change scores for the two correspond highly. For this reason, our analysis of the fit between two COL measures includes a calculation of the concordance correlation between their first differences. Two indicators can be deemed nearly identical if both their levels and their first differences yield concordance correlations close to 1.00.

Reliability

We assess the reliability of our deflator by examining its sensitivity to differences in the methodology and data used to construct it. In all, we construct four alternative deflators.[16] First, we vary the treatment of *regions* in two

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1996 to estimate the regressions at the SMSA/NMUR level, we were unable to predict state-level CSA-CPI values beyond 1995 as state median housing values could not be obtained for 1996.

[16] The coefficient estimates for the SMSA/NMUR-level regression associated with each of these four deflators are included in our replication data set.

TABLE 2

States' Cost of Living Index, 1960–95

Region	State	Estimated State Cost of Living Index (100 = Texas 1960) (1) 1960	(2) 1980	(3) 1995	(4) % Change 1960–1995
Northeast	Connecticut	139.02	347.13	665.70	478.85
	Maine	132.16	317.75	569.53	430.93
	Massachusetts	133.26	327.99	639.67	480.02
	New Hampshire	134.48	329.88	614.69	457.10
	New Jersey	133.96	337.33	642.46	479.60
	New York	122.97	314.65	605.20	492.13
	Pennsylvania	123.58	312.93	558.14	451.63
	Rhode Island	135.68	328.37	611.29	450.54
	Vermont	133.45	322.32	580.18	434.77
Midwest	Illinois	115.07	316.90	586.73	509.87
	Indiana	116.23	307.17	557.22	479.44
	Iowa	117.48	312.77	551.04	469.03
	Kansas	117.80	312.64	560.00	475.40
	Michigan	114.57	307.56	566.21	494.20
	Minnesota	118.91	322.06	583.98	491.10
	Missouri	117.11	307.54	563.94	481.54
	Nebraska	118.88	311.11	558.10	469.47
	North Dakota	118.75	311.98	550.06	463.22
	Ohio	113.59	308.66	562.95	495.61
	South Dakota	118.33	307.14	546.90	462.18
	Wisconsin	118.49	317.49	567.95	479.34
South	Alabama	105.01	277.01	502.42	478.47
	Arkansas	104.87	275.95	495.41	472.41
	Delaware	115.43	296.77	564.94	489.44
	Florida	106.98	285.44	522.79	488.66
	Georgia	105.37	279.56	522.08	495.45
	Kentucky	105.62	278.60	499.42	472.85
	Louisiana	106.90	286.16	493.50	461.62
	Maryland	110.39	303.28	574.26	520.20
	Mississippi	104.73	294.43	490.17	468.04
	North Carolina	103.57	277.47	515.31	497.55
	Oklahoma	106.72	284.57	497.92	466.59
	South Carolina	104.91	278.31	508.66	484.84
	Tennessee	104.74	278.72	511.89	488.74
	Texas	100.00	276.82	499.15	499.15
	Virginia	107.00	292.04	544.41	508.81
	West Virginia	106.49	283.16	495.53	465.32
West	Arizona	117.36	296.58	513.33	437.41
	California	107.20	302.75	592.86	553.02
	Colorado	118.55	307.09	529.13	446.35
	Idaho	116.88	289.78	496.95	425.17
	Montana	117.84	291.37	494.00	419.21
	Nevada	123.66	315.14	542.73	438.88
	New Mexico	116.79	288.10	502.37	430.16
	Oregon	117.14	300.03	510.11	435.46
	Utah	118.46	295.34	501.42	423.28
	Washington	117.07	303.11	533.97	456.12
	Wyoming	120.04	308.95	506.05	421.56

different ways. In one, we rely on a *seven*-region specification of equation [1] (in contrast to our primary index, which is based on the four-category classification).[17] Since the four NMURs are inconsistent with the seven-region coding, this alternative index must be based on an estimation of equation [1] using only the SMSA observations. A second deflator is based on estimating equation [1] (with the regional dummies excluded) in each of the four regions separately; this frees the estimated effects of per capita income, housing value, and population to vary across regions.

Next, we vary the specific measures used for independent and dependent variables in equation [1]. For one test, we recompute our state COL index using the intermediate family budget as the dependent variable in place of the CSA-CPI. For another version, we vary the housing value indicator for equation [1], using the National Association of Realtors (NAR) measure of the median value of all houses *sold* in a year in selected metropolitan areas.[18] For both alternatives, not only is a variable in equation [1] modified, but the sample of cases for estimation is changed. The regression involving family budgets relies on 112 SMSAs and 36 NMURs from 1970 to 1981 (37 of which are different from the 227 cases used for our original index). The regression using NAR housing data is estimated using 358 SMSAs between 1979 and 1996 (only 113 of which are used in the construction of our original index).

We constructed each of the four alternative COL indexes for all state-years between 1960 and 1995. Then for each we pooled all observations and computed concordance correlations comparing both levels and first differences for it with those for our original deflator. The results are presented in the top section of Table 3. Six of the eight concordance correlations exceed .98, and the remaining two are still quite strong at .84 and .87. Thus, there is compelling evidence that our state COL index is largely unaffected by the specific SMSAs and NMURs providing the data to construct the index, the precise classification of these SMSAs and NMURs into regions, the specific operationalization of dependent and independent variables in equation [1], and whether the effects of independent variables are assumed constant across regions. This constitutes very strong evidence of our deflator's reliability. However, reliability is only a necessary condition for a high-quality measure, not a sufficient one. Direct tests of indicator validity must also be persuasive.

[17] The Census Bureau divides its four regions into nine subregions. We combined those subregions having fewer than five SMSAs in our sample, thereby yielding seven ultimate regions: Northeast (New England and Middle Atlantic), E. North Central, W. North Central, Mountain, Pacific, South Atlantic, and South Central (E. South Central and W. South Central).

[18] For our purpose, the NAR measure of housing value is weaker than the Census Bureau indicator used in the initial regression since the NAR measure is based on a small subset of the population of homes (just those sold in a given year). The NAR data were obtained directly from the organization.

TABLE 3

Reliability and Validity Assessment of the State Cost of Living Index

RELIABILITY TESTS

	Analysis of Levels (1960–95)			Analysis of First Differences (1961–95)		
Fit between original state COL index and alternative index constructed . . .	concordance correlation[a] (ρ_c)	s.e.	n	concordance correlation[a] (ρ_c)	s.e.	n
. . . by allowing all effects to vary across regions	.994	<.001	1728	.986	<.001	1680
. . . using seven region classification	.844	<.001	1728	.871	<.001	1680
. . . using family budget as dependent variable	.995	<.001	1728	.989	<.001	1680
. . . using NAR measure of housing value	.996	<.001	1728	.994	<.001	1680

VALIDITY TESTS

	Analysis of Levels (1960–95)			Analysis of First Differences (1961–95)		
Fit between "aggregated" state COL index and the. . .	concordance correlation[b] (ρ_c)	s.e.	n	concordance correlation[b] (ρ_c)	s.e.	n
. . . regional CPI in Northeast (1967–95)	.991	.002	29	.850	.054	28
. . . regional CPI in Midwest (1967–95)	.999	<.001	29	.943	.018	28
. . . regional CPI in South (1967–95)	.995	.001	29	.957	.013	28
. . . regional CPI in West (1967–95)	.998	.001	29	.876	.045	28
. . . national CPI (1960–95)	.997	.001	36	.997	<.001	35

[a]These are all pooled correlations across all state-years.
[b]These are all time-series correlations.

Cross-Level Inference: The Extension of SMSA/NMUR Results to the State Level

The first evidence of the validity of our COL index is that the parameter estimates for the underlying regression model are consistent with predictions about their sign. This suggests that our basic COL model is sound, and that we are successfully predicting the COL of SMSAs and NMURs. However, a critical assumption underlying our strategy is that regression coefficients derived from a sample of metropolitan areas and nonmetropolitan regions accurately characterize relationships among the variables when these variables are measured at the state level. It is important to test this assumption empirically.

We can perform this test because our regression sample includes both substate (SMSA) and suprastate (NMUR) cases.[19] Hence, we can construct a deflator based on a regression involving just our SMSA observations, build an alternative deflator based on a regression with our NMUR cases only, and then compare the results. If a COL index constructed from a regression involving substate metropolitan areas proves very similar to an index derived from a regression involving nonmetropolitan areas within large multistate regions, it seems reasonable to infer that the same regression equation can be used to predict the COL accurately for the units "in between," namely, the American states.

There are 191 SMSA observations in our sample, and 36 NMUR cases. The regression results relying on the two subsamples are presented in Table 1—the "metropolitan" equation in column 2, and the "nonmetropolitan" equation in column 3. The table shows that coefficient estimates remain similar when the sample shifts from the SMSAs to the nonmetropolitan regions. The t-ratios are dramatically lower for the nonmetropolitan regression, but this is not surprising given that a model with 10 independent variables is being estimated with only 36 observations. Also, the coefficient estimate for population in the nonmetropolitan regression has a different sign than in the full-sample and SMSA regressions, but its magnitude is near zero, and the original prediction about its sign was ambiguous. Even more telling is a direct comparison of the state COL values derived from the two samples. Pooling deflator values across all state-years, the concordance correlation between the two measures is .98 (s.e. = .001; n = 1728) for levels and .99 (s.e. < .001; n = 1680) for first differences, indicating a very close correspondence between the two deflators. While analysts should always be cautious about extending regression results at one level of analysis to another, the great similarity between regression results based on substate metropolitan areas and those based on the nonmetropolitan areas

[19] To be precise, not all SMSAs are substate regions; some cut across state boundaries. Nevertheless, the vast majority of SMSAs are contained within a single state.

within four suprastate regions suggests that an extension of the results to the state level produces no substantial distortion in our COL index.[20]

Comparing Our State COL Index to National and Regional CPIs

There is no direct measure of state COL we can use to validate our deflator. But the CPI is available annually for the four Census regions between 1967 and 1995, and nationally since 1960. We can indirectly assess the validity of our measure by aggregating our state COL values to the regional and national levels, computing weighted averages based on states' shares of a region's (or the nation's) population. From these averages, regional and national deflators (fixed at 100 in 1967) can be constructed which can be compared to observed values of the CPI.

For the nation as a whole and in each of the four regions, we assess the correspondence between the CPI and our "aggregated" deflator, comparing both levels and first differences (see the bottom section of Table 3). For levels, all five time-series concordance correlations are .99 or greater. For the stronger test involving change scores, the results are not quite as impressive, but three ρ_cs are greater than .94, and the other two—for the Northeast and the West—are .85 and .87 respectively. As expected, the fit is closest with the national CPI, for which both ρ_c values exceed .99. This close correspondence between the national CPI and our deflator aggregated to the national level is also evident in Figure 1.

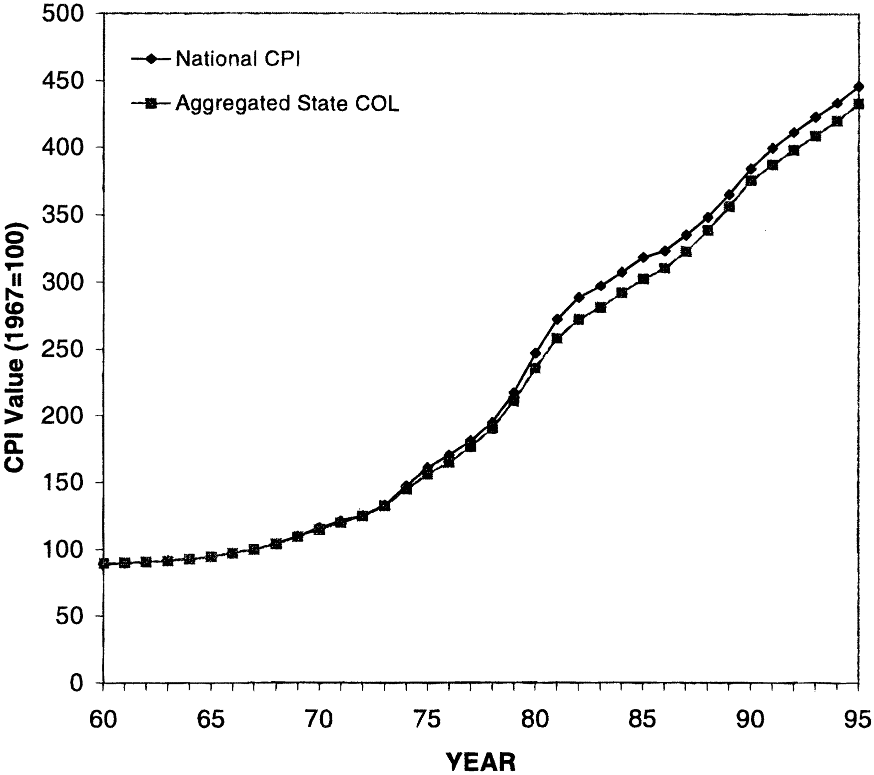
For purposes of comparison, we also aggregated McMahon's (1991) state COL index—constructed annually for 1981–90—to the regional level. His index has a respectable correspondence with the regional CPI when levels are considered; the concordance correlations in the four Census regions range between .55 and .86.[21] But when first differences are analyzed, the correspondence between McMahon's index and the CPI virtually disappears. For three regions, ρ_c is actually negative (ranging between $-.03$ and $-.17$); in the fourth region, the correlation is .26. For the same 1981–90 period, the concordance correlation between the first difference for our aggregated COL index and the change score for the CPI is at least .63 for all four regions and greater than .82 in two. These are lower correlations than we observed for the longer period from 1967 to 1995, but they are still impressive when we observe in Figure 1 that the 1980s is the decade for which the fit between our state COL index and the national CPI is

[20] Note that NMURs consist of urban units that are not within SMSAs. Thus, the similarity between deflators based on SMSA and NMUR information cannot be an artifact of the regional data somehow being an "aggregated version" of component metropolitan data.

[21] In calculating these correlations, all regional deflators were adjusted to equal 100 in 1981.

FIGURE 1

Validity Assessment of Our State Cost of Living Index: The Similarity Between Our COL Index Aggregated to the National Level and the National CPI

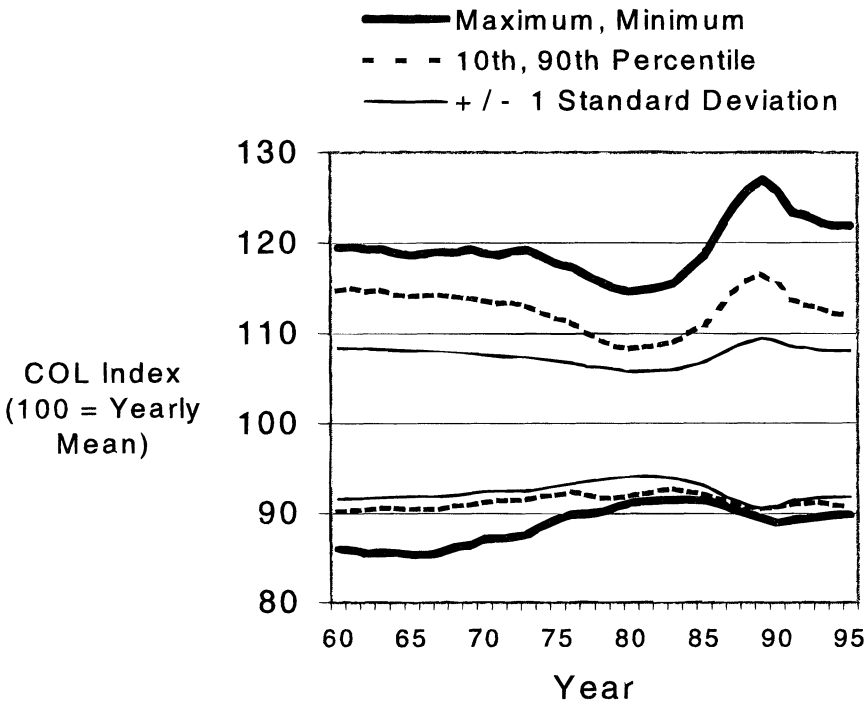


poorest. The high concordance correlations for our measures, and the low correlations between the regional CPIs and the McMahon measure, provide strong evidence for the validity of our COL index—and damning testimony about the quality of McMahon's COL measure.[22]

[22] We conducted a similar test on an unpublished state COL index developed by Craig and Palumbo (cited by Craig and Inman 1982) for the period 1969–89 (data provided by Mark Rom). When aggregated to the regional level, both the levels and change scores for Craig and Palumbo's measure correlate very highly with the regional CPI. However, the Craig and Palumbo measure indicates that living costs are essentially the same in the Northeast and Midwest and most expensive in the West (even when Alaska and Hawaii are excluded), a result inconsistent with the regional patterns

FIGURE 2

Cross-Sectional Variation in the Cost of Living, 1960–1995



Discussion

Scholars who use state-level monetary variables measured in nominal dollars or dollars deflated with a national price index implicitly assume that there are no appreciable geographic differences in the COL. This assumption can be checked using our COL index. Figure 2 shows the amount of cross-sectional variation in the COL for each year during the period 1960–95. To construct this graph, the COL index is rescaled so that for each year, 100 indicates the average value of the COL across states. The graph shows the lowest and highest COL index values across states in each year, the 10th and 90th percentiles (i.e., the index values of the fifth lowest and highest states when ranked), as well as the values that are ± 1 standard deviation away from the yearly mean of 100.

found in BLS family budget data. We have been unable to obtain a description of Craig and Palumbo's methodology to help us explain this troubling feature of their measure.

Several facts are clear. First, there is considerable cross-state variation in the COL throughout the period; the range in index values across states is never lower than 23.5 (its value in 1980) and is as great as 37.7 in 1989. Second, the extent of variation differs from year to year. The greatest variation occurred in the 1960s, the late 1980s, and the 1990s. This suggests that cross-sectional research conducted on data from these periods may be more prone to distortion than studies relying on data from the 1970s or early 1980s.

To illustrate the possible distortion from not adjusting for cross-state differences in the value of a dollar, we compared the rankings of the 48 states on monetary variables measured nominally to the rankings on the same variables after they have been deflated with our state COL index. Table 4 presents this comparison for per capita income and per capita state government tax revenues in 1995. For the income variable, the rank (1 through 48) of *26* states changes by five or more when the variable is deflated, with the largest shift being 14 spots (in Rhode Island, Texas, and Vermont). For per capita tax revenues, *25* states change ranks by five or more positions, with the largest disparity in positions exhibited in New Jersey (which moves from 10th to 28th). Other variables may yield more or less distortion than is evident in Table 4, but these examples clearly document the potential for distortion resulting from a failure to adjust for geographic differences in the cost of living.

TABLE 4

Comparing Nominal and Deflated Versions of State Monetary Variables: Per Capita Income and Per Capita State Tax Collections, 1995

	Nominal Version of Income		Deflated Version of Income		Nominal Version of State Taxes		Deflated Version of State Taxes	
State	Dollars	State Rank	Dollars	State Rank	Dollars	State Rank	Dollars	State Rank
Alabama	19254	35	20920	34	1196	43	1299	40
Arizona	20316	**33**	21605	**25**	1446	**24**	1537	**17**
Arkansas	18144	**46**	19993	**41**	1365	**31**	1504	**20**
California	24229	**12**	22309	**23**	1688	11	1554	15
Colorado	24517	**10**	25293	**4**	1209	42	1247	42
Connecticut	32603	1	26735	1	2285	1	1874	4
Delaware	26235	6	25350	3	2225	2	2150	1
Florida	23139	**18**	24162	**11**	1309	**39**	1367	**33**
Georgia	21940	**21**	22941	**16**	1316	**38**	1376	**32**
Idaho	19199	**36**	21090	**31**	1486	**21**	1633	**13**
Illinois	25580	8	23800	12	1407	**25**	1309	**39**
Indiana	21716	25	21274	28	1388	**28**	1360	**34**

continued

TABLE 4 *Continued*

State	Nominal Version of Income		Deflated Version of Income		Nominal Version of State Taxes		Deflated Version of State Taxes	
	Dollars	State Rank	Dollars	State Rank	Dollars	State Rank	Dollars	State Rank
Iowa	20826	32	20631	35	1549	16	1534	18
Kansas	21886	24	21335	27	1468	**22**	1431	**29**
Kentucky	18847	40	20601	36	1630	**13**	1781	**7**
Louisiana	18999	**39**	21016	**32**	1078	46	1193	45
Maine	20227	**34**	19387	**44**	1463	**23**	1403	**30**
Maryland	26567	5	25254	5	1600	14	1521	19
Massachusetts	28397	**3**	24234	**10**	1911	**4**	1631	**14**
Michigan	23767	16	22914	17	1858	7	1791	6
Minnesota	24097	**13**	22525	**21**	2021	3	1889	3
Mississippi	16743	48	18646	47	1335	**36**	1487	**23**
Missouri	21927	**22**	21225	**30**	1269	41	1229	43
Montana	18602	**42**	20556	**37**	1395	**26**	1542	**16**
Nebraska	21424	**27**	20955	**33**	1354	34	1325	37
Nevada	24809	9	24954	7	1760	9	1770	8
New Hampshire	25726	**7**	22847	**18**	800	48	710	48
New Jersey	29982	2	25475	2	1712	**10**	1454	**28**
New Mexico	18246	45	19827	43	1683	**12**	1829	**5**
New York	27850	4	25121	6	1885	5	1700	9
North Carolina	21233	**30**	22493	**22**	1587	15	1681	11
North Dakota	18504	**43**	18364	**48**	1494	20	1482	24
Ohio	22560	**19**	21876	**24**	1364	**32**	1323	**38**
Oklahoma	18748	41	20554	38	1348	**35**	1478	**26**
Oregon	21915	**23**	23452	**13**	1361	**33**	1457	**27**
Pennsylvania	23673	17	23153	15	1514	**17**	1481	**25**
Rhode Island	23783	**15**	21239	**29**	1502	**18**	1341	**35**
South Carolina	19073	37	20469	39	1299	**40**	1394	**31**
South Dakota	19032	**38**	18997	**46**	951	47	949	47
Tennessee	21350	**29**	22768	**19**	1126	44	1201	44
Texas	21381	**28**	23383	**14**	1079	45	1180	46
Utah	18317	44	19942	42	1367	**30**	1488	**22**
Vermont	21609	**26**	20332	**40**	1369	**29**	1288	**41**
Virginia	24284	11	24350	9	1328	37	1331	36
Washington	23974	**14**	24509	**8**	1872	6	1913	2
West Virginia	17576	47	19362	45	1497	**19**	1649	**12**
Wisconsin	22416	**20**	21545	**26**	1763	8	1694	10
Wyoming	20954	**31**	22603	**20**	1392	**27**	1502	**21**

Note: Variables are deflated using our state COL index adjusted so that the base value is the unweighted average of the COL across states in 1995. Rankings in bold indicate instances where the nominal and deflated rankings differ by five or more places.

Source: Nominal values of variables are from *United States Statistical Abstract 1996*, Bureau of Economic Analysis.

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