Estimation and Evaluation of State Price Indexes For The Period 1967-1978: An Empirical Note #

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I. INTRODUCTION

Much empirical work in economics utilizes data bases defined for individual states. In many cases, as for instance when estimating demand functions with pooled cross section and time series data, the correct specification of the hypothesized model requires a price index for each state. Heretofore, solutions to this problem have varied and included using the national Consumer Price Index, thereby ignoring the spatial variation in prices. The purpose of this research is to estimate and evaluate a set of state price indexes for the period 1967-1978 that can be used in further research efforts.

II. ESTIMATION OF THE STATE PRICE INDEXES

Currently, the Bureau of Labor Statistics publishes a consumer price index for major SMSAs using the ratio of expenditures in the current period to expenditures in a base period, with the quantities of each good constant in both periods.¹ This index is not comparable across SMSAs, however, since the prices for each good varied in the base period in each SMSA. Therefore, the SMSA consumer price indexes do provide a measure of price changes over time in a particular SMSA, but they are not comparable between cities because each city index is based upon a different expenditure in the base period.

The Bureau of Labor Statistics also publishes urban budgets for three standards of living for a family of four for thirty-nine major cities in the United States. The three standards of living are low, intermediate, and high and the family is assumed to consist of an employed husband, age 38, a wife not employed outside the house, and two children, a boy age 13 and a girl age 8.² The definition of a standard of living was determined from two basic sources: (1) nutritional and health standards were used for housing and food consumed within the household; and (2) the Bureau of

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Labor Statistics Survey of Consumer Expenditures and other related studies and surveys were utilized to determine other goods and services purchased for each standard of living. These are the same studies utilized by the BLS to define the commodity bundle of the current CPI.³

Since these budgets are comparable among the thirty-nine cities as a measure of the change in the cost of maintaining a certain standard of living, they provide a good starting point for the estimation of state price indexes. To complete the index development, standard of living budgets need to be available for the entire state and the state budgets then need to be expressed as a ratio of expenditures with a constant base. With this in mind, three categories of state consumers should be represented in the estimate of each state standard of living budget: (1) metropolitan dwellers living in cities with published budgets; (2) metropolitan dwellers living in cities without published budgets; and (3) non-metropolitan dwellers. Budgets are published for thirty-nine major cities, which included over one-third (~36%) of the total population and almost one-half (~50%) of the metropolitan population of the United States throughout the sample period. Budget estimates for categories (2) and (3) had to be developed for each state.

The budget utilized in this analysis is that reported for an intermediate standard of living for a family of four. The choice of one budget over the other two implies that changes in the cost of living for each standard of living category move in tandem and in proportion. Since the budgets are aggregates of all consumers in a particular metropolitan area, this assumption does not appear unreasonable.

The computation of each state budget was made as follows:

$$B_{st} = \left\{ \sum_{i=1}^r \left[(X_{ist}/X_{st}) \times B_{ist} \right] \right\} + \left\{ \left[\left(\sum_{i=1}^N X_{ist} - \sum_{i=1}^r X_{ist} \right) / X_{st} \right] \times (A_{st} \times B_t^1) \right\} + \left\{ \left[(X_{st} - \sum_{i=1}^N X_{ist}) / X_{st} \right] \times (A_{st} \times B_t^2) \right\} \quad (1)$$

where

s, t = state and time, respectively,

r = number of metropolitan areas in the state with published budgets (for $r=0$, all summations over r were set to zero),

N = total number of metropolitan areas in the state,

B_{st} = budget (expenditures) required for a family of four to maintain an intermediate standard of living in state s at time t ,

X_{ist} = population of the i^{th} metropolitan area,

X_{st} = population of the state,

- B_{ist} = budget for the i^{th} metropolitan area,
 B_t^1 = national metropolitan budget,
 B_t^2 = national non-metropolitan budget, and
 A_{st} = adjustment factor (ratio of state to national per capita income).

A typical state budget estimate is composed of the three distinct terms separated by addition signs (+) in the above formula. The first term accounts for metropolitan dwellers living in cities with published budgets, the second term accounts for metropolitan dwellers living in cities without published budgets, and the third term accounts for non-metropolitan residents of the state. The resulting state budget is a combination of the three average budgets in each category, with each average budget weighted by the relative population in the particular category. The average budgets in each category are weighted by the relative population in order to account for the number of consumers in the state that are represented in each budget category.

The budget estimates for state residents in categories (2) and (3) were obtained by weighting the national budgets for metropolitan and non-metropolitan areas, respectively, by the ratio of state per capita income to national per capita income.⁴ The reason for multiplying the per capita income ratio times the national metropolitan and non-metropolitan budgets is that the result of the calculation provides an estimate of the state metropolitan and non-metropolitan budgets. This can be seen as follows: let Y_p^s and Y_p^n be the state and national average per capita incomes and k_s and k_n be the percent of the state and national income required to maintain an intermediate standard of living for a family of four, respectively. Then

$$(k_s) (4) (Y_p^s) = \sum_{i=1}^G p_{it}^s q_{it}^s \quad (2)$$

$$(k_n) (4) (Y_p^n) = \sum_{i=1}^G p_{it}^n q_{it}^n \quad (3)$$

where

- G = number of goods,
 s = states,
 n = national averages,
 t = time period,
 p = price of i^{th} commodity, and
 q = quantity of i^{th} commodity.

We are trying to estimate the quantity on the right-hand-side of the equals sign in equation (2) by multiplying the ratio of per capita incomes times the quantity on the right-hand-side of equation (3). The result is:

$$\frac{(4) (Y_p^s)}{(4) (Y_p^n)} = \frac{(1/k_s) (\sum_{i=1}^G p_{it}^s q_{it}^s)}{(1/k_n) (\sum_{i=1}^G p_{it}^n q_{it}^n)} \quad (4)$$

$$\begin{aligned} & \frac{(1/k_s) (\sum_{i=1}^G p_{it}^s q_{it}^s)}{(1/k_n) (\sum_{i=1}^G p_{it}^n q_{it}^n)} \times (\sum_{i=1}^G p_{it}^n q_{it}^n) \\ & = (k_n/k_s) (\sum_{i=1}^G p_{it}^s q_{it}^s) \end{aligned} \quad (5)$$

By assuming that $K_n = K_s$, or that the percent of income required to maintain an intermediate standard of living for a family of four is fairly constant across all states, the final result from equation (5) provides an estimate of the state budget.⁵ This computation is performed for both the metropolitan and non-metropolitan population for all states using the appropriate national budget estimates. For those states with no budget estimates available from BLS, only the last two terms of equation (1) were used to estimate the overall state budget.

By using this procedure, the goods in the initial bundle remain constant for a given state over time. The bundles would be more representative of goods purchased within a state the greater the proportion of the population represented in the city metropolitan budgets published by the BLS.

To complete the development of the state price indexes, the state budgets were divided by a common base expenditure level obtained as a weighted average, by population, of the national metropolitan and non-metropolitan budgets for 1970. Using this common base expenditure in the denominator results in indexes that provide estimates of the relative cost of living among the various states in any one year and of the changes in the cost of living for each state over time. The complete set of state price indexes is listed in Table 1.

III. EVALUATION OF THE STATE PRICE INDEXES

Evaluation of the state price indexes (SPI) is undertaken by comparing the state indexes with the Consumer Price Index (CPI) and the ACCRA Inter-City Cost of Living Indicators. In order to compare the state price indexes with the Consumer Price Index, a national state price index was computed by averaging the price indexes for each state by year. Table 2 presents the ratio of two consecutive years for each price index, with the earlier year in the denominator. The numbers in the table reflect a high degree of consistency in the measured change in prices over the period 1967-1978. An interesting comparison is to examine the changes from one time period to the next for an indication of the growth path of prices over time resulting from each index. The asterisks (*) mark periods of divergence between the indexes in the growth path of prices.

Each divergence noted will be considered separately. First, the two CPI ratios for the periods 1968-1969 and 1969-1970 are 1.05 and 1.06, respectively. The comparable ratios for the average state price indexes are 1.06 for both time periods. In other words, the CPI measures a slight increase in the rate of growth in prices while the average SPI measures a constant rate of growth. For the time periods 1975-1976 and 1976-1977, the situation is reversed but the difference is less than 3%. Between the time periods 1970-1971 and 1971-1972, the CPI measured a decline in the rate of growth in prices of less than 1% while the average SPI measured an increase in the rate of growth of about 2%. These latter two periods are the only time periods for which the indexes measured changes in the rate of growth of prices of opposite signs and the only periods for which formal price controls were in effect. In the period immediately following the lifting of price controls, the average SPI shows a rapid adjustment in prices while the CPI shows the price changes occurring over a two year period.

As a further comparison of the two indexes, the ratio of the growth rates in the average state price index and the Consumer Price Index is also provided in Table 2. This ratio indicates that the price changes measured by both indexes are relatively consistent over the period 1967-1978.

The conclusion from this comparison is that a simple average of the individual price indexes for each state tends to reflect national price trends as measured by the Consumer Price Index. Since the Consumer Price Index is of the Laspeyres variety, questions are sometimes raised concerning the substitution bias in the index as consumers substitute among consumption items as a result of changes in relative prices. Recent evidence indicates this bias may be small and that the Consumer Price Index does reflect in a general way changes in the cost of living [Braithwait 1980].

The American Chamber of Commerce Researchers Association (ACCRA) publishes an index each quarter for major cities that is designed to reflect cost of living differences between these cities.⁶ The index is based each year on a total U.S. value of 100 and therefore does not measure price changes over time for the cities. To compute the index, ACCRA collects price information on the same selected consumer items in each city from the local Chamber of Commerce. Since participation is voluntary, the cities reported vary slightly from quarter to quarter. When utilizing the index, ACCRA suggests that differences of three points or less be considered insignificant.

An ACCRA Index for each state was obtained by computing a simple average of the index reported for each city in the state. A relative state price index was computed for each state by dividing the state index for each year by the simple average of all state indexes for that year. The results are shown in Table 3. The states were chosen to reflect differences in geographic location and to provide a sample for comparison.

Index values that exceed 100 indicate that the state in question has a higher cost of living than the nation as a whole while the opposite is true for values less than 100. There are 88 comparisons noted in the table. Those

TABLE 1
Listing of the State Price Indexes

State	Years											
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Alabama	0.60	0.64	0.68	0.73	0.77	0.81	0.90	1.04	1.13	1.23	1.26	1.38
Alaska	0.95	1.01	1.07	1.14	1.18	1.19	1.38	1.71	2.29	2.35	2.28	2.36
Arizona	0.74	0.80	0.86	0.93	0.97	1.02	1.11	1.25	1.31	1.39	1.44	1.61
Arkansas	0.57	0.61	0.65	0.69	0.72	0.75	0.88	1.03	1.08	1.14	1.20	1.29
California	0.93	0.98	1.03	1.08	1.10	1.13	1.26	1.43	1.54	1.64	1.73	1.84
Colorado	0.84	0.88	0.92	0.97	1.01	1.05	1.16	1.31	1.42	1.52	1.59	1.76
Connecticut	1.07	1.12	1.18	1.23	1.23	1.26	1.38	1.56	1.64	1.73	1.78	1.94
D.C.	0.87	0.92	0.98	1.04	1.06	1.11	1.23	1.42	1.50	1.60	1.70	1.90
Delaware	1.00	1.05	1.10	1.15	1.18	1.21	1.34	1.51	1.61	1.69	1.72	1.88
Florida	0.77	0.83	0.89	1.96	1.00	1.06	1.18	1.31	1.37	1.44	1.50	1.65
Georgia	0.71	0.75	0.79	0.84	0.87	0.93	1.04	1.18	1.25	1.32	1.38	1.51
Hawaii	1.00	1.06	1.12	1.18	1.21	1.25	1.37	1.57	1.74	1.80	1.90	2.10
Idaho	0.66	0.70	0.73	0.77	0.79	0.85	0.99	1.16	1.19	1.27	1.30	1.47
Illinois	0.91	0.96	1.01	1.07	1.10	1.14	1.26	1.43	1.52	1.60	1.67	1.82
Indiana	0.83	0.87	0.91	0.95	0.98	1.02	1.16	1.28	1.37	1.48	1.54	1.69
Iowa	0.78	0.82	0.86	0.90	0.90	0.96	1.17	1.26	1.39	1.40	1.49	1.70
Kansas	0.80	0.84	0.88	0.92	0.95	1.01	1.16	1.29	1.40	1.47	1.52	1.69
Kentucky	0.62	0.66	0.71	0.76	0.78	0.82	0.92	1.07	1.14	1.22	1.28	1.39

TABLE 1 (Continued)

State	Years											
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Louisiana	0.68	0.71	0.75	0.78	0.80	0.84	0.93	1.09	1.18	1.27	1.33	1.47
Maine	0.70	0.74	0.78	0.82	0.83	0.86	0.96	1.12	1.18	1.28	1.31	1.43
Maryland	0.86	0.92	0.98	1.04	1.07	1.11	1.23	1.41	1.49	1.59	1.65	1.79
Massachusetts	0.94	1.00	1.06	1.13	1.18	1.24	1.35	1.52	1.64	1.75	1.84	1.98
Michigan	0.88	0.92	0.97	1.02	1.05	1.11	1.23	1.38	1.48	1.58	1.67	1.83
Minnesota	0.83	0.88	0.92	0.98	1.00	1.05	1.20	1.35	1.43	1.51	1.62	1.77
Mississippi	0.50	0.53	0.57	0.61	0.64	0.69	0.77	0.89	0.94	1.02	1.07	1.18
Missouri	0.83	0.87	0.91	0.95	0.98	1.01	1.12	1.25	1.34	1.41	1.54	1.63
Montana	0.70	0.74	0.78	0.82	0.82	0.89	1.05	1.17	1.25	1.28	1.26	1.42
Nebraska	0.76	0.80	0.85	0.90	0.92	0.99	1.17	1.24	1.38	1.38	1.44	1.62
Nevada	0.96	1.03	1.10	1.19	1.21	1.24	1.37	1.51	1.63	1.74	1.85	2.07
New Hampshire	0.81	0.85	0.89	0.93	0.93	0.96	1.06	1.21	1.29	1.38	1.44	1.58
New Jersey	1.04	1.10	1.17	1.23	1.26	1.30	1.41	1.59	1.70	1.77	1.79	1.95
New Mexico	0.62	0.66	0.70	0.74	0.77	0.81	0.89	1.03	1.14	1.20	1.25	1.39
New York	0.96	1.02	1.08	1.15	1.19	1.23	1.34	1.54	1.62	1.71	1.78	1.92
North Carolina	0.65	0.70	0.75	0.80	0.83	0.88	0.99	1.12	1.19	1.27	1.37	1.44
North Dakota	0.64	0.67	0.70	0.73	0.78	0.92	1.34	1.34	1.34	1.28	1.26	1.52
Ohio	0.85	0.90	0.95	1.00	1.02	1.06	1.17	1.33	1.40	1.50	1.57	1.71

TABLE 1 (Continued)

State	Years											
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Oklahoma	0.71	0.75	0.79	0.84	0.85	0.89	1.00	1.16	1.26	1.35	1.42	1.56
Oregon	0.82	0.86	0.89	0.93	0.96	1.02	1.13	1.30	1.39	1.50	1.59	1.76
Pennsylvania	0.84	0.89	0.94	0.99	1.03	1.07	1.18	1.34	1.43	1.52	1.59	1.74
Rhode Island	0.89	0.93	0.98	1.02	1.04	1.09	1.16	1.33	1.42	1.51	1.54	1.66
South Carolina	0.60	0.64	0.69	0.73	0.76	0.80	0.90	1.05	1.11	1.19	1.22	1.34
South Dakota	0.65	0.68	0.71	0.74	0.78	0.85	1.10	1.10	1.14	1.10	1.24	1.45
Tennessee	0.66	0.70	0.74	0.79	0.83	0.88	0.98	1.11	1.17	1.25	1.30	1.44
Texas	0.76	0.80	0.85	0.90	0.92	0.96	1.07	1.23	1.34	1.43	1.50	1.65
Utah	0.70	0.74	0.78	0.82	0.86	0.90	0.98	1.11	1.22	1.29	1.33	1.45
Vermont	0.71	0.74	0.77	0.71	0.82	0.84	0.93	1.03	1.10	1.16	1.20	1.35
Virginia	0.77	0.82	0.88	0.93	0.97	1.03	1.13	1.30	1.39	1.49	1.53	1.61
Washington	0.90	0.94	0.98	1.02	1.03	1.07	1.19	1.37	1.50	1.58	1.65	1.81
West Virginia	0.62	0.66	0.70	0.74	0.78	0.81	0.90	1.05	1.17	1.25	1.29	1.42
Wisconsin	0.84	0.88	0.92	0.97	0.99	1.02	1.13	1.28	1.38	1.45	1.53	1.58
Wyoming	0.75	0.78	0.82	0.85	0.86	0.93	1.07	1.27	1.38	1.47	1.57	1.77
U.S. Average	0.79	0.83	0.88	0.93	0.95	1.00	1.12	1.27	1.37	1.45	1.50	1.65

TABLE 2
Comparison of the Average State Price Indexes
and the Consumer Price Index¹

Time Period	Ratios of Each Price Index for Two Consecutive Years ²		Growth Rate Ratio SPI/CPI
	CPI	Average SPI ³	
1977-1978	1.08	1.10	1.02
1976-1977	1.06 *	1.03	.97
1975-1976	1.06	1.06	1.00
1974-1975	1.09	1.08	.99
1973-1974	1.11	1.13	1.02
1972-1973	1.06	1.12	1.06
1971-1972	1.03 *	1.05	1.02
1970-1971	1.04	1.02	.98
1969-1970	1.06 *	1.06	1.00
1968-1969	1.05	1.06	1.01
1967-1968	1.04	1.05	1.01

¹Asterisks indicate periods of divergence between the indexes.

²Each ratio was computed with the earlier year in the denominator.

³Average State Price Index (SPI) equals the average of the individual state indexes.

comparisons marked with an asterisk (*) indicate the state and year where the indexes diverged in their views of the state relative cost of living. Eighteen comparisons are marked, or 20% of the total, with eight being in the state of Vermont. Although the reason for the index discrepancy in Vermont is unclear, removal of this state from the analysis leaves ten contradictions, or 13% of the new total of 78. A comparison of the 10-year averages shows that the discrepancy still exists for Vermont, but not for any other state. It should be noted that the ACCRA Index reported for Vermont was based upon prices from one town, Rutland.

In most cases each index was consistent in identifying high and low cost of living states for each year considered and over the entire span of ten years. In 80% of the cases, the indexes coincided; if those divergent comparisons where one index was within ± 2 points of 100 are ignored, the percentage of coincident measurements increases to 92% of the new total of 76. In other words, twelve of the comparisons considered divergent are based upon index values that do not fall outside the range of 98 to 102. The conclusion reached from this comparison is that the indexes are indeed relatively consistent in identifying high and low cost of living states.

TABLE 3
Comparison of the State Price Indexes and the
ACCRA Cost of Living Index¹

Year	California		Georgia		Illinois		Michigan		Nebraska	
	ACCRA	Rel SPI	ACCRA	Rel SPI	ACCRA	Rel SPI	ACCRA	Rel SPI	ACCRA	Rel SPI
1978	112	112	95	92	104	110	102	111	96	98
1977	103	115	96	92	101	111	102	111	91	96
1976	105	113	96	91	101	110	105	109	95	95
1975	108	112	97	91	99 *	111	104	108	92	101
1974	105	113	100 *	93	101	113	104	109	99	98
1973	102	113	102 *	93	100 *	113	104	110	98	104
1972	104	113	100 *	93	101	114	101	111	94	99
1971	102	116	98	92	103	116	104	111	96	97
1970	108	116	98	90	102	115	104	110	97	97
1969	100 *	117	100 *	90	104	115	109	110	100 *	97
Average	105	114	98	92	102	113	104	110	96	98

TABLE 3 (Continued)

Year	New York		Texas		Vermont		Washington	
	ACCRA	Rel SPI	ACCRA	Rel SPI	ACCRA	Rel SPI	ACCRA	Rel SPI
1978	118	116	97 *	100	102 *	82	—	110
1977	123	119	95 *	100	105 *	80	103	110
1976	128	118	94	99	107 *	80	115	109
1975	109	118	93	98	110 *	80	109	109
1974	107	121	92	97	116 *	81	102	108
1973	111	120	91	96	109 *	83	103	106
1972	115	123	92	96	98	84	106	107
1971	115	125	90	97	101 *	86	110	108
1970	111	124	94	97	103 *	87	104	110
1969	112	123	95	97	91	88	—	111
Average	115	121	93	98	104	83	106	109

¹Rel SPI refers to the relative state price index computed by dividing the state index for each year by the average of all state indexes for that year.

IV. SUMMARY

The purpose of this paper was to estimate a set of state price indexes for the years 1967-1978 that could be used in empirical analysis with cross section and pooled cross section and time series data. A comparison of the results with the Consumer Price Index indicates that an average state price index follows national price movements closely. Also, a comparison of state price indexes with a state average ACCRA Inter-City cost of living indicator shows that the state price indexes identify high and low cost of living states in a consistent manner. The advantages of the state price indexes presented in this paper are the spatial and temporal comparability characteristics that are not available in other indexes.

FOOTNOTES

¹U.S. Department of Commerce, Bureau of Labor Statistics, *Monthly Labor Review*.

²U.S. Department of Labor, Bureau of Labor Statistics, *Handbook of Labor Statistics 1975—Reference Edition*, 1975. Information in footnote to Table 141, p. 364.

³U.S. Department of Commerce, Bureau of Labor Statistics, *3 Standards of Living for an Urban Family of Four Persons*, Bulletin No. 1570-5. Annual.

⁴U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, Volume 59, No. 8, Part II. August, 1979.

⁵The assumption of a fairly constant ratio of expenditures to income can be partially tested by evaluating the thirty-nine cities for which intermediate standard of living budgets are available. For example, for the years

1971 and 1978, the following ratio was computed for each city: (intermediate standard of living budget) / (4 x SMSA per capita income). The results were: 1971, mean = 0.617, $s = 0.05$; 1978, mean = 0.555, $s = 0.05$. If the ratio (k_n/k_s) in equation (5) was equal to one, the estimates of s would be zero, in which case k_s would be equal for all states and k_n , the average of the k_s 's, would be equal to any k_s . The results for these two years indicate that an assumption of one for the ratio is a close approximation.

⁶American Chamber of Commerce Researchers Association. *Index Report: Inter-City Cost of Living Indicators*. Indianapolis, Ind.: Indianapolis Chamber of Commerce, Quarterly.

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