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A PRICE INDEX FOR POLICE INPUTS*

NORMAN WALZER

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Expenditures for police protection in Illinois cities have increased considerably in the past eleven years. One wonders what proportion of this increase has occurred because of expanded service levels and what proportion has resulted from price increases of inputs purchased. If expenditure increases due to sheer price changes were identified and quantified, they would be a useful planning tool for police administrators, especially in formulating future budgets.

Unfortunately, little effort has been devoted to developing a price index relevant to police inputs.¹ An estimate of price changes might, however, enable administrators to substitute capital for labor or vice-versa in an attempt to minimize the use of those inputs having the largest price changes. Of course, this requires that planners measure quality and quantity of service in some way so as to maintain a constant or increasing level of service at the same time that the substitutions are being made.

MEANING OF A PRICE INDEX

A price index attempts to measure changes in the price level which result solely from price changes. These price movements must be separated from quality changes if the price index is to be meaningful. Theoretically, this distinction is clear, i.e., alterations in an item improving its productivity or extending its life may increase its selling price. One can also understand that over time the price of an item may increase or decrease without any meaningful change in its construction or

*The author expresses his gratitude to Mr. John Kleberg of the Police Training Institute, University of Illinois, for his comments on an earlier draft. As usual, the author assumes sole responsibility for any errors in this analysis.

¹For one attempt, see ARLYN J. LARSON, A PRICE INDEX FOR ILLINOIS MUNICIPALITIES, (1964). Departmental price indices are included. For a recent updating of this index, see Norman Walzer, An Illinois Municipal Price Index and Its Meaning, ILLINOIS MUNICIPAL REVIEW, 4-7 (August, 1969).

usefulness. A price index is concerned with this latter change.

Although conceptually these price changes are easily differentiated, in practice the problem is more serious. It is difficult to evaluate a quality change in dollar terms even when it is known to exist. This problem reaches major proportions when services are being considered since the output produced is very hard to quantify. Another dimension must be added if the worker uses capital in rendering his service.

Even though the above limitations exist, it is still worthwhile, for planning purposes, to obtain an estimate of price changes. Ideally, one would like to have information on all items which are purchased by police departments along with their prices. Practically, even if available, this amount of data would be unmanageable. There is a method, though, which can be used to approximate price movements with much less expense.

CONSTRUCTION OF POLICE INPUT PRICE INDEX

A price index can be constructed by weighting price relatives appropriate for expenditure categories. The expenditure weights in this analysis are based on a survey of twenty-three police departments in Illinois cities with populations larger than 25,000. The price relatives have been obtained from the Wholesale Price Index, the Consumer Price Index, and various other sources.

A. *Expenditure Weights.* Percentage expenditure detail is calculated showing the percentage of the total police budget which each expenditure category represents. These expenditure weights are simply the ratio of expenditures on a specific group of goods and services to the total budget, expressed in percentage terms. These percentages are then used to weight the price movements of each type of goods and services.

An alternative to the fixed-weight approach is to calculate the expenditure weights for every year and incorporate these adjustments into the index.

TABLE 1
PRICE INDEX COMPARISONS

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Consumer Price Index	100.0	100.8	102.4	103.5	104.7	105.9	107.3	109.1	112.3	115.5	120.3
Wholesale Price Index	100.0	100.2	100.3	99.9	100.2	99.9	100.1	102.1	105.5	105.7	108.3
Implicit Deflator for GNP	100.0	102.6	105.9	109.4	113.2	116.5	119.5	123.5	128.4	137.1	145.0
Police Index (Illinois Municipalities)	100.0	104.5	109.8	116.5	120.8	125.2	129.8	135.4	141.2	157.8	168.2

This latter approach is time-consuming; and if expenditure patterns do not vary significantly, it may not greatly improve the price index. Naturally, every so often the fixed-weights must be revised to take account of changes in purchases, otherwise the index loses much of its relevance.

B. *Price Relatives.* After the expenditure weights have been calculated, it is necessary to estimate the price movements of each class of expenditures. This requires data on the prices of a large number of items for each of the eleven years in each city being studied. Since it would be nearly impossible to obtain this information, use is made of data in various published indices, such as the Consumer Price Index and the Wholesale Price Index. These indices have been carefully constructed to adjust for quality differences over time. In addition, the classification scheme is very detailed, permitting close matching of items purchased by police with those reported in the published index. One drawback with using these indices is that they are based on a national sample and do not consider differences in the Illinois cities from the national sample. In other words, the price movements in the "average" Illinois city must be assumed to correspond very closely with those reported in the national indices. The distortion caused by this assumption is inversely related to the percentage of the total budget which is covered by these indices. In the case of police expenditures, this error is small because of the large proportion of expenditures on wages and salaries.

The expenditure weights are multiplied by the price increases, expressed in percentage terms, and these products summed on an annual basis. Each annual value is then divided by the value for the first year to obtain a cumulative percentage increase over the period.

The meaning of a price index must not be misinterpreted. A price index does *not* compare price levels among various places at the same period of time. It does compare prices for the same observation over time. In other words, a price index sug-

gests how prices have moved in city X over the past eleven years. It does *not* say anything about the price level in city X as opposed to city Y in a specific year.

INTERPRETATION OF THE RESULTS

A comparison of four available price indices is made in Table 1. The purpose of this comparison is to show that indiscriminate use of existing indices may lead to considerable error as far as price increases in police inputs are concerned. This is not meant as a criticism of existing indices, *per se*, it is directed at the inappropriate use of them in situations where they clearly are not relevant.

The Consumer Price Index is "... a statistical measure of changes in prices of goods and services bought by urban wage earners and clerical workers, including families and single persons."² Since police departments provide police protection, they are closer to producers than final consumers. The sample upon which the Consumer Price Index is based has a significantly different expenditure pattern than the sample of police departments in this study.

In the private sector, movements of input prices are approximated by the Wholesale Price Index. This series "... has been considered a general purpose index to measure the general price level in other than retail markets."³ Expenditures for police protection are primarily for labor services so the Wholesale Price Index is inappropriate for describing these price movements.

The available index most appropriate for our purposes is the Implicit Gross National Product Deflator for State and Local Government purchases.⁴ This series, constructed by the Office of

² U.S. Department of Labor, Bureau of Labor Statistics, 1458 BLS HANDBOOK OF METHODS FOR SURVEYS, 70 (1965).

³ *Ibid.*, p. 91.

⁴ A detailed account of the construction of this index was made available by Charles A. Waite, National Income division, in a letter to the author, dated August 15, 1969.

TABLE 2
DETAILED PRICE INDEX FOR POLICE INPUTS

Expenditures	Expenditure Weight	1958		1963		1968	
		Price Relative	Product	Price Relative	Product	Price Relative	Product
Personnel Services:							
Supervisory Staff	5.80	100.0	580.0	139.3	808.0	192.8	1,118.5
Clerical	11.87	100.0	1,187.0	113.1	1,342.0	134.3	1,593.7
Patrolmen	54.81	100.0	5,481.0	129.2	7,079.8	180.7	9,901.4
Overtime	1.61	100.0	161.0	129.2	208.0	180.7	290.8
Temporary Help	1.30	100.0	130.0	129.2	167.9	180.7	234.8
School Crossing Guards	0.66	100.0	66.0	129.2	85.3	180.7	119.2
Contractual Services:							
Printing & Advertising	0.14	100.0	14.0	106.6	14.9	120.6	16.9
Postage	0.06	100.0	6.0	132.4	7.9	162.0	9.7
Travel Expense	0.30	100.0	30.0	108.1	32.4	120.0	36.0
Clothing Allowance	0.77	100.0	77.0	102.2	78.7	110.6	85.2
Dues & Subscriptions	0.05	100.0	5.0	102.2	5.1	148.1	7.4
Insurance & Bonds	1.10	100.0	110.0	106.9	117.5	130.1	143.1
Heat, Water, & Light	0.86	100.0	86.0	107.1	92.1	110.5	95.0
Telephone & Telegraph	0.27	100.0	27.0	104.3	28.2	102.0	27.5
Service on Fixed Equipment	0.39	100.0	39.0	107.2	41.8	129.8	50.6
Maintenance on Vehicles	1.21	100.0	121.0	99.7	120.6	104.6	126.5
Other	0.37	100.0	37.0	102.4	37.9	110.8	41.0
Investigation Materials	0.04	100.0	4.0	101.2	4.0	109.5	4.4
Training	0.37	100.0	37.0	125.0	46.3	260.0	96.2
Prisoner Care	0.16	100.0	16.0	113.2	18.1	136.3	21.8
Supplies & Materials:							
Office Supplies	0.35	100.0	35.0	99.2	34.7	105.1	36.8
Janitorial Supplies	0.07	100.0	7.0	119.4	8.4	163.7	11.5
Uniforms	0.13	100.0	13.0	102.2	13.3	110.6	14.4
Motor Fuel & Lubricants	0.72	100.0	72.0	100.2	72.1	103.4	74.4
Plant Equipment	0.13	100.0	13.0	104.4	13.6	115.8	15.1
Vehicles	0.13	100.0	13.0	98.7	12.8	100.7	13.1
Miscellaneous Materials	0.20	100.0	20.0	102.4	20.5	110.8	22.2
Veterinary & Medical Matls.	0.26	100.0	26.0	94.6	24.6	92.8	24.1
Laundry Supplies	0.02	100.0	2.0	110.5	2.2	142.4	2.8
Photo. Supplies	0.11	100.0	11.0	107.8	11.9	113.8	12.5
Ammunition & Arms	0.16	100.0	16.0	100.2	16.0	107.4	17.2
Minor Tools	0.01	100.0	1.0	103.3	1.0	116.0	1.2
Capital:							
Buildings	0.03	100.0	3.0	114.3	3.4	142.4	4.3
Office Machines	0.11	100.0	11.0	103.1	11.3	113.5	12.5
Operating Equipment	0.91	100.0	91.0	103.1	93.8	115.2	104.8
Public Equipment	1.56	100.0	156.0	98.7	154.0	100.7	157.1
Construction Equipment	0.30	100.0	30.0	109.5	32.8	129.5	38.8
Other Equipment	0.13	100.0	13.0	104.4	13.6	115.8	15.1
General Expenditures:							
Equipment Rental	1.61	100.0	161.0	104.4	168.1	115.8	186.4
Real Estate Rental	0.04	100.0	4.0	106.7	4.3	115.0	4.6
Police Pension	10.87	100.0	1,087.0	135.2	1,470.1	187.3	2,036.1
Totals (Normalized)	99.99		100.0		125.2		168.2

TABLE 3
COMPARISON OF WAGE INCREASES IN POLICE AND MANUFACTURING EMPLOYMENT
(1958 = 100.0)

Wage	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Patrolman	100.0	105.3	112.0	120.4	125.4	129.2	134.5	141.0	147.7	168.1	180.7
Production worker ^a	100.0	103.6	107.3	110.4	113.6	116.2	119.8	123.5	128.3	134.5	143.4

^a Calculated from "Average Hourly Earnings of Production Workers on Manufacturing Payrolls," Table 85, *Handbook of Labor Statistics, 1969*, Bureau of Labor Statistics, (Washington, D.C.: U.S. Government Printing Office, 1969), p. 184.

Business Economics, pertains to total state and local government expenditures. State and county government expenditure patterns differ considerably from those of municipal police departments and, thus, this index is not as relevant for our purposes as it might be.

The differences among these indices are clearly shown in Table 1. The price index for police inputs increased nearly eight times as fast as the Wholesale Price Index and approximately three times as rapidly as the Consumer Price Index. Much as was expected, the state and local government index more closely approximates that based on the sample of police departments.

EXPLANATION OF THE RESULTS

To be most useful in planning, the detail of the index must be known, i.e., the origins of the price increases must be identified. Table 2 presents the detail behind the index values in the previous table.⁵ Specifically, column 1 shows the percentage composition of expenditures for police inputs in the Illinois sample. It will be seen, for example, that 5.8 per cent of total expenditures was for wages of salaries of supervisory staff, 11.87 per cent was for clerical employees, etc. These figures are for the "average" city in the sample of Illinois cities.

The even numbered columns list the price increases as percentages of the 1958 levels. It will be noted, as an instance, that the salaries of supervisory employees in 1963 were 139.3 per cent of their level in 1958. The odd-numbered columns beginning with column 3 show the product of the expenditure weight and the price relatives. The sum of the products is shown at the bottom of the respective columns after the totals have been

divided by 100. This expresses the annual values as percentages.

Careful study of Table 2 suggests that wage and salary increases of this period have contributed the most to the price rises. This occurs both because of the large proportion of expenditures on wages and because of the large wage and salary increases in this period. The reader is reminded that this index pertains solely to input prices and no attempt has been made to adjust for output changes.

Since it has been claimed that wage and salary increases of police officers have contributed significantly to the measure of price increases developed in this paper, police wage increases should be compared to those of workers in the private sector. One must exercise caution in comparing wages between two groups, however, since other factors, such as fringe benefits and job specifications, may be changing significantly. For example, police work may have become more dangerous and more unpleasant over the past decade while production work has remained fairly constant in these respects. If such is the case, police wages can be expected to increase more rapidly than those in the private sector.

A comparison of the wage increases of these two groups is presented in Table 3. The values for each year have been divided by the 1958 value so that percentage increases are shown. As will be seen, patrolmen's wages have increased almost twice as much as those of production workers. This strengthens the argument that price indices developed for the private sector do not adequately reflect the price movements of inputs purchased by police departments.

LIMITATIONS OF THE ANALYSIS

As in all price indices, one is never sure that quality has remained constant over the period.

⁵ Due to space constraints, only three years have been included in Table 2. The years chosen represent the beginning, middle, and final year of the analysis. Detail for the remaining years is available.

Whenever possible, BLS indices have been employed, taking advantage of the large resources available to the Bureau of Labor Statistics for data-gathering purposes. Unfortunately, data on wages and salaries had to be obtained elsewhere. Specifically, this information was available from an annual salary survey conducted by the Illinois Municipal League. Although salary detail is available, no measure of training increase or average training of police officers could be found.

There is no doubt that police officers in 1968 are more qualified and cope with more demanding situations than they did in 1958. However, quantifying this quality change is virtually impossible. Since no adjustment has been made for this increased effectiveness, the index may be somewhat overstated.

APPENDIX

PRICE RELATIVES AND THEIR CONSTRUCTION

The primary goal in the construction of price relatives is to measure *only price* changes. Frequently, a product will be altered making it better by improving its life or productivity in some way. If the price of the improved item increases, this cannot be included as a "pure" price increase.

Although the above concept is quite clear, it is extremely difficult in practice to ascertain when a "significant" change in a product's specifications has actually occurred. In addition, even though a change can be detected, just as many problems are experienced in correcting the price increases for this observed quality change. This dilemma is not unique to the work conducted here but plagues everyone who works with the construction of index numbers.

PRICE RELATIVES EMPLOYED

A. Contractual Services

1. *Printing and Advertising.* The mean of "average hourly union wage scale for workers in the printing trades" and the price movements of "pulp, paper, and products, excluding building paper and board" in the Wholesale Price Index was used. Data on union wage scales is found in the *Handbook of Labor Statistics*, 1969, Table 83. The data for paper products is found in the same source, Table 117.

CONCLUSION

As municipalities face increasing pressures on their budgets, efforts must be directed to using available resources more efficiently. This will involve research on a better allocation of resources to maintain the same or increasing levels of service. It will also be necessary to watch the price increase of inputs carefully.

More intelligent planning and procurement of inputs requires that administrators be aware of price changes in the past and have some expectation of future changes. As was suggested above, the indiscriminate use of existing indices may lead to serious inaccuracies. The index presented in this paper is at least a small attempt to provide police officials with a reasonable description of price changes in the past and some anticipation of what can be expected in the future.

2. *Postage.* "Postal charges," Consumer Price Index.

3. *Travel Expense.* An average of "railroad fares, housing, and food" price relatives from the Consumer Price Index was used in this case.

4. *Clothing Allowance.* "Apparel," Wholesale Price Index, was used for both this classification and for "uniforms" appearing under Supplies and Materials.

5. *Dues and Subscriptions.* An average of "U.S. periodicals" described in *Library Journal* and "newspapers, street sale and delivery," found in the Consumer Price Index was used. No price relative was found to represent dues.

6. *Insurance and Bonds.* The largest portion of these expenditures was for insurance. Interest payments were included as a separate category under Miscellaneous General expenditures. To represent price movements in this class, an average of "mortgage interest rates, property insurance rates, and automobile insurance rates," all listed in the Consumer Price Index, was used.

7. *Heat, Water, and Light.* An average of "fuel oil, coal, gas, electricity," and "residential water and sewerage services" price relatives was used.

8. *Public Utilities.* Expenditures in this classification were mainly for telephone service. No price relative was found for commercial telephone charges; therefore, "residential telephone service" relatives from the Consumer Price Index were used.

9. *Service on Fixed Equipment.* Expenditures in this class were for maintaining both buildings and fixed machinery, but *not* for the maintenance of automotive machinery. The price movements for this category were approximated by "housing—maintenance and repairs" in the Consumer Price Index.

10. *Maintenance on Public Equipment.* The expenditures included in this group relate to repairs on automotive equipment. The price relatives were obtained from "machinery and motive products," Wholesale Price Index.

11. *Other.* This classification is a catchall for expenditures which did not coincide with any other type. In addition, there were too few similar expenditures in other cities to warrant the forming of another category. Price movements in this case were approximated by "other miscellaneous products," Wholesale Price Index.

12. *Special Services.* Special projects which were not likely to be repeated annually were occasionally encountered. For this group, "other goods and services" in the Consumer Price Index was used.

13. *Training.* Data were made available by the Police Training Institute, University of Illinois, on the average cost of training a police officer in the basic four-week course.

B. *Supplies and Materials*

1. *Office Supplies and Materials.* Unfortunately, the Wholesale Price Index no longer lists the "office supplies and accessories" category. Consequently, "paper and allied products," Wholesale Price Index was used.

2. *Cleaning and Household.* Expenditures included in this category are for janitorial services. "Domestic service and general housework," Consumer Price Index was used in this case.

3. *Uniforms.* "Apparel," code 03-5, Wholesale Price Index.

4. *Motor Fuel and Lubricants,* "Petroleum products refined," code 05-7, Wholesale Price Index.

5. *Plant Equipment.* "Miscellaneous metal products," code 10-8, relatives was used.

6. *Vehicles.* "Motor vehicles and equipment," code 14-1, Wholesale Price Index.

7. *Miscellaneous Materials.* "Other miscellaneous products," code 15-9, Wholesale Price Index.

8. *Chemicals.* "Chemicals and allied products," code 06, Wholesale Price Index.

9. *Laundry.* These expenditures are for towel and uniform cleaning in general. A price index for this type of service was not available; therefore, an average was taken of "drycleaning—men's suits, etc." and "paper napkins" price relatives in the Consumer Price Index.

10. *Photographic Supplies.* "Photographic equipment and supplies," code 15-4, Wholesale Price Index.

11. *Books and Supplies.* These expenditures are for office materials. Price increases are approximated by "paper and allied products," code 09-1, Wholesale Price Index.

12. *Minor Tools.* "Hand tools," code 10-42, Wholesale Price Index.

C. *Capital*

1. *Buildings.* In this classification, the American Appraisal Index for construction of "non-residential structures" was used.

2. *Office Machines.* "Miscellaneous machinery," code 11-9, Wholesale Price Index.

3. *Operating Equipment.* "Machinery and equipment," code 11, Wholesale Price Index.

4. *Public Equipment.* "Motor vehicles," code 14-1, Wholesale Price Index.

5. *Various Other Equipment.* "General purpose machinery and equipment," code 11-4, Wholesale Price Index.

D. *General Expenditures*

1. *Rental—Equipment Pool.* Price movements were approximated by "general purpose machinery and equipment," code 11-4, Wholesale Price Index. The justification for this choice is that rental prices have to adjust according to the replacement cost of the equipment being rented.

2. *Real Estate Rental.* "House rent," Consumer Price Index.