Chapter 4
ECONOMIC FACTORS

4-1. GENERAL

To portray the impact of price level changes over the acquisition span of a program, economic adjustments must be made. These economic adjustments involve the use of an index. This section addresses. the construction of indices and the terminology and definitional differences between common usage and SAR usage.

4-2. DEFINITIONS

a. Inflation. For purposes of SAR preparation, inflation is defined as a rise in the general price level of goods and services produced in the economy. Inflation is measured by the rate of rise of *some* general product-price index in percent per year. It should be noted that this is not the only definition of inflation, but it is the most appropriate for SAR purposes. The definition involves rising prices for current output. Rising prices for bonds, equity claims (stocks), existing durable goods, and land may accompany inflation but they do not constitute inflation. Also, the price increases must occur across many lines of goods and services. For example, if the price of a particular machine tool is increasing but comprehensive indices, such as the implicit GNP price index, are relatively stable, the increase probably cannot be attributed to inflation. A supply and demand imbalance or declining productivity at the plant or in the industry may be responsible.

(1) The purpose of this short discussion on inflation has not been to make the reader an expert on the subject. Rather, the reader should begin to appreciate the technical complexities associated with measuring inflation.

(2) The terms inflation and escalation in this text are considered to be synonymous. However, the following distinctions may occasionally be encountered:

(a) Inflation is sometimes used in connection with historical price level changes only (that is those that have already occurred).

(b) Escalation is then defined as those price level changes that are predicted to occur.

(c) For SAR purposes these distinctions are of no importance. In fact, the distinction may be confusing in that Format G of the SAR includes a column headed Escalation that portrays the total impact of inflation, both prior and future, by variance category. The figures in the Escalation column are referred to as program change-related escalation for all variance categories other than Economic.

b. Current Dollars. Dollars that are current to the year in which the cost is incurred. When incurred costs are stated in current year dollars, the figures given are the actual amounts paid out or owed. When future costs are stated in current dollars, the figures given are the actual amounts that will be or are expected to be paid, including any amount due to future price changes. The word current in current dollars does not refer to the year in which the estimate is made or to any other single year. The terms current, then-year, and escalated dollars are synonymous.

c. Constant Dollars. Dollars that are always associated with a given base year (e.g., FY 77 constant dollars). The terms constant, constant year, and base year dollars are synonymous. An estimate is said to be in constant dollars if costs for all work contemplated in each year of a multiyear program are adjusted so that they reflect the average level of prices prevailing in the base year. An average can be calculated from monthly or quarterly data, but the precision is probably not worth the effort. Common practice is to assume the average level of prices to be the prices prevailing at the midpoint of the fiscal year.

(1) For those SAR programs that have funding prior to the base year, the Format E constant dollar entries should be the sum of prebase year actuals and the constant dollar amounts for the base year and all subsequent years- Inflating prebase year actuals to their base year "values is correct for cost analysis purposes where all costs must be normalized to the same base year. For SAR purposes, however, prebase year values should not be adjusted. A footnote should be added identifying the amount to be added in order to put the entire program in base year constant dollars. For example, if *the* base year is FY 75 and inflation from FY 74 to FY 75 was 10 percent, the actual (current) dollars for FY 74 must be increased by 10 percent to be in constant FY 75 dollars. If the FY 74 actuals were $10M, show $11.0M ($10M x 1.10 = $11.0M) even though only $10M is spent. The extra $1.0M is sometimes called negative inflation.

(2) The phrase "program base year constant dollars" references the purchasing power year that is held constant, or the program base year. The phrase is redundant unless the program base year is identified in context. For clarity, it is better to use terminology that is self-explanatory such as "constant FY 78 dollars."

4-3. INDICES

An index number is a number that expresses the relative relationship between two or more figures, where one of the figures is used as a base. If there is a time series of prices for a particular item, an index is established by dividing each price by the base period price. The single commodity index just described is called a simple index. If we combine the simple indices for several commodities into a single summary figure, the result is a composite index. In common practice, no distinction is made between

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the terms simple index and composite index. Price level index refers to a summary measure of relative price level changes that is made up of numerous individual commodities.

a. Price Level Index. An index describing the changes. in purchasing power of the" dollar over 'time. A price level index can measure price changes for anything from paper clips to the Gross National Product and every relevant combination in between. Table 4-1 is a typical DoD index.

PRICE LEVEL INDEX
Research, Development, Test & Engineering

Fiscal Year	1970=100	1974=100	Annual Rate(%)
1967	87.73	71.69	
1968	90.92	74.30	3.6
1969	94.76	77.44	4.2
1970	100.00	81.72	5.5
1971	105.07	85.87	5.1
1972	109.00	89.08	3.7
1973	113.17	92.49	3.8
1974	122.36	100.00	8.1
1975	135.64	110.85	10.9
1976	144.04	117.71	6.2

Source: Department of Defense Deflators (Outlays), Office of the Assistant Secretary of Defense (Comptroller) , January 28, 1976.

TABLE 4-1

Several points about the data in the table are worth noting:

(1) The two indices differ only in that they measure from a different base year. The base year is that year for which the index value is 100. For example, if every number in the column with base year 1970=100 is divided by the value for 1974 (122.36) and multiplied by 100, the 1974=100 column will result. This procedure can be used to normalize an index to any desired base year.

(2) Since the two indices differ only by base year, the annual rate of inflation is the same for both. For example, the annual rate from FY 1972 to FY 1973 is shown in the table as the FY 73 rate of 3.8 percent. This can be calculated from either series by dividing the 1973 value by the 1972 value and multiplying by 100:

for 1970=100: $\frac{113.17}{109.00} \times 100 = 103.8\%$ or an increase of 3.8%

for 1974=100: $\frac{92.49}{89.08} \times 100 = 103.8$ or 3.8%

(3) The price level index in Table 4-1 is for fiscal year changes. This means price level changes are being measured from the middle of one fiscal year to the middle of the next fiscal year. The index is applied to amounts. to be spent in each fiscal year. In DoD terminology such amounts are called outlays and the price level index is called an outlay deflator.

b. Outlay-Weighted Index. As stated earlier, no distinction is made between the terms simple or composite index in general practice. However, within the Department of Defense, the term composite index has been used to mean a price level index that has been combined with outlay or expenditure rates. The most appropriate term would be outlay-weighted index.

(1) An outlay-weighted index is required because SAR inflation calculations are typically performed on the TOA amounts of the RDT&E, Procurement, and Military Construction appropriations. As shown in paragraphs 4-3.c. and 4-3.d., these calculations can be performed on either the constant or current dollar values. The annual price level index (outlay deflator) cannot be applied directly to the TOA amount because TOA funds are usually expended over a period of 2 or more years. TOA is a term used by the Department of Defense; it is not a Government-wide term. It refers to the value of the direct Defense program for each fiscal year. For example, if it is proposed to procure 10 aircraft at a cost of $1 million each, to be funded by a $9 million appropriation and a $1 million FMS transfer, that is $10 million in TOA. For the remainder of this discussion, TOA is assumed to equal the appropriation. For SAR programs this assumption is usually valid. However, if this assumption is not true, as in the aircraft example above, calculations are made against TOA. Table 4-2 displays. a typical TOA profile and outlay pattern.

Fiscal Year	TOA (Millions of $)	OUTLAYS					
		Fiscal Year (11%)	FY+1 (50%)	FY+2 (18%)	FY+3 (16%)	FY+4 (5%)	Total (loo%)
1970	50	5.5	25.0	9.0	8.0	2.5	50
1971	60	6.6′	30.0	10.8	9.6	3.0	60
1972	70	7.7	35.0	12.6	11.2	3.5	70
1973	80	8.8	40.0	14.4	12.8	4.0	80
1974	60	6.6	30.0	10.8	9.6	3.0	60
1975	20	2.2	10.0	3.6	3.2	1.0	20

TABLE 4-2

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(2) The table shows that $50M appropriated for FY 70 is expended *over* a 5-year period from FY 70 through FY 74. In FY 70, $5.5M or 11 percent of the total is expended. Four years later, in FY 74, the. last $2.5M (5 Per cent) is expended. Similarly, the $20M, FY 75 appropriation, is expended over the period FY 75 through FY 79. FQr simplicity, the transition quarter between FY 76 and FY 77 has been ignored. See paragraph 3-4. As the table indicates, the amount appropriated in a particular year must include the expected impact of inflation on that part of the appropriation that will be expended in subsequent years. For this reason; the annual price level index cannot be applied directly to the appropriation amounts to make economic adjustments.

c. Constant Dollar Outlay Rates. There are two ways to handle the outlay problem. One is to apply the annual price level factors to the individual constant dollar outlay amounts of a given year's appropriation and sum the total. This procedure is illustrated in Table 4-3 for a FY 71 appropriation whose value, in FY 70 constant dollars, is $80M. That is, the base year for this program is FY 70 and one year's appropriation (TOA) is being inflated.

Fiscal Year	Outlay (%)	Outlay Amount In FY70$	Price Level Index (FY70=100)	Outlay Amount Inflated
1971	11	8.8	105.1	9.2
1972	50	40.0	109.0	43.6
1973	18	1 4 . 4	113.2	16.3
1974	16	12.8	122.4	15.7
1975	5	4.0	135.6	5.4
Total	100%	$80.0M		$90. 2M

TABLE 4-3

The calculation for the FY 71 outlay is:

$$(\text{Constant \$ appropriation}) \times \frac{(\text{outlay \%})}{100} \times \frac{(\text{index})}{100} = \text{inflated amount}$$

$$(\$80) \times \frac{(11)}{100} \times \frac{(105.1)}{100} = \$9.2$$

The other outlay years are computed in a similar fashion. Summing the individual outlay years yields an inflated total of $90.2M for the FY 71 appropriation. The amount attributable to escalation is $10.2M ($90.2 - $80.0) or 12.8 percent ($10.2 ÷ $80). If the FY 71 index factor had been applied to the $80M total, the escalated total would be escalated by $6.1M:

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$$.'380 \text{ X } \frac{105.1}{100} = \$84.1$$

$$\$90.2 - \$84.1 = \$6.1$$

(1) The method just demonstrated in Table 4-3 is correct but tedious if applied to a 10 or 20 year funding profile. It is easier if the annual index is converted to incorporate the outlay rate. Table 4-4 displays such a conversion. Note that the outlay and price level columns are the same as in Table 4-3 except for the division by 100.

Fiscal Year	Outlay (% ÷100)	X	Price Level Index ÷ 100 = (FY 70 = 100)	Outlay Weighted
1971	0.11		1.051	0.116
1972	0.50		1.090	0.545
1973	0.18		1.132	0.204
1974	0.16		1.224	0.196
1975	0.05		1.356	0.068
Total	1.00			1.129

TABLE 4-4

The sum of the composite column is the outlay-weighted index for FY 71. In this case the value is 1.129. The Table 4-3 result is derived by using the outlay weighted factor as follows:

$$\$80 \text{ X } 1.129 = \$90.3$$

The slight difference between 90.3 and 90.2 is caused by rounding. Table 4-5 displays a tabular format for adjusting a complete price level index series where outlay rates are assumed to apply to constant dollar outlays.

(a) The outlay-weighted index numbers at the bottom of Table 4-5 are computed by multiplying the outlay factor (second column) by the price level index for the appropriate year, and summing the resultant figures along the diagonal. A comparison of the underlined figures in the FY 71 diagonal (see Table 4-5), the underlined price level index values from FY 71 through FY 75, and the underlined outlay factors with the computations in Table 4-4 clarifies the procedure demonstrated in Table 4-5.

(b) Observe in Table 4-5 that the base year is FY 70 and its price level index value is 1.0. However, the value of the outlay-weighted index number for FY 70 is 1.074, reflecting a 7.4 percent inflation amount. The base year of the outlay-weighted index is still FY 70, but the outlay-weighted series will not have a value of 1.0 for any year, except by chance. It is possible to divide each outlay-weighted number by the outlay-weighted number for FY 70 and derive an outlay-weighted series in which FY 70 has a value of 1. Such a procedure shifts the purchasing power measurement point

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from the middle of the fiscal year to the middle of the outlay period. Instead of measuring inflation based on purchasing power at the end of December 1969 (the middle of FY 70), this procedure would measure from a purchasing power base some 12 to 24 months. later, given the outlay period and rates, assumed in the example. An outlay-weighted index that is normalized in this manner is called a TOA deflator. TOA deflators are used in some DoD budget analyses but should never be -used in SAR computations. The point to remember is that the actual dollar amount appropriated for FY 70 is not a constant FY 70 dollar unless the total amount is planned to be expended within FY 70.

(2) It is common practice to back into the escalation amount. This is especially true for those programs which use contractor estimates rather than the PM's best estimate. While backing into the escalation amount is not encouraged, it should be noted that the current dollar TOA when divided by the outlay-weighted index will result in the base year dollar value of the TOA.

(3) The use of outlay rates contains a small distortion. Expenditures do not necessarily reflect when costs are incurred but when bills are paid. Inflation impacts only Up to the point where the cost is incurred. However, the relatively small error introduced using outlay rates does not justify the effort required to collect more precise information. Also, the outlay rates in this discussion are constant dollar outlay rates. If outlay rates are derived from actual (current dollar) experience, the data should be normalized to a constant dollar base before determining the outlay rates. Otherwise, distortion will be introduced if the rates are used to spread constant dollar amounts. If the analyst has only current dollar outlay rates, the outlay-weighted index should be derived by the procedure discussed in the next paragraph.

d. Current Dollar Outlay Rates. The preceding discussion has considered outlay rates as a percent of the constant dollar TOA equivalent. If outlay rates are assumed to apply to current dollar TOA, an alternative procedure is used to construct weighted indices. Assuming an FY 1971 appropriation of $90.2M in current dollars, we can recalculate Table 4-3 as shown in Table 4-6.

Fiscal Year	Outlay (%)	Outlay Amount Current $	Price Level Index (FY70=100)	Outlay Amount in FY70$
1971	11	9.9	105.1	9.4
1972	50	45.1	109.0	41.4
1973	18	16.3	113.2	14.4
1974	16	14.4	122.4	11.8
1975	5	4.5	135.6	3.3
Total	100%	$90.2M		$80.3M

TABLE 4-6

Fiscal Year	Out ay % ÷ 100	≡69	970	971	972	≡ 3	974	1≡75	197≤	977	978	· 979
Price Level Index ÷ 100		0.948	1.	1.051	1.080	. 132	1.224	1.356	1.440	.49≤	.558	1.620
Appropr at on Year	0 11	0.104	0.110	0.116	0.120	0. 25	0.135	0.149				
P us	0.50		0.500	0,526	0.545	0.56≤	0.612	0.678	0.720			
P us 2	0.18			0. 89	0.196	0.204	0.22	0.244	0.259	0.270		
Plus 3	0.16				0.174	0.181	0.196	0.217	0.230	≈ 24	0.249	
Plus 4	0.05					0.057	0.061	0.068	0.072	0.075	0.078	0.081

Outlay Weighted Index	1.024	1.074	1.129	1.195	1.28≤	.390	1.4≤9
Fiscal Year	1969	1970	1971	1972	1973	1974	1975

≡ase = FY 1970 Constant Do lars

TABLE 4-5

The calculation" for the FY 71 outlay is:

$$\text{(Current \$ appropriation)} \times \frac{\text{(outlay \%)}}{100} \div \frac{\text{(index)}}{100} = \text{Amount in FY 70\$}$$

$$(\$90.2) \times \frac{(11)}{100} \div \frac{(105.1)}{100} = \$9.4$$

Note that the fiscal year spread of outlays, in both current and constant dollars, is different from Table 4-3,' resulting in an increased total outlay amount in FY 70 dollars.

(1) It may appear that this method requires advance knowledge of the current dollar TOA and cannot be applied to the constant dollar TOA equivalent. This is not the case. Review of the Total line in Table 4-4 shows that the outlay represents the escalation of a hypothetical amount of $1.00 in constant FY 70 dollars up to $1.129 in current dollars. The corresponding table for the current dollar application of outlay rates is as follows:

Fiscal Year	Current $ Outlay (% ÷ 100)	÷	Price Level Index ÷ 100 (FY 70 = 100)	=	FY70$ Outlays
1971	0.11		1.051		0.105
1972	0.50		1.090		0.459
1973	0.18		1.132		0.159
1974	0.16		1.224		0.131
1975	0.05		1.356		0.037
Total	1.00				0.891

TABLE 4-7

(a) This procedure deescalates a hypothetical $1.00M in current dollars FY 71 TOA to $0.891M in constant FY 70 dollars. Since inflation indices are commonly stated as a ratio of current dollars to constant dollars, the 0.891 value is the reciprocal of the desired index value. The final weighted index must be obtained as follows:

$$\frac{\text{Then-Year \$ Total}}{\text{FY70 \$ Total}} = \frac{1.00}{0.891} = 1.122$$

The Table 4-6 result derived by use of the weighted factor is:

$$\$90.2 \div 1.122 = \$80.4$$

where, again, the slight difference between $80.3 and $80.4 is caused by rounding.

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(b] The weighted index of 1.122 was obtained independent of the TOA amount and can be used to inflate constant dollar requirements. to current dollar TOA.

(2) Table 4-8 displays the tabular format for adjusting a complete price level index series, using current dollar outlay rates. Entries in the body of the table are obtained by dividing the outlay factor (second column in table) by the price level index for the appropriate year. Entries are then summed along the diagonal to obtain the reciprocal (see paragraph 4-3.d.(1) (a),) of the weighted index. The underlined values in Table 4-8 can be compared with the computations in Table 4-7 to clarify the procedure.

e. Selection of Outlay Weighting Procedure. The" determination of whether to use the procedure outlined under paragraph 4-3.c. or paragraph 4-3.d. is, made on the basis of outlay rate assumptions as follows:

(1) If program-peculiar outlay rates are established based on constant dollar assumptions, use the procedure under paragraph 4-3.c.

(2) If program-peculiar outlay rates are established based on current dollars, use the procedures under paragraph 4-3.d.

(3) If outlay-weighted indices are prepared using outlay rates published by OASD(C), use the procedure under paragraph 4-3.c. or d.

(4). If the activity preparing a SAR uses outlay-weighted indices provided by a higher authority, the indices can be applied directly to constant dollar TOA equivalents (by multiplication) or to current dollar TOA (by division). It is the responsibility of the activity providing the outlay-weighted index to use the proper method based on the considerations above.

f. Application of Outlay-Weighted Indices. Tables 4-9 and 4-10 show how to use an outlay-weighted index with either constant dollar TOA equivalent or current dollar TOA, respectively.

FISCAL YEAR	TOA EQUIVALENT (FY70$)	X	OUTLAY WEIGHTED INDEX	=	TOA (CURRENT $)	ESCALATION (CURRENT $ - FY70$)
1971	20		1.129		22.6	2.6
1972	40		1.195		47.8	7.8
1973	50		1.286"		64.3	14.3
1974	50		1.390		69.5	19.5
1975	30		1.469		44.1	14.1
Total	$190M				$248.3M	$58.3M

TABLE 4-9

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Fiscal Year	Outlay % ÷ 100	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Price Level Index ÷ 100		0.948	1,000	1.051	1.090	1.132	1.224	1.356	1.440	1.498	1.558	1.620
Appropriation Year	0.11	0.116	0.110	0.105	0.101	0.097	0.090	0.081				
Plus 1	0.50		0.500	0.476	0.459	0.442	0.408	0.369	0.347.			
Plus 2	0.18			0.171	0.165	0.159	0.147	0.133	0.125	0.120		
Plus 3	0.16				0.147	0.141	0.131	0.118	0.111	0.107	0.103	
Plus 4	0.05					0.044	0.041	0.037	0.035	0.033	0.032	0.031
Reciprocal						0.978	0.933	0.891	0.843			
Weighted Index .						1.022	1.072	1.122[1]	1.186			
Fiscal Year						1969	1970	1971	1972	1973	1974	1975

Base = FY 1970 Constant Dollars

1/ $\frac{1}{0.891} = 1.122$

TABLE 4-8

FISCAL YEAR	TOA (CURRENT $)	OUTLAY WEIGHTED INDEX	= TOA EQUIVALENT (FY70$)	ESCALATION {CURRENT $ - FY70$)
1971	22.6	1.129	20	2.6
1972	47.8	1.195	40	7.8
1973	64.3	1.286	50	14.3
1974	69.5	1.390	50	19.5
1975	44.1	1.469	30	14.1
Total	$248.3M		$190M	$58.3M

TABLE 4-10

g. Program-Peculiar Indices. In general, program-peculiar price level indices and outlay rates are prohibited. Only those indices and outlay rates published by OASD(C) may be used. Exceptions are limited to the following:

(1) Program-peculiar price level indices for projection purposes are limited to specific contractual arrangements with the prime contractor through contract options or multiyear contracts. Such exceptions must be specifically noted in POM and budget submissions for review and approval by OASD(PA&E) and OASD(C).

(2) Use of program-peculiar outlay rates must be based on the expected contractor payment pattern. Exceptions must be approved by the Assistant Secretary (Financial Management) of the Military Department concerned with an information copy of the approval notice and supporting documentation forwarded to the ASD(C).

(3) Adjustment to the assumed escalation in TOA for years prior to the current budget year may be made to reflect actual inflation experienced. However, prior ASD(C) approval must be granted (see paragraphs 3-2a. and 3-2a.(3)).

4-4. 197T/1977 ANNUAL RATES

Tine transition quarter (FY 7T, July 1, 1976, through September 30, 1976) has caused some problems in determining equivalent annual rates for FY 7T and FY 77. Table 4-11 shows a typical procurement index and the associated periodic and annual rates:

Fiscal Year	Procurement Index	Periodic Rate (%)	Annual Rate (%)
1976	.92.1	6.6	6.6
197T	96.0	4.2	6.8
1977	100.0	4.2	6.7
1978	106.2	6.2	6.2

TABLE 4-11

The periodic rates represent the. rate from one fiscal year (quarter in the case of FY 7T) to the next and are determined by dividing each index value by the preceding value. For example, FY 77 = 100.0 ÷ 96.0 = 1.042 or .2 percent. The index values, or their equivalent periodic rates, are used in all escalation computations including the construction of outlay-weighted indices and rates. The column display Annual Rate represents the rate of inflation as measured on an annual 12-month basis. If it were not for the transition quarter of 3 months, the annual and periodic rates would be the same. The annualized rates for FY 7T and FY 77 are for expository purposes only and are computed as follows:

The midpoint of FY 1976 is December 31, 1975; the midpoint of FY 197T is August 15, 1976; The total period midpoint to midpoint is 7.5 months or 0.625 year:

$$\frac{7.5 \text{ months}}{12 \text{ months/year}} = 0.625 \text{ year}$$

This means that the periodic rate is only 0.625 of the annual rate or, conversely, that the annual rate equals the periodic rate divided by 0.625. This can be generalized as follows:

$$\frac{\frac{Y2}{Y1} - 1}{\frac{P}{12}} \times 100 = RA$$

Y2 = subject year index value
Y1 = previous year index value
P = period in months from midpoint of subject year to midpoint of prior year
RA = annualized rate

By the above formula, the annualized rate for FY 7T is:

$$\frac{\frac{96.0}{92.1} - 1}{\frac{7.5}{12}} \times 100 = 6.8\%$$

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This method is an approximation that is sufficiently accurate for SAR annual rates that are not used in calculations. When the derived rates are to be used in subsequent calculations, the following exponential formula should be used:

$$\left[\left(\frac{Y2}{Y1}\right)^{\frac{12}{P}} - 1\right] \times 100 = RA$$

For the given example, this yields:

$$\left[\left(\frac{9660}{92.1}\right)^{\frac{12}{7.5}} - 1\right] \times 100 = 6.9$$

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