WAGE RATE AND MATERIAL PRICE LEVEL ADJUSTMENT PROVISIONS IN DOD PROCUREMENT

Task 67-4 (Rev)

MAY 1968

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I. INTRODUCTION

A. STUDY OBJECTIVES

Task Order 67-4 (Rev)[1] requested LMI to examine alternative ways of handling changes in wage rates and material prices resulting from general price level fluctuations during contract performance, and to determine whether new techniques of pricing or special contractual provisions are required for long-term defense contracts. The preliminary phase of this effort ended with the publication of an interim report in January 1967 which described the various price adjustment techniques used in DoD contracting, identified the number and dollar value of contracts employing these techniques, and presented some initial findings on industry and Government reactions to the use of these techniques.

The original Task Order contemplated a general study of the problem of wage rate and material price adjustments. To provide a focus for an initial study it was decided that we would assess the feasibility of applying indexes in one segment of defense procurement: the airframe industry.[2]

B. SCOPE OF THIS STUDY

Following the plan to concentrate on one area of defense procurement, LMI organized its efforts around data relating directly or indirectly to the airframe industry. While the study has been concentrated on this one industry, the conclusions

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[1] Appendix

[2] Appendi

and recommendations appear to be generally applicable -- especially to multi-year procurement.

LMI has discussed many of the conclusions and recommendations with personnel of the Department of Defense and several major airframe contractors. However, LMI did not attempt to obtain agreement on all points. There is no assurance that any particular index or application will be acceptable in a specific contract situation. Indeed, as will be made evident in this report, there is no unanimity of opinion among contractors or government personnel on some of the significant items.

This study owes much to the cooperation of many procurement people in the three military departments who provided wise counsel from their experience with the problem. Particular expressions of appreciation are due to many persons in the Bureau of Labor Statistics of the Department of Labor and the Office of Business Economics in the Department of Commerce who guided us through the maze of data and responded cheerfully to every request for additional information. The contribution of industry personnel, both in providing data and reaction to ideas, was no less essential to the progress of this study.

II. SUMMARY OF MAJOR RECOMMENDATIONS

A. GENERAL APPLICATION

1. The use of escalation provisions is generally to be preferred to adding estimates of future price level changes in contract prices.

2. Indexes should encompass the widest possible industrial base compatible with the objectives of escalation provisions to avoid the possibility that contractors may influence the index and that escalation adjustments may contribute to spiraling price levels.

3. Escalation provisions should not require audit or statement of actual costs as a condition for applying the escalation adjustment. (Specific methods are described in Section VI.)

4. Escalation provisions should be included in all multi-year procurement contracts and in contracts containing priced options. (Specific indexes are described in Section VII.)

5. Studies should be made to determine the appropriate labor and material indexes for other major commodity areas where long-term contracts are employed.

B. SPECIFIC APPLICATION TO AIRFRAME CONTRACTS

1. It is feasible to use indexes in fixed-price airframe contracts to protect the parties from the effect of future price level changes. (A specific index is described in Section ' .)

2. Escalation provisions should be included in fixed-price airframe contracts involving substantial labor costs or additional material commitments to be incurred more than one year after final price agreement.

III. PRICE ESCALATION

A. WHAT IS PRICE ESCALATION?

The terms "price escalation," "escalation," and "price level changes" used in this report are synonymous with the popular terms "inflation" and "deflation." They describe a change in the price per unit of labor or material resulting from general market-place influences or pressures. To the manufacturer, escalation is an increase in the cost per unit of product of the labor and materials he purchases, an increase which he intends to reflect in an increase in the price of the goods he sells. The adjustment provisions which are the subject of this study are the contract provisions which will make it possible to change the contract prices as required (or as intended) to reflect the impact of certain defined changes in the contractor's costs. Escalation means either increases or decreases in these costs. In an inflationary period we fall into the habit of expressing our thoughts in terms of increases; but both increases and decreases are implied notwithstanding any other impressions.

There are three parts of this definition which require emphasis. One is the unit costs aspect. An increase in the cost of total input because more hours of labor (more units) are actually required than were estimated is not escalation. An increase in the quality (and, therefore, in the price) of units produced because higher levels of labor skills or more costly types of material are required than were expected is not escalation. Escalation is limited to changes in the cost of the same unit of input -- the same labor skill or material.

The second part that requires emphasis is that these must be price changes resulting from market influences. They must be beyond the control or significant influence of the specific contractor, his suppliers or employees, and reflect the play of market influences on his costs. It is an explicit assumption that escalation does not include price level changes resulting from the free choice of the contractor or actions which he can control.

The third part that requires emphasis is that these must be price changes resulting from general economic pressures, reflecting national effects. Individual categories of labor and particular materials are affected by a variety of factors, such as temporary dislocations of supply and demand and special local conditions. These special factors are outside of the scope of escalation and their effect on prices must be considered separately.

Another aspect of escalation is important in this study. Escalation of material costs can be measured directly by changes in the prices paid in the market for like materials. Escalation of labor costs cannot be measured directly by changes in the wages paid to workers because increases in productivity (more output per unit of labor input) may offset all or part of the wage changes. A part of the gains in productivity are ordinarily passed on to labor in the form of higher wages, but increases in wages not exceeding productivity gains do not result in higher costs to the manufacturer. If wages increase 50 percent and productivity also increases 50 percent, there is no change in the unit costs -- costs per unit of product.

Productivity changes in labor can be reflected either by discounting changes in wage rates by changes in productivity,

or by reducing the number of hours of labor required to produce a fixed amount of product. The end result is the same, but these different approaches have important implications in the selection of devices to measure escalation as discussed in a following section.

B. IMPORTANCE OF THE PROBLEM

The problem of changes in wage rates and material prices arises out of the fact that contractors will (and should) insist on protection against increases in these costs during performance of a contract. The usual method of handling these changes is for the contractor to estimate the magnitude of the anticipated changes over the period of performance. The ability of the contractor to make accurate estimates is significantly affected by the length of the period over which he must project and the stability of the data on which the estimates are based. The recent interest in methods for dealing with changes in wage rates and material prices caused by economic fluctuations is a result of the interaction of two developments: the increasing use of long-term, fixed-price contracts by DoD and the accelerated rate of price level changes over the past few years.

A conspicuous example of the use of long-term contracts by DoD is the development and evolution of the Total Package Procurement (TPP) Concept. An integral part of this concept is that there will be price commitments at the outset of the program extending through the phases of development, production and support. The first TPP contract (C-5A Program) was executed late in 1965 and involved projection of costs to be incurred by the contractor as late as 1975. This TPP concept has since been

applied to several major programs in all three Services.[1]

Another example of long-term contracts is Multi-Year Procurement (MYP), involving firm fixed-prices for total anticipated requirements of some three to five years and the consequent projection of costs for as much as six to eight years. Although there were only 42 MYP contracts entered into from 1961 through FY 1964, there were a total of over 200 through FY 1967. A recent study of subcontracting problems under MYP prime contracts disclosed that the need to project firm costs over a period of three to five years was a major impediment to the efforts of prime contractors to obtain firm commitments from their vendors over the period of the prime contract commitments.[2]

During the last three years there has been increasing concern on the part of contractors and Government procurement personnel regarding the stability of price levels. During the late fifties and early sixties there was general price stability. The acceleration of price level changes during the last few years can be observed in the annual average index levels of the Consumer Price

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[1] See LMI Report, Total Package Procurement Concept, Synthesis of Findings, June 1967, Appendix D. (LMI Task No. 67-3, Defense Documentation Center No. AD-655814.)

[2] "The problems inherent in projecting costs over the longer period involved in MYP was the major problem reported by the prime contractors. Many subcontractors were unwilling to quote prices for more than the current year's requirements because they were too uncertain about future cost trends. Other subcontractors added such a large contingency for future costs that the prime would not accept the MYP price and elected, rather, to procure subcontracted items on an annual basis as MYP requirements become firm commitments." LMI Report, Multi-Year Procurement At the Subcontractor Level, June 1967, p. 23. (LMI Task No. 67-13, Defense Documentation Center No. AD-655815.)

Index and the Wholesale Price Index using, for example, the WPI for Industrial Commodities:[1]

	CPI (All Items)		WPI (Industrial Commodities)	
Annual Period	Index (1957-59=100)	Change From Prior Year	Index (1957-59=100)	Percent Change From Prior Year
1960	103.1		101.3	
1961	104.2	1.1%	100.8	(1.5%)
1962	105.4	1.2	100.8	0
1963	106.7	1.2	100.7	(0.1)
1964	108.1	1.3	101.2	0.5
1965	109.9	1.7	102.5	1.3
1966	113.1	2.9	104.7	2.1
1967	116.3	2.8	106.3	1.5

The price instability since 1964 has caused some defense corporations to be increasingly concerned with the risks assumed in these circumstances. Some company presidents feel that price escalation provisions are so essential in long-term contracts that they will not contract for firm prices over an extended period without the protection afforded by escalation provisions. The problem is not restricted to defense contracts: several airframe companies are now using escalation clauses in commercial sales.

Some government officials have also indicated that contractors will build contingencies into their bids which cost the government more than if price adjustments were used to reimburse the contractor only in the event these contingencies did occur. Thus,

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[1] Economic Report of the President, February 1968, Table B-46, page 262 and Table B-48, p. 264.

both the government and industry have expressed interest in exploring approaches to this problem.

Defense contracts of the type described above require contractors to assume contractual risks for longer periods than are normally assumed in the commercial business environment. There is a common misconception that long-term contracts are customary in commercial sales and that industry is accustomed to accept the risk of escalation over these long periods. A study by the National Industrial Conference Board for LMI under this Task indicates that contract terms in excess of one year are quite exceptional, and terms in excess of two years are most exceptional.[1]

Industry Group	Up to 6 Months	7 - 12 Months	1 - 2 Years	2 - 3 Years	Over 3 Years
Foods and kindred products	100				
Textile mill products	83	17			
Paper and allied products	65	35			
Printing and publishing	20	34	46		
Chemicals & allied products	57	30	8	2	2
Petroleum & coal products	57	20	3	0	20
Rubber & plastic products	40	48	11	1	
Stone, clay & glass products	33	47	18	2	
Primary metal products	68	26	6	0	
Fabricated metal products	49	35	13	1	2
Machinery, excluding electrical	51	34	11	3	1
Electrical machinery	53	24	19	2	2
Transportation equipment	25	38	21	9	8
Instruments & related products	59	35	6		
Miscellaneous & unclassified	56	45			

[1] Memorandum on Escalation Clauses in DoD Procurement Contracts, by Daniel Creamer, February 1967, p. 24. (Detail in each row of this table will not necessarily add to 100 because of rounding.)

Not all industry is concerned with the question of price level changes. There are some directors of pricing in airframe plants who are substantially unconcerned with the problem. They maintain that changes in wage rates and material prices are not important factors in determining whether they will make or lose money on a particular contract. Much more important to them is the selection of the right learning curve and a close estimate of the volume of business that will prevail in later years as a base for determining the bid overhead rates.

This lack of interest in price level changes is not unusual. In 1966 the National Industrial Conference Board arranged a seminar meeting on this topic which was attended by some 30 company executives. The consensus of this gathering was that escalation was no problem; that industry could take care of the need for escalation in the regular course of bidding; that the government's concern would lead to more control and more costly administration of contracts; and that no index existed which reflected their unique history and problems, nor could one be constructed. (It should be noted this meeting took place <u>before</u> the substantial price level changes in 1966 and 1967 were generally observed.)

A measure of the impact of escalation on contract price can be obtained by calculating the possible effect in a constructed contract situation. A hypothetical example has been developed in Appendix III which portrays an essentially realistic "average" situation. This example tends to overstate the effect of escalation since costs would not be spread equally throughout any contract period, but would be concentrated in the earlier years. The earlier costs are incurred, the less would be the spread between actual and bid costs attributable to price level changes.

The example explains why some contractors think that this

problem is not worth special consideration. Assuming that the largest annual increases in labor and material costs in recent history were to have prevailed in each of the following years, the contractor would not have a loss due to escalation (costs exceeding profit objectives) in a 5-year program --- even if he included nothing for anticipated escalation in his bid. If the contractor included only a modest, unsophisticated projection for escalation, he would not have a loss in an 8-year program.[1] On the other hand, this same example also shows that the contractor would have lost 22 percent of his profit objective at the end of the first year with a conservative projection and 34 percent of his profit objective if he had included nothing for price level changes in his bid. If for no other reason than this, price level changes ought to be considered a major problem in defense contracting. In addition, there is no assurance that the recent history of the United States is a valid reflection of what will occur in the future.

LMI concludes, therefore, that notwithstanding other important pricing problems, price level changes are a significant problem.

C. METHODS OF PROVIDING FOR ESCALATION

In the buyer-seller relationship there are essentially two ways that price escalation can be handled: (a) the seller can include a contingency factor in his price, or (b) the buyer can

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[1] This latter point is the root of an oft heard proposition that "normal" escalation is no problem -- that protection is needed only for "abnormal" escalation such as that in Argentina or Brazil. Based on 1957-1959=100, the Consumer Price Index in 1965 was 109.9 in the United States, 578.0 in Argentina, and 189.6 in Brazil. Bureau of Labor Statistics, Handbook of Labor Statistics, Bulletin No. 1555, p. 288.

offer to cover all changes resulting from future price fluctuations (constant dollar approach). These two methods can be combined, and the buyer can reimburse for abnormal escalation and allow the seller to include a lesser contingency in his price.

1. Contingency Factor in Price

The most common method of handling escalation is for the contractor to project his estimate of wage and material price changes, and to add a contingency sum in the prices bid to cover these anticipated changes. It is an accepted practice for the Government to accept such contingencies in the negotiation of contracts, and it is an established practice for contractors to include such contingencies in the prices bid in price competitive procurements. There are four factors which indicate that this method is less than a satisfactory solution for the problem:

(a) The Uncertainty of Estimating

Critics of this usual method point to the inherent disadvantage that it assumes that future developments will follow a path defined by past events. While sophisticated analyses of long-term trends appear to have guided some contractors through these shoals, a few examples will illuminate the basis of this criticism:

- From 1960 through 1964 the average hourly earnings of production workers in the aircraft industry increased an average of 2.6 percent per year, the largest annual increase being 3.2 percent. In 1965 the increase was 5.0 percent; in 1966 it was 6.0 percent; in 1967 the increase was 4.2 percent--still higher than any year in the period 1960-1964.

- From 1960 through 1964 the Wholesale Price Index (Industrial Commodities) went down one-half of 1 percent. In 1965 it went up 1.3 percent; in 1966 it increased 2.1 percent; in 1967 the increase was 1.5 percent.
- From 1960 through 1963, the Wholesale Price Index (nonferrous Metals--10-2) went down 4.6 percent. In 1964 it went up 6.9 percent; in 1965 it went up 8.8 percent; in 1966 it went up 5.0 percent; in 1967 it went down two-tenths of 1 percent.

The question is whether it is reasonable to expect contractors to make accurate projections of future price levels or to expect Government negotiators to be able to evaluate these projections. The assertion is made by pricing personnel in industry and in Government that projections are fine when the economy is stable or changing in a consistent pattern, but unfair to both industry and the Government as soon as perturbations are encountered. It is precisely because of these perturbations in the past few years that the use of escalation provisions in contracts has received so much attention.

(b) Conservative (High) Projections

The effect of the contingency pricing method of handling escalation is two-sided. The contractor assumes the risk of loss resulting from projecting less than the actual increases. Contractors have a natural tendency to be conservatively high in their estimate of price contingencies, since they bear the full risk if the estimate is too low. There is

a natural tendency, therefore, for the estimate of future price level changes to be cast on the high (rather than the low) side. At the same time, the contractor passes to the Government the cost of what he projects, and a profit on this cost. The cost may be too high when recent large swings in price levels result in the contractor and the Contracting Officer responding to their worst fears. In contrast, the use of escalation provisions in contracts might be said to be an effort by the Government to move from the status of the one who pays the insurance premium to the status of the underwriter.

(c) Inflationary Spiral

Some economists believe that escalation provisions contribute less pressure on spiraling wage (and material) costs than adding an element of contingency pricing. The element of contingency pricing is a definite contribution to the spiral. There is, in a sense, a pre-payment of the amount of escalation anticipated by the parties to the contract and added by the contractor as a contingency in his price. In addition, as already noted, there is a natural tendency for the contractor's estimate of future price level changes to be on the high side. Escalation provisions are an indefinite and uncertain contribution: payment is made only if the price levels actually change and the payment is limited to the change actually experienced.

A contingency allowance written into a long-term contract assures that that additional government expenditure is built into the economy over the life of the contract. An escalation provision defers the answer until the amount of any price

change can be measured. This would leave more control over future price levels in the hands of the Government since it controls fiscal and monetary policy, two principle factors in price levels. In general, therefore, escalation clauses would appear to be less inflation-generating than contingency allowances written into long-term contracts in anticipation of future developments.

(d) Effect of Chance

The use of contingency pricing estimates gives rise to the possibility of substantial gains or losses if the expected increases do not coincide with the actual increases. In either case, the result is the consequence of developments outside of the contractor's control. Public policy would suggest that some other method would be preferred.

2. Elimination of Contingencies

The other basic approach to escalation is to eliminate all projections of future price level changes in the pricing of contracts. Building on the kind of data contained in the preceding section, advocates of this approach maintain that the idea of requiring projections of anticipated future escalation is conceptually unsound. Advocates of this concept subscribe to what is often called "the constant dollar" approach. Basically, the thought is that all prices should be based on known, current price levels. The contract prices should then be adjusted proportionately to reflect the whole difference between the price levels embodied in the contract price and those prevailing at the time the contract costs are incurred.

This is essentially the approach used by the Navy in the Steel Vessel Construction Index. The date of the base index

is specified so that ordinarily it will be one prevailing at the time price proposals are being prepared. The escalation adjustments are based on the average price levels prevailing in each quarterly period of production, commencing with the first quarter after contract award. The Navy introduces some twists in the application of the index, some of which result in a more limited adjustment. Nevertheless, the use of this index is an example of a "constant dollar" approach.

A distantly related approach is to resolve the problem of price escalation by means of a cost-incentive pricing arrangement. If the contractor's share is shallow enough, and the ceiling price is high enough, the effect of escalation can be absorbed within the cost sharing provisions.[1] There is some indication that incentive arrangements are sometimes entered into for just such a purpose although this is a perversion of the intended use of cost-incentive provisions.

3. Protection Against "Abnormal" Escalation

The third approach to escalation is that the pricing risks attending "normal" escalation are inherent in our economic system and that Defense contractors should not be relieved of these risks. Advocates of this position feel that removing all risk of economic fluctuations will disturb the traditional balances in industry-labor relations and add to the inflationary pressures on both wages and materials.

This approach is based on the proposition that "normal" trend lines can be projected by the contractor and that, within upper and lower boundaries drawn around long-term projections, the contractor should assume the risk (or possible advantage) of actual price levels varying from the projected lines. The

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[1] The ultimate resolution of the problem following this approach would be a cost-reimbursement contract.

contractor's risks are limited, however, by adjusting the contract prices for price level changes beyond these boundaries.

The Air Force's approach to this concept concludes that only long-term contracts--those where significant costs will be incurred more than three years in the future--should be considered as candidates for escalation provisions. It also concludes that escalation adjustments should be made only for those costs incurred more than three years after contract award, with the contractor to include escalation as a contingency factor in the price for the first three years.

4. Conclusion

LMI concludes that the deficiencies of the contingency pricing method of dealing with escalation make it unsuitable to long-term contracts. These same deficiencies make the abnormal escalation approach unsuitable also. Price level changes should be handled by escalation provisions related to index movements--if indexes and techniques of application can be found which do not introduce greater problems.

IV. INDEXES

A. CRITERIA FOR INDEXES

A major objective of this study was to determine if there is a yardstick or index that could be used to represent the cost escalation experienced in the airframe industry. The criteria for an acceptable index for the airframe industry are the same as those for acceptable indexes in any application. Such a standard (or index) should have a sound theoretical basis; reflect the movements of price level changes; be statistically valid; be beyond significant influence by the contractor, his suppliers and employees, and be convenient to use.

1. Sound Theoretical Basis

An index should have a logical relationship with the thing being measured. Fortuitous coincidence is not an acceptable substitute. If the retail price of bananas were found to have been an exact reflection of changes in the average earnings of aircraft industry workers for a period of 15 years, no one would want to adjust future prices by changes in the banana index.[1]

The most appropriate index would be one which measures changes in the particular item we want to track. At the same time, however, the fact that the index should not be directly susceptible to influence by the contractor or his suppliers usually requires that the index measure some larger aggregation of items. Feasibility of application and availability of useful measures also usually require a larger aggregation of

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[1] See Appendix XII for a discussion of some general price indicators.

items. The aggregation should not be so large and diverse that it is significantly affected by things we are not measuring and which may conflict with what we are measuring.

2. Reasonable Representation

An index should reasonably simulate the direction, magnitude and timing of movements of the costs or price levels which it purports to measure. It is not enough that they have the same percentage of change over a period of years, they should have the same percentage of change year-by-year (or by whatever other period is to be used as a basis of adjustment).

3. Statistical Validity

An index should have statistical validity. This is a function of sample size and selection. BLS personnel emphasize that indexes of the larger aggregations are to be preferred over indexes measuring narrow segments of an industry.

Another advantage of using more inclusive indexes is that they are less likely to be discontinued or significantly changed and thus introduce problems in the administration of the escalation provisions of a contract.

4. Influence of Contractor on Index

The extent to which an individual contractor might influence an index is a function of the relative weight of his material purchases and the number of his employees in the index population. It is also a function of the extent to which his actions may establish a pattern followed by others. The ability of a contractor to influence an index for either of these reasons is diminished by using more general indexes embracing

a larger population of materials, a larger population of workers and a greater variety of industries.

5. Influence of Index on Labor-Management Relations

The question of the extent to which escalation provisions might disturb normal labor-management relations is perhaps impossible to answer. The aircraft industry has for years obtained much of its business from the Government, most of it without price competition, and with escalation included as a contingency in prices. One might suppose that over a period of years this set of circumstances would afford essentially the same opportunity to push up wage rates as there would be with widespread use of escalation provisions. History does not indicate, however, that the earnings of aircraft workers evidence any unusual amount of escalation.[1] Whether this is because the opportunity was not seen or because wage objectives are established by other forces, no one can say.

Nevertheless, the extent to which management might be motivated to make liberal wage concessions because of escalation provisions would be affected by the degree of certainty that these concessions would be reflected in the index movement. Similarly, the ability of labor to obtain these concessions would be affected by its ability to convince management that similar concessions would be obtained on a wide enough basis to ensure that the index would move correspondingly. In either case, the conclusion follows that the index with the largest population and the greatest variety of different industries is most likely to thwart any effects of this kind.

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[1] See Appendix VIII.

6. Convenience of Application

Government contracts usually involve a substantial amount of major subcontracting with industries which would not be included in indexes specifically designed for the prime contractor. If indexes of limited application are used in the prime contract, and escalation provisions are to extend to these subcontracts, theory would suggest that separate indexes should be used for each major industry involved in a major subcontract activity. If a broad industry index were used, the one index could be used for subcontract escalation as well as for prime contract escalation. Similarly, a single index based on prices (the combined labor, material, etc.) would be more convenient than using indexes of individual cost elements.

These several criteria for indexes are intended as guides for the selection among alternative choices. They are not intended as absolute standards since no index we examined satisfied all of these criteria.

B. IMPLICIT PRICE INDEX (IPI)

The search for a measure of price level changes for use in DoD airframe contracts might have ended with the selection of the IPI. This index is a by-product of the efforts of the Office of Business Economics, Department of Commerce, to determine changes in Gross National Product in terms of fixed dollars, purged of the effect of changes in price levels. (This index is sometimes referred to as the Implicit Price Deflator for Total Gross National Product--or GNP Deflator.) The result is a general, national index of price inflation which takes into account changes in productivity.[1] Changes in this index, when

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[1] An extensive description of this index will be found in a publication of the National Industrial Conference Board, Inflation and the Price Indexes. Studies in Business Economics No. 9', July 1966, pp. 90-106.

applied to total contract or unit price, would be a measure of the price level change from the date of contracting.

There are some reservations concerning the use of the IPI as a general index of price level changes.[1] Even apart from these reservations, however, we do not think the IPI is a suitable measure of price level change in the airframe industry for three important reasons:

(1) This index measures net price changes, including the effect of productivity changes. Consequently, applying this index to labor costs is equivalent to reducing the amount of wage changes by offsetting changes in productivity. If productivity changes are also reflected in a reduced estimate of the total hours required to perform a contract, the cost reduction due to increased productivity is included in two places--once in the estimate of hours and again in the calculation of the escalation adjustment.[2] In the airframe industry (and in other

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[1] Ibid., pp. 47-52 and 71-72.

[2] A simplified example will illustrate this. The formula for adjusting contract price developed with use of a learning curve is:

$$[C \cdot L \cdot (1-P) \cdot W] \quad [I] \ ,$$

where C = First unit hours
L = Learning curve less productivity element
P = Productivity element
W = Wages prevailing at time of bid

$$I = \text{Net price index (IPI)} = \frac{\frac{W + \Delta W}{W}}{\frac{P + \Delta P}{P}}$$

industries) the benefit of productivity changes is passed to the Government by the use of learning curves to estimate labor hours. The learning curve is a summation of all of the factors contributing to declining units of labor per unit of product, including changes in tooling and equipment.[1] Many learning curves for particular plants and products have been developed and refined. If the productivity element had to be removed from the learning curve analysis--as it would have to be if the IPI were to be used for escalation of labor costs--it would disturb long-established pricing methods and place an unnecessary burden on both Government and industry.

(2) The IPI is developed from general measures of productivity changes not specifically related to individual industries. There would be no way of showing the extent to which productivity changes in the airframe industry were accurately measured by estimates of national, average productivity changes. The

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The first factor $[C \cdot L \cdot (1-P) \cdot W]$ is the bid price; the second $[I]$ is the effect of the change in the escalation index. The amount of the adjustment is determined by subtracting the first factor from the product of the two. Substituting for I, we have

$$\left[C \quad L \cdot \frac{1}{1 + \frac{\Delta P}{P}} \cdot W\right] \quad \left[\frac{\frac{W + \Delta W}{W}}{\frac{P + \Delta P}{P}}\right]$$

Simplifying $\frac{1}{1 + \frac{\Delta P}{P}}$ and reducing the second factor, we have

$$\left[C \cdot L \cdot \frac{P}{P + \Delta P} \cdot W\right] \quad \left[\frac{W + \Delta W}{W} \cdot \frac{P}{P + \Delta P}\right]$$

The term $\frac{P}{P + \Delta P}$ appears in both factors and is considered twice.

[1] Defense Contract Audit Manual, par. F-101(d). See, also par. F-105(b).

data built up over the years on expected learning curves in individual plants would probably reflect a more accurate measure of these productivity changes.

(3) Material costs to a contractor are net costs after reflecting productivity changes. Hourly wage costs do not reflect productivity changes. The application of a price index would be very severe in airframe contracts because of the large spread in ratios of materials to direct labor in individual contracts.[1] A generalized index applied to both labor and material costs, which contains important (and probably incorrect) assumptions concerning changes in labor productivity, might be applied if the ratios of these costs in different situations were reasonably similar. Its use when these ratios differ significantly in individual situations is highly suspect.

The deficiency of the IPI and the discussion of productivity measures have two important implications on the further development of this subject. The first is that we will have to deal separately with labor and material. The second is that the use of wages as an index in the absence of accurate measures of productivity changes means that it will be difficult (or impossible) to limit adjustments for labor costs to price level changes only.

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[1] See p. 29

V. ANALYSIS OF THE AIRFRAME INDUSTRY

A. COMPANY DATA

Fundamental to a study of escalation provisions in airframe contracts was the need to obtain a measure of actual changes in wage and material price levels. One important question was whether there was any correlation of actual trends among the major airframe contracts. Five contractors were asked to furnish data on labor and materials over the period 1960-1967 for this purpose.

1. Labor

It was initially contemplated that wage data would be obtained by bidding categories, since data of this kind would be readily available to each contractor and would also be most familiar to Government analysts. It very quickly became evident that these data would not disclose the trend of economic escalation for two major reasons: the data would be significantly affected by (1) changes in the mix of different labor skills comprising a bid category and (2) changes in employment levels.[1]

To avoid these problems, the companies were asked to provide data on a representative sample of specific job classifications. This would have developed data at the lowest level of aggregation and, while perhaps not eliminating the effect of changing employment levels within that group, would come as close as feasible to measuring true wage escalation. In some

[1] Average wage rates rise in periods of lay-offs and decline in periods of rapid build-up because the effect is concentrated on the lower skill levels in both cases.

cases the data were not available; in other cases they were available only at considerable expense; in some cases they were readily available, but escalation was too much obscured by the effect of changing employment levels, even within specific skill groups.

The data finally used for the purpose of comparing the experiences of the contractors are the data on average wage rates by bid categories. It must be emphasized that these average rates by bid categories are a reflection of several factors influencing costs. One is true escalation. Another is the general upgrading of labor skills (within specific categories and among categories) as more sophisticated production tools are introduced. Another is the effect of changing employment levels on average labor rates.

The data obtained for production labor, direct engineering labor, all indirect labor, and the cost of fringe benefits are summarized in Appendix IV. Two conclusions are obvious: not only is there no reasonable correlation of the escalation trend within the industry, there is no reasonable correlation among different labor categories within a single company.[1]

2. Material

None of these contractors had long-term data on actual escalation of material costs. As with labor, material costs are plagued by the lack of fixed standards: varying quantities purchased from year to year; changes in specifications; changes in suppliers; and varying delivery requirements, resulting in more or less escalation being buried in the vendors' prices.

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[1] The data on labor illustrate the pronounced effect employment level changes have upon average labor rates. The large swings in fringe benefit costs are attributable partly to the same effect--new employees get less vacation, for example--but mostly to variations in annual pension contributions resulting from revised actuarial estimates of current funding requirements.

3. Implications of Contractor Data

The absence of any usable data on material prices compels us to look outside of the industry for measures of price changes-- or indexes. The wide disparity of experience on labor rates, demonstrating the significant impact of forces other than escalation, similarly makes it impossible to use any of the company data directly as an index of the escalation of wage rates within the industry.[1] Measures of price level changes will have to be developed from other data sources.

It is also apparent from the disparity of experience demonstrated by the contractor data that no index will reflect an individual contractor's unique experience in the past. Equally, no contractor can assume that an index will reflect his situation in the future. If a contractor believes that changes in employment levels in his plant will result in labor rate increases exceeding those projected by an index, he cannot (and should not) ignore this fact. An index, in fact, is only useful as a measure of average experience of the population used in the analysis. Contractors must in addition project their estimates of the variations of their future costs from the average.

Because there is no way to determine actual escalation in the airframe industry, even after it occurs, approximation must be used. For labor, average hourly wages rates (which include the effect of other factors such as changes in job mix and employment levels) will approximate escalation. For material, wholesale price change information is the most logical approximation.

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[1] There are reasons relating to contractor influence why an index based on the company data might not be desirable, even if one could be derived from these data.

4. Separation of Labor and Material

There are several levels of aggregation of contractor costs that could be used in applying an index. The largest aggregation, and the most desirable because of simplicity of application, would be the total contract or unit price. It was observed, however, that there are large differences in the proportions of labor and materials on airframe contracts. There is no fixed pattern such as one might expect in the manufacture of washing machines or automobiles. A survey of some eight large production contracts disclosed ratios of purchased items to direct labor ranging from 5.6 to 1 at one extreme to .73 to 1 at the other.[1] These varying ratios of prime cost elements mean that it is impossible to describe a standard mix of labor and material as a basis for a universal airframe cost index suitable for every contractor in every program buy. It means also that separate indexes must be applied to the various individual cost elements, such as direct labor, indirect labor, other indirect costs, and materials.

B. LABOR INDEXES

1. Production Labor

The Bureau of Labor Standards of the Department of Labor publishes a series on average hourly earnings of production workers in a variety of different industry classifications at

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[1] As will be discovered, labor costs have risen faster than material costs because productivity increases are reflected in material costs. Over a recent one-year period, the extremes of these ratios of material and labor would have resulted in different escalation adjustments on total costs in the order of thirty percent.

various levels of aggregations.[1] Moving from the specific to the general, indexes encompassing the aircraft industry can be found at four levels of the Standard Industrial Classification (SIC):[2]

Category	Percent of Aircraft Workers to Total Workers in Category, 1966
Aircraft (SIC 3721)	100.0
Aircraft & Parts (SIC 372)	53.9
Transportation Equipment (SIC 37)	17.6
Durable Goods Manufacturing	2.1

These BLS series are no more indexes exclusively of escalation than are the data provided by the five companies. The average hourly earnings reported by BLS are a reflection of the same influence of changes in skill levels within the production worker group, and the same influence of employment level changes. We may assume, perhaps, that on such a wide sample the effect of these other influences can be considered insignificant.[3] Whatever their defects, however, they are the only broad labor series available which encompass the

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[1] Data from 1909 are compiled in Bulletin No. 1312-5, Employment and Earnings Statistics for the United States, 1909-1967. Monthly data are published in the issues of Employment and Earnings and Monthly Report on the Labor Force, Table C-2.

[2] See, also, Appendix V.

[3] There could be a problem in individual cases on very long-term contracts where the contractor's method of estimating wage costs included (either implicitly or explicitly) a factor for industry-wide upgrading of skill levels. This would be particularly true in periods of rapid technological change within the industry.

airframe industry workers. It should be noted that the BLS wage series only include production workers' hourly wages. They do not include wages and salaries of engineers, technicians, clerical or administrative personnel, nor do they reflect the changes which occur in labor costs other than in wage rates (e.g. fringe benefits).

2. Elimination of Overtime

The average hourly earnings reported in this BLS series include overtime pay. It is possible, however, to calculate the straight-time rate for most categories since the weekly earnings, average weekly hours, and average weekly overtime hours are also reported. There is general agreement among the contractors we interviewed that the effect of overtime premium pay on average hourly earnings further obscured identification of escalation, and should be eliminated.[1]

This would require discarding the Aircraft earnings series from consideration, since overtime hours are not reported at that industry level. Overtime hours are reported for Aircraft and Parts, Transportation Equipment, and Durable Goods.

3. Engineering Labor

Appendix VI is a summary of changes in engineering labor costs disclosed by three different surveys. The entry for production workers in Aircraft and Parts is included for reference.

The data from these surveys are not too satisfactory since they have different base periods. However, they indicate

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[1] The effect of eliminating overtime premium is to reduce the apparent escalation of labor costs during the period 1960-1967. See Appendix V.

that, on the whole, the apparent trend in engineering salaries exceeds the changes reflected in the BLS data on hourly earnings of production workers.

4. Clerical Labor

The only general index for clerical workers is the BLS survey: National Survey of Professional, Administrative, Technical, and Clerical Pay. Data on the two most numerous classifications in the clerical series are summarized in Appendix VII, together with data on hourly earnings of production workers as a reference. These data indicate that, on the whole, the BLS data on hourly earnings of production workers show a greater amount of change than the apparent trend in clerical costs.

5. Use of a Single Labor Index

Although the BLS data on earnings of production workers do not mirror the apparent trends in engineering and clerical labor groups, it would be administratively infeasible to use other indexes as measures of changes in those groups. The possible inequities are diminished by the fact that the changes reflected by the BLS data on hourly earnings of production workers appear to be low in relation to one group (engineers) and high in relation to the other (clerical personnel). Moreover, in interviews with airframe contractors it was indicated that they generally pass on to other employees the same percentages of wage increases and benefits given to production workers. On balance, therefore, it would seem to be appropriate to use one of the BLS series on hourly earnings of production workers as an index of changes for all labor groups, direct and indirect.

6. Selection of a Labor Index for Airframe Contracts

Among the criteria for indexes decribed in Section IV, two are particularly important and in a real sense mutually conflicting. The index should have a sound theoretical basis; it should measure the specific item we want to measure. But, it should also be isolated from significant influence by the contractor and his employees. The first criterion suggests that we should use the BLS wage series for Aircraft and Parts--the lowest level of aggregation at which overtime premium can be eliminated. However, aircraft workers comprise 54 percent of the total production workers in the Aircraft and Parts series; this is too large a proportion, particularly if escalation provisions were to be used widely in airframe contracts.

The BLS wage series for Transportation Equipment would be suitable--aircraft workers comprise only 18 percent of that series and an industry which was something less than a 20-25 percent component of a series would appear to satisfy the requirement for isolation from direct influence. However, during interviews with the airframe contractors there was frequent reference to a tendency to pattern aircraft worker settlements after settlements in the automobile industry. Production workers in the combined BLS categories of Aircraft and Motor Vehicles comprise approximately 44 percent of the total workers in the Transportation Equipment series.

LMI concludes that the BLS wage series for Durable Goods,[1] adjusted to eliminate the effect of premium wages on

[1] Embracing the SIC codes 19, 24, 25, 32-39.

overtime hours, is a suitable index for use in airframe contracts and is to be preferred over any index more closely related to that industry. Further, as the use of escalation provisions becomes more common, the need to use a broad industry index is more strongly indicated.

C. MATERIAL INDEXES

1. Introduction

Material costs comprise approximately 40-55 percent of the total cost in a typical airframe contract. In addition to being normally the largest element of cost, it is a conglomeration of a wide variety of elements ranging from raw material (such as sheet aluminum) to major subcontracts for subsystem development and production, such as radar equipments.

The Wholesale Price Index (WPI), also published by the Bureau of Labor Statistics, is the only measure of price changes for a wide variety of goods sold in primary markets in large quantities.[1] It is designed to measure general price levels in other than retail markets, and is intended to measure "pure" price changes not influenced by changes in quality, quantity, product mix, etc. The WPI is an index of some 2200 individual items, aggregated into many product groups which are finally aggregated into two classes -- (1) Farm products, Processed Foods, and Feeds; and (2) Industrial Commodities -- which are then combined in the All Commodities class. One problem with the WPI, therefore, is the selection of an appropriate class. There is no problem eliminating the farm products sec, but it is not

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[1] An extensive description of this index will be found in Handbook of Methods for Surveys and Studies, BLS Bulletin No. 1458, pp. 91-104.

so evident that the Industrial Commodities class should be used when other specific commodity indexes (e.g. Nonferrous Metals) appear to be more appropriate in the airframe industry. (As will be shown later, they are not more appropriate.)

While the BLS attempts to base the WPI on actual transaction prices, list prices are used if transaction prices are not obtainable.[1] Some BLS people feel that this is enough of a disparity to suggest that the WPI does not, in fact, measure actual changes in the cost of what the airframe contractor buys. The WPI does not include military products in its universe. Items such as air conditioning units or electric motors in the WPI are massive stationary motor-generator units or household air conditioners and bear little relation to their aircraft counterparts in material or design. Although the WPI is the best measure available for measuring general material price increases, it does not necessarily measure escalation of defense materials.

A significant portion of what is called "material" in airframe contracts are major subcontracts which include such items as radar equipments and navigation systems. These are built to specifications, and have even less relation to the specific items included in the universe of the WPI than do the other materials. For this and other reasons, major subcontracts are distinguished from the balance of material items in the following analysis.

2. Raw Material and Purchased Parts Indexes

There are three major BLS indexes relating to materials and purchased parts pertinent to airframe industry.

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[1] Ibid., p. 92.

WPI - Industrial Commodities

WPI 10 - Metals and Metal Products

WPI 11 - Machinery and Equipment[1]

The Industrial Commodities index would be the most preferred for several reasons. BLS states that it is more reliable.[2] It would embrace all materials used on a contract and eliminate the risk of individual judgment in selecting WPI indexes. It would shield the Government effectively against the contractor or his suppliers influencing the material index. It would also eliminate the need to treat materials under subcontracts by indexes appropriate to the specific subcontract.

Unfortunately, the Industrial Commodities index is not suitable for airframe contracts because major components of this index have varied widely in price changes, and the composite index reflects significant weighting of items not pertinent to airframe contracts. (See page 37 for table.)

In examining other WPI indexes, we were urged by BLS personnel to use the index with the widest possible coverage consistent with our objectives. An example of the difficulties which are encountered in using the component classes of the WPI as an index was disclosed in analysis of the Nonferrous Metals index (10-2) -- a component of WPI 10 -Metals and Metal

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[1] Pertinent parts of WPI 11 are: 11-41, Pumps and Compressors; 11-45, Mechanical Power Transmission Equipment; 11-72, Electrical Integrating and Measuring Instruments; 11-73, Motors and Generators; 11-78, Electronic Components and Accessories.

[2] "The Wholesale Price Index is based on a purposive, judgment sample. The All Commodities Index can be assumed to be more reliable than a component group index, in general." Handbook of Methods, p. 103.

WHOLESALE PRICE INDEX, INDUSTRIAL COMMODITIES

(Index: 1957-1959 = 100)

Industry (WPI number)	Percent Weighting in Composite Index	1967 Index Value
Textile products and apparel (03)	9.8%	102.1
Hides, skins, leather & related products (04)	1.7	115.8
Fuels & related products & power (05)	9.8	103.6
Chemicals & allied products (06)	8.8	98.4
Rubber & rubber products (07)	3.2	97.0
Lumber & wood products (08)	3.3	105.4
Pulp, paper & allied products (09)	6.7	104.0
Metals & metal products (10)	17.6	109.5
Machinery & equipment (11)	16.6	111.8
Furniture & household durables (12)	4.9	101.0
Nonmetallic mineral products (13)	4.2	104.3
Transportation equipment (14)	9.9	102.1
Miscellaneous products (15)	3.4	109.2
Industrial Commodities	-	106.3

Products. The Nonferrous Metals index would appear to be most appropriate in airframe contracts since aluminum products are in this index. However, copper products are the major component of 10-2--and aluminum prices have declined since 1960 while copper prices have increased very substantially.[1] As a consequence, the use of this index as a measure of the

[1] Analysis of the material weightings in the BLS index 10-2, Nonferrous Metals, reveals that copper products comprise 47.8 percent of that classification; aluminum, titanium and magnesium products 26.6 percent; and other nonferrous metals (cadmium, nickel and precious metals) 25.6 percent.

escalation of aluminum prices would not satisfy the criterion of a sound theoretical basis for an index. The following table summarizes these difficulties and provides some perspective on the movement of the WPI indexes:

WHOLESALE PRICE INDEX CHANGES, 1960-1967

(Index: 1957-1959 = 100)

	1960	1967	Percent Change
Industrial Commodities	101.3	106.3	4.5
Metals & Metal Products (10)	101.3	109.5	8.1
Nonferrous Metals (10-2)	103.9	120.6	16.1
Nonferrous, Mill Shapes (10-25)	105.9	111.8	5.6
Mill Shapes, Aluminum (10-25-01)	103.9	93.8	(9.7)
Mill Shapes, Copper & Copper Base (10-25-02)	104.7	128.2	22.4
Wire & Cable (10-26)	101.0	125.4	14.2

The kind of problems disclosed on analysis of WPI 10-2 persuades LMI to conclude that material indexes should not be used at a level of aggregation lower than the two-digit list on page 37 above.

An analysis of seven major airframe contracts disclosed that approximately one-half of the materials were related to items included in WPI-10 and one half were related to items included in WPI-11. Based on this sample, LMI concludes that a composite index, with equal weighting of the two indexes--WPI 10 and 11--should be used as the basis for escalation adjustments for raw material and purchased parts in airframe contracts. (A composite index, summarizing the changes over the period 1960-1967 compared with the Industrial Commodities index, is contained in Appendix IX.)

3. Subcontracts

A "subcontract" is an uncertain term. It usually denotes a purchase of something made to special order; not a catalog item. This is too broad a term to distinguish "subcontracts" from other material items in the treatment of escalation because the WPI includes many items (such as digital voltmeters, motors, pumps) which are analogous to a variety of special components purchased under airframe contracts. Perhaps "major subcontracts" is a better term because we are trying to describe orders for things which involve an unusual proportion of labor; orders which require cost analysis in the absence of adequate price competition; orders in which price competition is not likely.[1] A likely way to distinguish this group of orders is to say that it embraces those for which certificates of current cost or pricing data must be obtained by the prime contractor.[2] These major subcontracts usually involve separate consideration of labor and material cost elements and are more like prime contracts than they are like the prime contractor's raw materials and purchased parts.

If the Durable Goods index of hourly wage rates is used as the basis for escalation adjustments for labor costs, as recommended earlier, no special index is required for the labor element in these major subcontracts. If, however, a special aircraft index were used, the subcontract labor would have to be examined since the specific indexes appropriate

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[1] These are uncertain terms, also. See ASPR 3-807.1 and 3-807.2.

[2] ASPR 7-104.42.

for the subcontracts might vary considerably from the specific index selected for the prime contractor's labor costs.

The material element in subcontracts is likely to involve other WPI classifications (such as Rubber and Rubber Products), or markedly different proportions of the WPI-10 and WPI-11 codes than are applicable to the prime contract. Except under the most unique circumstances, however, the development of separate indexes for subcontract materials would not be worth the effort. The net effect on the composite index for the prime contract would be very small unless the subcontracting were very large in proportion to total price. Moreover, the administration of escalation provisions is more complicated when different indexes are to be applied to essentially the same cost elements; for one thing, separate accounting has to be maintained for each element under its appropriate index to determine the escalation adjustments for these elements.

LMI concludes, therefore, that a composite index, WPI-10 and WPI-11, should be used with respect to the prime contract for all materials--including subcontracts.

D. OVERHEAD

A special study by the Defense Contract Audit Agency of overhead costs of major defense contractors has disclosed that on the average approximately 40 percent is indirect labor, 20 percent is fringe benefit cost, and 40 percent is composed of other costs such as rent, telephone, travel and depreciation.[1]

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[1]The range in this study was 30.8-50.4 percent indirect labor; 12.8-29.6 percent fringe benefits; and 29.7-44.7 percent other costs.

The labor component was discussed earlier. It was concluded there that indirect labor should be treated the same as production workers for the purposes of escalation.

The Department of Commerce publishes data on national industry costs of statutory programs of social security, and contributions to pension and welfare programs. These data are summarized in Appendix X, together with the data on production workers' earnings as a reference. These data should be compared with the company data in Appendix IV. It will be noted that again there is no reasonable correlation among the companies or between the company data and the national data.

LMI concludes, therefore, that there is no reason to use a different index for fringe benefits than the index recommended for other labor costs.

No data were developed on the balance of overhead items; but there was substantial agreement among the contractors interviewed in this study that many of these items might well be considered as having essentially no escalation.[1] As a total, the reflection of productivity changes in these costs means that the rate of escalation of these "other" overhead costs is more like materials than labor.

Escalating overhead by the same percentage change as reflected in the bases for overhead (which are mostly labor)

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[1] The interesting point was made that including depreciation among the items subject to escalation would give some recognition to the fact that replacement values were higher than the acquisition costs recovered through depreciation over the life of the equipments.

apparently significantly overstates the amount of escalation. Forty percent of overhead is no insignificant sum; it amounts to some 10 percent of total costs in an "average" situation. Some recognition should be given to this high percentage of more or less stable costs. They are not truly stable: per diem rates are likely to go up under the pressure of rising room and food costs; rental charges go up over a period of time under the pressure of generally rising cost levels.

LMI concludes that, on balance, a reasonable treatment of total overhead would be to treat 60 percent of it in the same manner as labor and 40 percent of it in the same manner as material.[1]

E. COMPOSITE (PRICE) INDEX

The different indexes applicable to labor and to material, and the fact that these costs are incurred in varying and different proportions throughout a contract term, lead to the conclusion that escalation adjustments should be based on the individual cost elements. There may be circumstances, however, when it would be desirable to use a composite price index in airframe procurements. An appropriate index in this case would be one comprised of one part labor (average hourly earnings, less overtime premium, in Durable Goods Manufacturing) and two parts material (equal portions of WPI 10 and WPI 11).[2]

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[1] In a negotiated procurement, the appropriate percentages should be determined by analysis of the overhead accounts. The 60-40 ratio is only an "average" situation and a general guide.

[2] See Appendix XI for the derivation of this index.

VI. APPLICATION OF ESCALATION PROVISIONS

A. ASPR PROVISIONS

The Department of Defense has made prior efforts to cope with price escalation. ASPR 7-106, Price Escalation Clauses (Established Prices) is addressed to changes in established prices for basic metals and directly related standard and non-standard supplies. ASPR 7-107, Price Escalation Clause (Labor and Material), relates to changes in established labor rates of pay for identified types of labor and in unit costs of specified materials and purchased parts. This clause can be used only where there is no major element of design engineering or developmental work. It also requires detailed description of the amounts of labor, specific classes of labor, and specified materials allocable to each unit of the supplies to be delivered.

Both ASPR provisions are addressed to situations of very limited scope, not directly pertinent to this study. Major airframe contracts may be characterized as (1) the procurement of systems in contrast to the procurement of parts contemplated by the ASPR clauses; (2) not relating directly to any "standard" or "commercial" items; and (3) not being based on price levels set in the operation of the free market place.

There have been other significant efforts to cope with price escalation. The Tactical Vehicle Index used by the Army in competitive contracts for trucks and other vehicles and the Steel Vessel Construction Index used by the Navy in competitive procurement of ships, are major contributions. The efforts of the Army Aviation Materiel Command and the Air

Force in developing escalation provisions for major systems' procurements have also contributed to the theory and practice of dealing with price escalation.

B. DETERMINATION OF THE COST BASE

In addition to the selection of indexes, a clear definition is needed of the dollar base to which the index change will be applied. The two major elements of such a definition are: (1) the cost elements to be included in base, and (2) the time when costs should be recorded as incurred for the purpose of escalation adjustments. Time is important because escalation adjustments reflect changes in index numbers from one period to another.

Each element of contract cost--labor, overhead, material and major subcontracts--is discussed below.

1. Direct Labor

The dollar base for direct labor should be the direct payroll dollars charged to the program. Since labor is only charged when it is expended, there is no problem with the element of time.

2. Overhead

The dollar base for overhead should be the amount allocated to the program over the period being considered. Since overhead is allocated by periods, there is no problem with the element of time.

3. Raw Material and Purchased Parts

While the definition of the cost elements in the material base normally is no problem, the question of when

these costs should be considered to have been incurred is a major problem.

No matter what escalation provisions are included in prime contracts, most of the materials will be acquired by the prime contractor (and by the subcontractors) under fixed-price orders. The contingencies for future price level changes will be included in the prices quoted to the prime contractor. If the vendors include contingencies for escalation in the prices quoted to the prime contractor, and these prices are used by the prime in developing his price proposal, that amount of escalation has been passed on to the Government in the prime contract price. The escalation adjustments made later during performance should be discounted then by the amount already absorbed by the Government in the contract price. The amount of the escalation included in the vendors' prices is based on the cost increases projected to the time of delivery of orders to the prime contractor. The escalation adjustment for the prime theoretically, therefore, should be based on the time when a commitment is made to vendors for these orders--not when the vendor is paid or when the material is formally charged to the prime contract.[1] While it is, therefore, correct to base escalation adjustment for material on commitments, the accounting systems of all of the contractors interviewed in the course of this study were based on accounting for expenditures. Each of the contractors had some system of

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[1] To be completely accurate, no escalation adjustment should be made on items for which the prime had firm price quotations which he included in the contract price. This point need not be overlooked in negotiations.

following commitments as a part of program financial control, but none had a formal system which appeared to be adequate for pricing contract adjustments.[1] As a consequence, it seems that unless major changes are to be required throughout the industry, material escalation adjustments will have to be based on costs as now recorded by the contractors' formal accounting systems. The many compromises implicit in developing a set of indexes for airframe contracts suggest that this bias toward higher material escalation adjustments is not so significant as to require radical changes in contractors' accounting systems.

LMI concludes that the use of expenditure accounting for escalation adjustments of raw material and purchased parts is adequate. Such a procedure can be followed by the contractor with a minimum of additional effort.

4. Major Subcontracts

The bias introduced by expenditure accounting for materials is one reason for treating major subcontracts apart from raw material and purchased parts. The dollar amounts affected by the bias, and the longer production periods involved, may well result in a cumulative magnitude of bias on major subcontracts which should not be ignored. These subcontracts could be isolated for special treatment more equitable to the Government in an inflationary period, and more equitable to contractors in a deflationary period.

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[1] One example given was that the commitment accounting systems did not provide for adjustments to reflect discounts taken.

Therefore, IMI concludes that major subcontracts should be accounted for escalation purposes on the basis of the time of commitments and not of expenditures.

C. SELECTION OF INDEX PERIODS

BLS publishes data on earnings monthly. The data are preliminary and subject to revision for two months; they are published as final in the third month. The WPI indexes are also published monthly, four to five weeks after the pricing date. The data are preliminary for one month after issue; they are published as final in the next (third) month. Annual averages for both earnings and materials are published in February each year.

As would be expected, the change in prices levels within a year are approximately in the same range as changes in annual averages from one year to another. Unless actual costs are incurred in more or less equal proportions in each month, the annual data are not accurate measures of the appropriate escalation adjustment. Substantial inequities can result from applying annual data to costs concentrated in either the early or later months of the year -- particularly where there is a continuing upward (or downward) movement of price levels. Further, monthly data on labor costs and material expenditures are readily available from the accounting systems used by contractors. The use of monthly index and cost data does not imply that escalation adjustments need to be effected monthly. The monthly calculations can be summed by any convenient period (one year or even the whole contract period) and the contract amended accordingly.

LMI recommends, therefore, that where escalation adjustments are to be determined using actual costs as the basis of the adjustment, final monthly index values should be used in preference to annual average index values.

D. LENGTH OF CONTRACT AND APPLICABLE COSTS

The question of what contracts should contain provisions for escalation adjustment must be considered. Analysis leads to the conclusion that there is no definite answer to this question. It is a matter of judgment and not of discovery.

LMI believes that escalation provisions should be used in any contract where significant costs (labor or additional commitments) will be incurred more than one year in the future. These are three major factors influencing this conclusion:

- Contract commitments in excess of one year are the exception in commercial dealings.
- Significant price level changes, such as those which occured in 1965, indicate that there is no way contractors can accurately project future price level changes in periods of price instability.
- Escalation can significantly affect profits.

We do not believe that the uncertainties in estimating future price level changes should lead to any other conclusion.

Another question arises immediately: if a contract contains escalation provisions, should all costs be subject to escalation adjustment--even costs incurred in the first year? As noted earlier, different approaches are now followed

by the services. The Navy's Steel Vessel Construction Index provides for escalation adjustment of all costs. The Air Force approach provides for adjustment of only those costs incurred more than three years after award of the contract.

If escalation provisions are only used in contracts with substantial costs to be incurred more than one year after contract award--if escalation provisions are not used in all contracts--many contractors will be required to assume the risks of projecting price level changes during a period of one year. Equity suggests that contractors receiving the protection of escalation clauses should assume the same risks. For example, escalation provisions for multi-year contracts should not give contractors protection for costs incurred within the first year that is not available to other contractors who have similar liabilities under annual contracting procedures.

LMI concludes, therefore, that escalation adjustments should not extend to any costs to be incurred in the first year.

What are "significant" costs must also be a matter of judgment. In most cases the proportion of total costs to be incurred more than one year in the future would be an acceptable standard; in some cases the total dollars may be so large as to be the proper basis of consideration. The size of the contractor has some bearing on the subject; smaller companies require more protection because they are more vulnerable than larger companies to the effects of incorrect estimates on any one contract.

There may be reasonable differences of opinion concerning the minimum period of contract appropriate for escalation provisions. But LMI believes there should be no disagreement on

the proposition that escalation provisions ought to be used whenever the contractor is compelled by the Government to postpone substantial commitments for more than one year. The most conspicuous examples are priced options and multi-year procurement (MYP). These contracts force the contractor to avoid firm commitments with his vendors; they prevent him from scheduling production early if he wants to; and they cause the same problems to be passed on to major subcontractors.

LMI also concludes that escalation provisions should be used in all MYP contracts and in all contracts with substantial option commitments.

E. INDEX PROJECTIONS BY THE GOVERNMENT

It was noted in the earlier discussion of contractor data that no index will reflect the unique experience of a single contractor; therefore, every contractor will have to project or estimate the future price level changes appropriate to his situation, no matter what escalation provisions are included in the contract. The contractor's projection reflects his estimate of the net effect resulting from the combined influences of his hire-fire forecast, skill level changes peculiar to his activities, abnormal local market conditions for labor or material, and any other condition which will affect his prices--including the escalation of costs expected as a result of general price level changes. Some contractors extrapolate labor projections from historical data and cannot identify the specific increment for general escalation of costs which is included in their bid prices. The historical data used are a reflection of the effect of every influence on the trend of costs, without identification of the effect of any particular

influence. However, a contractor can estimate the amount he expects to receive from an index specified by Government, whether or not the Government makes a projection of the future trends of that index. If a contractor were given an RFP or IFB that contained an escalation clause, theoretically he would assess what costs he expected to incur in the way of contingencies due to his situation and then modify the resultant price calculation by what he expected to receive back from the Government in the form of escalation payments.

If the Government not only described the index but also gave its own projection of the index movement, the contractor would also have to determine how his projection of the index compared with the Government's estimate to determine how much he expected to recover under the escalation provision. Thus, if the Government makes a projection, the contractor will have an additional step in his pricing procedures. In addition, there are some disadvantages in a Government projection. The Government must go through the effort of developing a good projection and there is some belief that the Government may be in fact warranting the accuracy of its economic projections.[1] At the very least, the Government is in the position of appearing to forecast future price level changes; and perhaps thereby influencing the price levels.

The Government does not need to make a projection or even agree with the contractors in a price competitive situation. Competition will tend to cause the contractor to back out of his price any contingency for escalation which he believes will be reflected by the index.

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[1] See Federal Contracts Report, Number 189 (October 2, 1967), pp. A-1 and A-2.

However, in a non-competitive procurement, or in one where there is not price competition adequate to cause the contractor to be consistent in estimating escalation and the expected return from an index, the Government and the contractor must come to some agreement on the amount of the projected general price level change already absorbed by the Government in the contractor's price.[1] It also becomes essential for the parties to agree on some trend line of the escalation included in the contractor's price. The trend line would have to be expressed in terms of the index which is to be used to measure escalation under the contract. The deviations of future index values from the trend line, and not the index movements themselves, would measure the escalation adjustments which should be made. If more than one index is to be used in the contract, similar agreements would have to be reached on every index.

The question then arises whether price adjustments should be effected for any deviation, however small, between the established trend line and the actual index movements. Several contractors voiced concern that minor decreases in the national index would require price reductions under their contracts, notwithstanding the fact that their actual costs were as projected. They suggested that upper and lower limits be negotiated about the trend line, and that no adjustments be made for escalation

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[1] The amount could be zero. The contractor would not be likely to agree on a zero sum if partial payments (not progress payments) on completed units were expected to be substantial. In those circumstances a zero sum would require the contractor to invest working capital to the extent of the effect of escalation pending the escalation adjustment. The amount might properly be established as zero if escalation adjustments were effected at frequent intervals--perhaps quarterly.

(both above or below the trend line) within the boundaries established by these limits. The Navy's Steel Vessel Construction Index and the Army's Tactical Vehicle Index require price adjustments directly proportionate to the index movements; no apparent difficulties have been encountered in this requirement. Moreover, establishing a boundary about a projected line is likely to lead to "gaming" of the projected line.[1]

LMI recommends, therefore, that all escalation adjustments be directly proportional to the whole amount of the changes in index levels--both upward and downward; that provisions limiting adjustments to changes in index levels of some certain magnitude not be used.[2] A small dollar limit to escalation adjustments to avoid the administrative expense involved in amending the contract or in processing the adjustment is clearly desirable, but that is quite a different matter.

F. ESCALATION ADJUSTMENT CEILINGS

One objective of an escalation provision is to reduce the contingencies which are added by the contractor because of uncertain price level changes in the future. Another is to protect the contractor (and the Government) from the effect of abnormal price level changes which would cause significant losses or windfall gains for reasons beyond the contractor's

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[1] If, for example, the contractor believed that escalation would be at a rate of three percent (perhaps as low as two and one-half and as high as three and one-half), and if there were to be a one point boundary, he should strive to add the three and one-half increment in his pricing.

[2] This recommendation assumes that a proper index is used: one which is far removed from influence by a contractor. If a proper index is used there is no need to limit reimbursement to something less than the whole effect of the index movement. Reimbursing something less--perhaps only 90 percent of the total effect--would reintroduce a part of the contingency pricing which escalation is intended to eliminate.

control. Neither of these objectives is served by provisions which would limit escalation adjustments within some specified ceiling amount. Indeed, it is when extraordinary sums would be involved that escalation provisions play their most important role.

LMI concludes that price ceilings limiting escalation adjustments are incompatible with the objectives of escalation provisions.

G. ESCALATION ON DELINQUENT DELIVERIES

Many Government personnel insist that the contractor must not have any less incentive to complete a contract on time as a consequence of anticipating extra rewards under the escalation clause. Some voice the opinion that an escalation provision would be unacceptable to them if it allowed a contractor to obtain additional sums when he was "delinquent."

LMI is of the opinion, however, that escalation adjustments should be made without regard to the contract delivery date.

This opinion flows from the concept that the basic objective of escalation arrangements is to eliminate the addition of contingencies in anticipation of future price level changes. Contract slippages do occur, and for a variety of reasons. If the contractor believes he is exposed to a risk, he will try to protect himself against the risk in the pricing of the contract. An arrangement limiting the escalation will reintroduce a part of what escalation provisions are intended to eliminate. We believe that if the Government decides, all things considered, not to terminate a contract, a commitment to continued

escalation is one of the items already settled in the original negotiations on the contract price.[1]

H. ESCALATION ON COST OVERRUNS

The question whether escalation adjustments will be applied to costs exceeding target costs must also be considered. This is much the same problem as escalation on late deliveries discussed in paragraph G above. LMI believes that escalation should be applied to the total of actual costs for two reasons: (1) the contractor and the Government anticipate the reasonable possibility that actual costs will exceed target; and (2) if the contractor is exposed to the risk of absorbing escalation on costs in excess of target he will include a contingency for that event in his pricing. Limiting escalation adjustments to target costs would encourage the contractor to reintroduce a part of the contingencies which escalation provisions are intended to eliminate.

LMI concludes, therefore, that the target cost (and the ceiling price) should be adjusted by the sum of the effect of escalation on all costs incurred by the contractor excluding only those costs incurred in the first year.

I. PROFIT ON ESCALATION ADJUSTMENTS

Escalation adjustments which result in an adjustment of unit prices in proportion to the change reflected by some one

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[1] In a firm-fixed-price contract, however, where the escalation arrangement is based on a predetermined allocation of costs by specified periods (as described in paragraph K following) there would be no adjustment for costs incurred in later periods.

or combination of indexes automatically result in an adjustment to profit at the same rate as was used in developing the original price. Where escalation is handled by being included as a price contingency and not by formal escalation provisions, it is accepted practice to apply the weighted guidelines profit factors to the whole cost including the contingency sum.

When we can see the details of the operation of an escalation provision--as in incentive contracts--there are some persons who question whether a profit should be paid on the increment of escalation adjustment; whether target profit should be adjusted together with target cost and by the same ratio between these items. Some say that the target profit should not be adjusted as consideration for the reduced cost risk assumed by the contractor with escalation provisions in his contract.[1]

The "reduced cost risk" is the elimination of chance as an influence on profits: that profits will be increased or decreased depending on Government policy dictating whether actual price levels will be either higher or lower than the contractor's estimate of the future price levels. In either event, the consequence would be the result of Government policy and actions which the contractor could not significantly influence. Further, if it were known at the time of negotiation what the actual price levels would be two or three years later, the effect of these price level changes would be included in

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[1] Would the same proposition hold true in a deflationary period when downward adjustments were anticipated?

the cost base for determining profit. Escalation should provide the same result as nearly as practicable.

Therefore, LMI concludes that an increment of profit on the escalation should be included in the adjustment.

J. ADJUSTMENTS FOR CHANGES IN FEDERAL LAWS

From time to time the Federal Government may take unilateral action in the form of Federal statutes or regulations which may affect the costs of a Government contractor. Examples of this are changes in the company's portion of social security and unemployment insurance contributions, and minimum wage rates. Since the contractor cannot predict or control these added costs, it is reasonable that the Government make price adjustments for such changes.[1] In treating the fringe benefits part of overhead (an average of 20 percent of total indirect costs) the same as labor for the purpose of escalation, the contractor might recover a part of the effect of legislative action through the operation of the escalation clause. An example would be a change in minimum wages, which change would also be reflected in the earnings data used for escalation of labor costs. The interaction between changes in federal law and escalation provisions will have to be considered on a case-by-case basis; each contractor and the index could be affected differently by changes in minimum wage laws.

K. ESCALATION ADJUSTMENTS IN FIRM-FIXED-PRICE CONTRACTS

Contractors will object if the proposed escalation adjustment requires a statement or audit analysis of actual costs

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[1] Appropriate clauses were apparen first used in the C-5A prime contracts.

incurred as a basis of effecting the adjustment, except in circumstances where the contractor is already required to disclose these costs--as with incentive contracts. Government policy also points to avoiding audit analysis on firm-fixed-price contracts. Escalation provisions intended for use in firm-fixed-price contracts should be based, therefore, on a technique for escalation adjustment which is independent of any comparison of actual costs and the contract price.

In most firm-fixed-price contracts there is no established cycle within the contract on which to key escalation adjustments as there is, for example, in MYP contracts. A solution to this dilemma has already been developed by the Navy in the Steel Vessel Construction Index. The Government can specify the percentage of total price (labor, material, overhead, and profit) that will be based on the various indexes of labor and material, and the percentage of these costs that will be considered to be incurred in each stated period throughout the contract. The escalation adjustment is therefore based on applying index movements to predetermined, fixed amounts of cost in each time period.

If there is price competition, the Government need not be unduly concerned with the fact that the percentages of the total contract price attributed to labor and material will vary with the make-or-buy decisions of each bidder. Nor need it be concerned with the fact that the schedule of actual costs will vary for each bidder. These differences can be considered by each bidder and he can make the appropriate adjustment in the price bid. For the same reason it is not necessary to develop separate indexes for major subcontracts. These can

be included in the material index. Costs can be allocated by periods according to an estimated production program or be based on actual cost schedules developed from previous contracts for the same or similar item.

The Navy uses quarterly periods as the cost periods in the Steel Vessel Construction Index, escalating the derived percentages of total contract price allocated to labor and to material in that period by the percentage changes in the average of the monthly indexes within that quarter compared to the index in a specified month preceding or coincident with submission of bids. When the escalation adjustment as in this arrangement will be based on predetermined cost allocations, only more or less coincidental with actual cost commitments, averaging index measures over quarterly periods (although less accurate in measuring the effect of escalation than monthly periods) is not objectionable.

In a situation where there is no price competition, the percentages for the allocations between labor and material costs and periods should be developed as much as possible from data furnished by the contractor.[1] The percentages based on data furnished by the contractor would undoubtedly result in a better escalation plan, more closely approximating actual experience and, therefore, requiring less of a contingency sum in the contractor's price.

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[1]Where final agreement is on price, and not on the individual elements of price, some give-and-take will be needed to arrive at these allocations between cost elements.

There are a large number of situations where firm-fixed-price contracts will not be used in airframe contracts, but where some form of cost-incentive contract (either FPI or CPIF) will be used instead. In these cases, costs are audited and escalation adjustments should be based on actual costs instead of being based on a predetermined estimate of costs by kind and by calendar periods. If adjustments are based on actual costs, the contractor need not add contingencies for the possibility that actual costs do not follow the predetermined pattern.

VII. INDEXES AND APPLICATION OF ESCALATION PROVISIONS IN MULTI-YEAR PROCUREMENT (MYP)

A. INTRODUCTION

Although the primary objective of this study was to develop approaches to escalation on airframe contracts, the basic concept is applicable to other procurements. It is particularly appropriate for MYP contracts. There are several factors which make them prime candidates for escalation provisions with relatively simple techniques:

- They are long-term contracts for up to five years' requirements, with production extending even beyond five years.
- They require the contractor to program his work and purchases over several years.
- They are price competitive.
- They have the same unit price for each years' requirements, thereby providing a simple base for escalation adjustments.
- They have an annual cycle. The Government obligates itself for specified quantities by notice to the contractor, thereby providing a logical time base for implementing escalation adjustments.

B. MYP ESCALATION PROVISIONS

In substance, what is proposed for general use on MYP contracts is only a slightly modified version of the Army's

General Purpose Tactical Vehicles Index A used in MYP contracts for these vehicles. The procedure is simple: the level unit prices applicable to each successive year's requirements (after the first) are adjusted by the percentage change in the index between the time of contract award and the notice to proceed with that year's requirements.[1]

The Army uses an average of the indexes for the three months preceding, coincident to, and following the contract award and its anniversary dates to smooth minor perturbations in the monthly indexes. The idea is a good one.

The selection of index measures for MYP contracts should proceed theoretically along the same lines followed in the selection of indexes for airframe contracts. This would involve analysis of the appropriate set of BLS data on average hourly earnings of production workers; an evaluation of the use of a specific series as an index for all labor; analysis of overhead costs; analysis of materials and selection of an appropriately weighted WPI index; and determination of the relative weights of labor and material in a composite (price) index.

It is not feasible to expect an analysis in this depth for each MYP contract. Indeed, such a requirement would be a major impediment to the use of this form of contracting. On the other hand, contingencies for price level changes are a significant part of the pricing problem in MYP contracts.

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[1] The amount of contingency which the contractors must include in their proposals would be reduced if the base period of the index were coincident with pricing of proposals instead of contract award. This technique is used by the Navy in its Steel Vessel Construction Index.

While an index based on a specific procurement must be preferred to a generalized index theoretically applicable to a wide variety of different procurements, a generalized index can be used to provide the essential benefits of escalation provisions where the only alternative would be contingency pricing. Such a generalized index can be found in the higher levels of aggregation of BLS data for labor and materials.

- Labor

  The BLS earnings data for Durable Goods, adjusted to eliminate the effect of overtime premium pay, constitute an appropriate index. This index is applicable to general manufacturing activities, and avoids any problem of the contractor influencing the index movement.

- Material

  In most cases it should be possible for the Contracting Officer to select the most appropriate WPI industry index from the level of major industry categories listed on page 37--perhaps selecting more than one category and estimating their relative weighting. In the absence of any reasonable basis for selecting one or more specific industry categories, the WPI index, Industrial Commodities, would be an appropriate index.

- Composite Index

  A composite index of one part labor and two parts material represents an "average" situation in which materials are roughly 50 percent of total sales and 40 percent of overhead are material-like

items. This composite index is applicable to the level unit price.

There are basically two different approaches which could be taken in providing for escalation on multi-year procurement contracts. We could provide for escalation of the level unit price at the end of each program year, establishing a new price applicable only to the units to be delivered under the following year's requirements. Alternatively, we could provide for escalation of the level price for each program year's requirements retroactively, adjusting the price by the average escalation applying to that year's quantity.

The first approach (prospective application) protects the contractor against price level changes affecting future years' quantities, but it gives him no protection at all for changes which might occur during production of a given year's requirement. In addition to obtaining no protection on the first year's requirement, the contractor must include in his price a contingency for his estimate of the acceleration of the rate of price level changes in each of the periods of the contract. The second approach (retroactive application) protects the contractor against price level changes all through the contract, in both the first year and within each successive year.

The application of escalation on multi-year contracts has followed the pattern developed in the Army's Tactical Vehicle Index, which provides for prospective application only; but if the rate of price level changes is accelerating, the prospective application of escalation adjustments results in less of an adjustment than is needed.

LMI recommends, therefore, that escalation adjustments for MYP contracts be applied retroactively to costs in all years except the first year.

MYP contracts are firm-fixed-price contracts entered into following price competition. They should not be subjected to audit for the purpose of effecting the escalation adjustment. The technique for accomplishing retroactive adjustment is essentially that described in Section V, K. The Government should specify the percentage of total contract price for the whole MYP contract quantity that will be considered allocated as costs incurred in each quarterly period throughout the contract. The escalation adjustment is then simply an application of the percentage change in the index from the date of contract applied to the estimated, predetermined dollar amount allocated to a specific period.

There is no doubt that the recommended approach is more complicated for the Government than prospective escalation adjustments of MYP contracts. The latter approach would not require the Government to prepare estimated schedules of production costs. Nevertheless, it is important to face up to the problem of changes in the rate of escalation over long periods of production lead-time; and there is no other alternative except to have audits of actual costs performed in procurement situations where audits have been traditionally avoided. It should also be noted that the existence of price competition in MYP contracts reduces the need for accuracy in the estimated schedules of production costs. Each bidder will make the adjustments he considers necessary because his production-cost schedule is not the same as the Government's

schedule, and these adjustments will be reflected in the price bid by each contractor.

While it is true that we are relying on price competition to provide a necessary measure of forbearance for the index and approach recommended, the end result is not incompatible with the intended use. The point is not that these approximations for MYP contracts would be as good as the results of close analysis, particularly of material costs and selection of better WPI indexes. The point is that they are adequate for the purpose and provide a ready solution to the need for escalation provisions in these contracts.

C O P Y

APPENDIX I

ASSISTANT SECRETARY OF DEFENSE
Washington, D. C.

Installations and Logistics

DATE: 25 August 1966
Revised: 25 October 1966

TASK ORDER SD-271-58
(TASK 67-4) (Rev.)

1. Pursuant to Paragraph C, Article I of the Department of Defense Contract No. SD-271 with the Logistics Management Institute, the Institute is requested to undertake the following task:

A. TITLE: Wage Rate and Material Price Level Adjustment Provisions in DoD Procurement

B. BACKGROUND: As new procurement methods are introduced, such as multi-year and total package contracting, involving lengthening periods of contract performance, both the Government and industry are being exposed to increasing risks in contract pricing particularly during periods of a fluctuating economy.

It is important, therefore, to review existing methods and to consider needs for revised or new techniques which can be employed to mitigate these risks.

C. SCOPE OF WORK: The objective of this task is to identify alternative ways of handling wage rate and material price level adjustments occasioned by economic fluctuations and, to determine whether new techniques of pricing or special contractual provisions are required for long term defense contracts. To accomplish this, LMI will review and analyze:

a) The experience of DoD and its contractors in the use of escalation provisions and the problems involved in the use of price indexes.

b) Pricing and price adjustment methods employed by industry during periods of fluctuation in wage rates and material price levels.

c) Comparative difficulties and benefits associated with such methods.

d) The necessity and feasibility of developing new indexes.

TASK ORDER SD-271-58
(TASK 67-4) (Rev.)

If the study indicates that the use of some formal methods of handling market changes is required, then LMI will formulate appropriate recommendations for a follow-on task to accomplish the following:

a) Development of recommended revisions to existing methods and, if necessary, new methods for handling wage rate and material price level changes.

b) Recommendation of specific revisions to DoD policy to reflect any changes made necessary by a), above.

c) Development of at least one sample price index (wage and material) compatible with policy revisions developed in a), above, for use in a specific contract to be selected for test. Further, a list of recommended additional indexes, if needed, will be developed.

2. SCHEDULE: An interim report on this work will be submitted on 15 January 1967. The task is scheduled for completion with the submission of a final report on 1 March 1967.

/S/ PAUL R. IGNATIUS

ACCEPTED /S/ BARRY J. SHILLITO

DATE October 25, 1966

ACCEPTED with the understanding that LMI may employ consultants or a subcontractor for some of the work involved, but will monitor the subcontract work, keep informed as to its progress, and coordinate it with other LMI activities to provide interchange and review of all products of the work.

APPENDIX II

ADDENDUM TO STUDY PLAN

TASK 67-4 (Revised)

The objective of this task is to identify and evaluate alternative ways of handling wage rate and material price level adjustments occasioned by economic fluctuations and to determine what new techniques of pricing or special provisions may be required for long term contracts. The first phase of this study, completed in January 1967, resulted in the identification of alternative methods available for handling wage and price level changes and indicated the desirability of examining the use of general indexes to measure these changes. The second phase of the study now being initiated is to: 1) determine the feasibility of developing indexes for wage rate and material price level changes in the airframe industry; 2) develop sample indexes, if feasible.

To accomplish this effort, LMI will specifically review and analyze the following:

1) Wage rates and material price level changes experienced by at least five airframe contractors during the past ten years.
2) The correlation of the experience of each contractor with the average experience of all.
3) The BLS or other price indexes which most clearly simulate the actual price movements experienced.
4) New indexes which will more closely simulate the actual price movements experienced.

At the conclusion of this phase, LMI will submit useful indexes for the airframe industry or a conclusion that the use of indexes in the airframe industry is not feasible. If airframe industry indexes are feasible, LMI will submit recommendations for further study as may be required: 1) to develop

specific guidance on conditions for the use of indexes in the airframe industry; and 2) to develop additional indexes for other industries.

Completion of this phase is scheduled for 1 May 1967.

HYPOTHETICAL EXAMPLE OF IMPACT OF ESCALATION ON CONTRACT COSTS

A. Assumed Data

(1) Base Cost Breakdown

Labor and labor related	$ 340
"Fixed" Overhead	115
Material	545
Total Estimated Cost	$1,000
Profit (10%)	100
Total Price (1 year)	$1,100

NOTE: This is a generalized, representative cost breakdown reflecting the fact that approximately 40 percent of overhead is indirect labor, an additional 20 percent is composed of fringe benefits, and 40 percent is composed of "fixed" costs such as rent, utilities, depreciation, etc. The indirect labor and fringes elements have been added in with direct labor.

(2) Index Data Available to Contractor

	LABOR (Aircraft Production Workers; Earnings/Hr.)		MATERIAL (WPI, Industrial Commodities)	
	Hourly Rate	Percent Change from Prior Yrs	Index	Percent Change from Prior Yr.
1960	$2.71		101.3	
1961	2.78	2.6%	100.8	(1.5%)
1962	2.87	3.2	100.8	0
1963	2.95	2.8	100.7	(0.1)
1964	3.00	1.7	101.2	0.5

B. Contractor's Projection

A conservative, but reasonable projection might be the average of the four periods of labor--2.6%; and 0.5% for material.

C. Actual Data for Following Periods

	LABOR		MATERIAL	
	Hourly Rate	Percent Change from Prior Yr.	Index	Percent Change from Prior Yr.
1965	$3.15	5.0%	102.5	1.3%
1966	3.34	6.0	104.7	2.1
1967	3.48	4.2	106.3	1.5

D. Comparison of Costs and Profits

If we assume the worst increment of change were experienced--a cumulative 6 percent per year for labor and 2.1 percent per year for material--we can compare "actual" costs with prices (cost plus 10 percent) based on no allowance for escalation and based on the conservative projection developed in B, above. This comparison is on the page following.

CUMULATIVE PERIODS	2 YEARS	4 YEARS	6 YEARS	8 YEARS	10 YEARS
1) Actual Costs	2097.01	4333.51	6722.87	9279.96	12021.28
2) Bid Prices, no escalation	2200.00	4400.00	5600.00	8800.00	11000.00
3) Bid Prices, conservative escalation	2238.45	4529.97	6876.84	9281.44	11746.31
4) Profit (or Loss)					
Actual and no escalation	4.9%	1.5%	<1.9%>	<5.5%>	<9.3%>
Actual and conservative escalation	6.7%	4.5%	2.3%	0	<2.3%>

(Note: Odd-number years are omitted on interest of brevity)

APPENDIX IV

YEAR-TO-YEAR PERCENTAGE CHANGE IN AVERAGE RATES IN FIVE AIRCRAFT COMPANIES

Production Labor

Year	Companies				
	A	B	C	D	E
1960-1	1.1%	2.8%	6.4%	1.1%	1.6%
1961-2	1.5	1.7	<1.1>	<1.4>	3.8
1962-3	2.6	<1.4>	4.3	5.7	5.9
1963-4	4.7	2.8	4.5	2.4	5.9
1964-5	4.1	<0.7>	1.3	2.6	4.9
1965-6	5.9	4.1	2.9	5.8	2.2
1966-7	5.9	4.5	4.1	5.1	6.8

Direct Engineering Labor

Year	Companies				
	A	B	C	D	E
1960-1	5.8%	5.7%	NA	6.5%	4.5%
1961-2	1.4	2.8	NA	2.6	6.9
1962-3	3.8	3.6	2.7%	3.2	7.3
1963-4	1.1	2.8	6.4	<2.9>	4.5
1964-5	9.9	0.6	0	7.9	7.6
1965-6	7.2	3.4	0.2	4.2	3.4
1966-7	2.7	5.5	3.0	6.7	8.6

ALL INDIRECT LABOR

Year	Companies				
	A	B	C	D	E
1960-1	1.8%	5.3%	NA	NA	NA
1961-2	<1.4>	4.5	NA	2.7%	NA
1962-3	4.1	<2.8>	NA	5.0	NA
1963-4	3.4	1.9	NA	5.0	NA
1964-5	7.9	2.3	NA	3.8	NA
1965-6	1.0	8.1	NA	4.6	NA
1966-7	2.0	6.1	NA	1.8	NA

FRINGE BENEFIT COSTS

Year	Companies				
	A	B	C	D	E
1960-1	NA	8.4%	14.0%	NA	14.2%
1961-2	8.6%	<23.0>	3.4	NA	19.0
1962-3	11.9	23.4	10.5	NA	8.9
1963-4	0	13.4	<6.9>	NA	<2.4>
1964-5	10.6	<0.6>	<0.5>	NA	4.6
1965-6	18.6	<2.4>	12.6	NA	37.7
1966-7	5.4	8.7	3.3	NA	5.3

APPENDIX V

YEAR-TO-YEAR PERCENTAGE CHANGE IN AVERAGE HOURLY EARNINGS OF PRODUCTION WORKERS IN SELECTED INDUSTRY CATEGORIES, (BLS)

	Aircraft Workers (incl. overtime)	Aircraft & Parts Workers (incl. overtime)	Aircraft & Parts Workers (excl. overtime)	Transportation Equipme Workers (excl. overtime)	Durable Goods Workers (excl. overtime)
1960-1	2.6	2.6	2.3	2.6	2.5
1961-2	3.2	3.6	3.0	2.6	2.5
1962-3	2.8	2.8	3.3	3.6	2.4
1963-4	1.7	2.4	2.5	2.1	2.8
1964-5	5.0	4.0	3.1	3.1	2.3
1965-6	6.0	5.4	3.6	4.0	3.4
1966-7	4.2	3.9	4.5	3.8	4.4
1960-7	28.4	27.4	24.3	23.8	22.0

APPENDIX VI

YEAR-TO-YEAR PERCENTAGE CHANGE IN AVERAGE EARNINGS

SCIENTISTS AND ENGINEERS

	LOS ALAMOS SURVEY			BLS SPECIAL SURVEY	
	Total Private Industry	Aeronautical Industry	Identical Companies	Scientists & Engineers	Technicians
1961-2	-	-	-	4.6	5.0
1962-3	-	-	5.3	2.9	5.0
1963-4	5.5	3.2	5.0	4.0	4.3
1964-5	4.0	1.1	3.8	4.5	3.5
1965-6	4.8	5.7	4.9	-	-
1966-7	4.8	4.6	5.1	-	-

Sources:

a) Los Alamos Survey: National Survey of Professional Scientific Salaries, Los Alamos Scientific Laboratory of the University of California. Data are for non-supervisory personnel with BS or MS degrees. Data are as of 1 July each year.

b) BLS Special Survey: Special survey for the Department of the Army on research activities. Data are for annual periods.

	BLS SURVEY			
	Engineer IV	Engineering Technician III	Engineering Technician IV	Production Workers, Aircraft & Parts (excl. overtime)
1961-2	2.6	-	-	3.0
1962-3	4.7	2.9	2.9	3.3
1963-4	2.7	3.7	3.3	2.5
1964-5	3.3	2.3	2.2	3.1
1965-6	3.6	2.3	3.0	3.6
1966-7	5.4	3.6	5.2	4.5

Source:

c) BLS Survey: National Survey of Professional, Administrative, Technical, and Clerical Pay. Bulletin No. 1585 is the latest issue. Data are for varying periods of 12-15 months.

APPENDIX VII

YEAR-TO-YEAR PERCENTAGE CHANGE IN AVERAGE EARNINGS --CLERICAL WORKERS

	BLS Survey: General Stenographer	BLS Survey: Typist I	Production Workers Aircraft & Parts
1961-2	-	2.7	3.0
1962-3	2.5	2.4	3.3
1963-4	2.5	2.4	2.5
1964-5	1.6	2.2	3.1
1965-6	0.6	0.9	3.6
1966-7	5.5	7.2	4.5

BLS Survey: National Survey of Professional, Administrative, Technical, and Clerical Pay; Bulletin No. 1585 is the latest issue.

APPENDIX VIII

PERCENTAGE INCREASES IN AVERAGE HOURLY EARNINGS OF PRODUCTION WORKERS IN SELECTED INDUSTRIES

	Aircraft (SIC 3721)	Cigarettes (SIC 211)	Machinery, Except Electrical (SIC 35)	Durable Goods
1947-1950	19.1	21.5	19.4	18.8
1950-1955	34.0	30.0	30.0	30.9
1955-1960	24.9	23.1	22.6	22.1
1960-1966	23.2	29.3	20.8	19.3
1947-1966	145.6	151.4	129.9	126.6

(Note: Overtime is not excluded in these calculations)

APPENDIX IX

COMPOSITE INDEX FOR AIRCRAFT RAW MATERIALS AND PURCHASED PARTS (INDEX COMPOSED OF 50% WPI 10 AND 50% WPI 11)

	WPI-10 (Metals & Metal Products)	WPI-11 (Machinery & Equipment)	Composite Index	Percent Change from Preceding Year	Industrial Commodities Percent Change from Preceding Year
1960	101.3	102.9	102.1		
1961	100.7	102.9	101.8	<0.3%>	<0.5%>
1962	100.0	102.9	101.5	<0.3>	0
1963	100.1	103.1	101.6	0.1	<0.1>
1964	102.8	103.8	103.3	1.7	0.5
1965	105.7	105.0	105.4	2.0	1.3
1966	108.3	108.2	108.3	2.8	2.1
1967	109.5	111.8	110.7	2.2	1.5

APPENDIX X

YEAR-TO-YEAR PERCENTAGE CHANGES IN FRINGE BENEFIT COSTS PER EMPLOYEE

	Employer Contributions for Social Insurance	Employer Contributions to Private Pension and Welfare Funds	Production Workers Aircraft and parts
1960-1	4.0%	7.1%	2.3%
1961-2	13.0	6.6	3.0
1962-3	8.5	5.7	3.3
1963-4	0	9.8	2.5
1964-5	1.6	9.8	3.1
1965-6	18.6	6.1	4.0

Department of Commerce, National Income and Product Accounts, tables (1.10) and (6.3 and 6.4).

COMPOSITE AIRFRAME PRICE INDEX

A. Distribution of Contract Costs

An analysis of five major airframe contracts disclosed the folio ing average percentage distribution of contract costs:

Labor	14.8%
Overhead	25.8%
Material	48.5%
Profit	10.9%

Allocation of 60 percent of overhead to labor and 40 percent to material, in accordance with the discussion in part IV D4 of the report, develops the following:

Labor	30.3%
Material	58.8%
Profit	10.9%

Allocating the profit element to the labor and material elements develops the following:

Labor	34.0%
Material	66.0%

B. Indexes

The indexes would be the same as those developed in Section V of the report for application to airframe contract cost elements: average hourly earnings (less overtime premium) for production workers in Durable Goods to be applied to the labor portion and equal weights of WPI-10 (Metals and Metal

Products) and WPI-11 (Machinery and Equipment) for the material portion.

The resulting index is a generalized index for adjusting contract or unit prices (not costs) in an airframe contract.

APPENDIX XII

GENERAL PRICE INDICATORS

A. Indexes

1. Implicit Price Index (GNP Deflator)

The IPI index is discussed in Section IV B.

2. Consumer Price Index (CPI)[1]

The CPI is a measure of changes in prices of goods and services bought by urban wage and clerical workers, and is published by the Bureau of Labor Statistics in the Department of Labor.

The importance of the CPI lies in the fact that "it is one of the most widely used measures of inflationary pressures."[2] Moreover, it has a significant driving influence on labor costs: at the end of 1966, the wages of 2.2 million workers under major collective bargaining agreements were subject to automatic escalation following changes in the CPI.[3] Its overall influence on wages is considerable because the wages of many workers not under collective bargaining agreements are affected by the wage adjustments for these workers who are under collective bargaining agreements.

The use of the CPI as an escalation index in the airframe industry is not generally accepted, although there are some instances where it has been used as a basis for price in adjustments commercial contracts within the industry. It is a

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[1] An extensive description of this index will be found in the Handbook of Methods, BLS Bulletin No. 1458, pp. 69-90.

[2] Ibid, p. 85.

[3] BLS, Major Wage Developments, 1966, "Current Wage Developments," No. 232, Supplement, 1 April 1967, p. 11.

measure of changes in the price of "market basket" goods, clothing and services which are too far removed theoretically from the costs of the airframe contractor.

3. Wholesale Price Index (WPI)

The WPI, also published by the Bureau of Labor Statistics in the Department of Commerce, as an index of material costs is discussed in Section V of this report. As an index of price, another aspect should be noted which probably accounts for the slow movement of this index. The WPI reflects sales prices, and therefore reflects changes in profit margins dictated by market conditions. The fact that suppliers sometimes absorb increases in labor costs over a period of years is not a reason for reflecting only a part of the increase in labor costs actually experienced by airframe contractors under defense contracts. In addition, the ratios of labor to materials are probably higher in major defense contracts than in the WPI commodities group since some development work is usually required in these major defense contracts.

B. Comparison of Recent Trends

Although by definition only an intellectual exercise in discovery of coincidence, it is interesting to compare the trend of these general price indicators with the index developed for aircraft based on one part labor (Durable Goods) and two parts combined WPI-10 and WPI-11 materials:

YEAR-TO-YEAR PERCENTAGE CHANGES IN SELECTED INDEXES

	GNP Deflator[1]	CPI (All Items)[2]	WPI (Industrial Commodities)[3]	Aircraft[4]
1960-1	1.3%	1.1%	0.5%	0.7%
1961-2	1.1	1.2	0	0.7
1962-3	1.3	1.2	0.1	0.9
1953-4	1.6	1.3	0.5	2.1
1964-5	1.8	1.7	1.3	2.1
1965-6	2.7	2.9	2.1	3.0
1966-7	3.0	2.8	2.5	3.0

[1] Economic Report of the President, February 1968; Table B-3 p. 212.

[2] Ibid; Table B-45, p. 261.

[3] Ibid; Table B-48, p. 264.

[4] The Aircraft index is the price index developed in Appendix XI.

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13. ABSTRACT

The study concluded that contractual provisions for price changes were preferred to contingency pricing by adding estimates of future price level changes to the contract price, for any contract where significant costs would be incurred more than one year after award.

It was recommended that the BLS average hourly earnings of production workers in Durable Goods Manufacturing be used as the index for direct and indirect labor, and for labor-related elements of overhead accounts. In the absence of a detailed examination of the Bill of Material, it was recommended that equal proportions of the BLS wholesale price index numbers for Metals and Metal Products (WPI-10) and Machinery and Equipment (WPI-11) be used as the index for material and material-like elements of overhead accounts.

Other recommendations were made concerning the specific application of contract provisions in both airframe contracts and Multi-Year Procurement.

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