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JUNE 1966

A STUDY OF FORMALLY ADVERTISED PROCUREMENTS

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PREFACE

This RAND Memorandum was prepared as part of The RAND Corporatio continuing effort to understand and to help improve the procurement methods of the U. S. Air Force. The study concentrates on formally advertised procurement -- a process which has received relatively little attention in the past. The Memorandum examines both the desir able and undesirable aspects of this method of procurement, and suggests some means for eliminating the undesirable ones.

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SUMMARY

As a method of procuring goods and services, formally advertised procurement offers a number of advantages. These include the prevention of fraud and favoritism, and the provision of equal opportunity to all prospective suppliers.

Used indiscriminately, however, the process may result in prices higher than those desirable and obtainable. This study points out how this may occur, with emphasis on the problems associated with non-competitive underlying market structures and too few bidders. More specifically, the study indicates that four or fewer bidders may be considered too few, and almost two-thirds of all contracts are let in these cases. This is done by examining over 2,300 contracts let under formal advertising procedures. A measure of price dispersion is regressed against the number of bidders, the cost of the item, and the size of the firm. It is found that the greater the number of bidders, the greater the price dispersion.

Even with too few bidders, valuable price information may be generated by use of the bidding procedure. This likelihood, in conjunction with the manifest virtues of the bidding process, leads to several suggestions that would enable the process to yield even better results than currently obtained, while avoiding the undesirable features of the process. These suggestions include a more formal method of determining which products the process should be used for, and a means whereby postbid negotiations may be utilized to take advantage of price information without committing the purchaser to what may be a too-costly contract.

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I. INTRODUCTION AND THEORY

The regulations and procedures developed to permit the free play of price competition in military procurement have evolved almost imperceptibly over the past 150 years. As early as 1809, Congress decided the only way to insure honesty and guarantee free pricing was to require the use of advertising in all Governmental purchases. In the lexicon of military procurement, advertising has meant any notice that "gives reasonable publicity to the needs of the Government, and results in the benefits of all available competition."*

Since the passage of legislation in 1860 that ultimately became Revised Statute 3709, the number of exceptions to the formal advertising requirement has increased. Nevertheless, Congressional support for the advertising process has remained firm. Congress has continually reiterated the purposes of this process: to prevent fraud and favoritism; to afford equal opportunity to all bidders; and to secure to the Government the advantages of bona fide competition.

The advertising process is now a well-defined and formal procedure, fully described in Section 2-101 of the Armed Services Procurement Regulation (ASPR). It includes the following steps:

1. Preparation of the invitation for bids, accurately describing the requirements of the Government, but avoiding unnecessarily restrictive specifications or requirements that might unduly limit the number of bidders.

2. Publicizing the invitation for bids through distribution to prospective bidders, posting in public places, and other means that may be appropriate, in sufficient time to enable prospective bidders to prepare and submit bids before the time set for public opening.

3. Submission of bids by prospective contractors.

4. After the bids are publicly opened, awarding the contract to that responsible bidder whose bid, conforming to the invitation for bids, will be most advantageous to the Government, price and other factors considered.

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*3 Comp. Gen. 862-864 (1924).

This process is the preferred method of procurement, and the ASPR further requires it be used "whenever such a method is feasible and practicable under existing circumstances, even though such conditions and circumstances would otherwise satisfy the requirements for negotiated procurement." The ASPR also requires that "procurement shall be made by soliciting bids from all qualified sources of supplies or services deemed necessary by the contracting officer to assure full and free competition consistent with the procurement. . ."*

Despite this proviso, formally advertised procurement is employed relatively little. In the fiscal years 1962-1964, it accounted for only 3.2 percent of all Air Force expenditures.**

Study of advertised procurement is warranted by two considerations. First, in absolute terms, considerable procurement funds are spent via formal advertising--in fiscal years 1962-1964, just short of one billion dollars. Second, there has been, and continues to be, substantial emphasis by policy-makers on the desirability of expanding the role of formal advertising at the expense of alternative methods of contractor selection.***

The principal concern of this study is whether formally advertised procurement indeed yields the benefits of competition, prevention of fraud and favoritism, and equal opportunity afforded to prospective contractors.

It should be observed that the last two factors form the chief rationale for the formally advertised procurement process, since price competition may be obtained by other means; namely, by negotiated price rivalry. Negotiated price rivalry resembles formally advertised procurement in that contractors are selected on the basis of price. It differs, however, in that it is left to the discretion of the

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*ASPR 2-101.

**G. R. Hall and R. E. Johnson, A Review of Air Force Procurement, 1962-1964, The RAND Corporation, RM-4500-PR, May 1965, p. 10.

***See, e.g., U. S. Congress, Joint Economic Committee, Background Material on Economic Aspects of Military Procurement and Supply, Materials Prepared for the Subcommittee on Defense Procurement, February 16, 1960, pp. 83-89.

procurement officer which firms shall be solicited for bids, and which bids shall be even considered. Moreover, no bid need be considered final under this method.

Similarly, the other methods of contractor selection, sole-source negotiation, and design rivalry allow procurement officers considerable latitude in selecting firms to be considered and chosen; the resultant dangers are clear. Even if there were no conscious favoritism or fraud unconscious bias or poor judgment could result in less-qualified firms being selected. This could result in inferior products, excessive prices, or both. The formal procedures of advertised bidding, by contrast, are designed so all prospective bidders can be informed. Also, the actual award is largely beyond the control of the procurement personnel, depending as it does on public opening of the bids and selection of the low bidder. As a result, it may be concluded with considerable confidence that formally advertised procurement does offer an effective safeguard against price and contractor selection abuses by procurement personnel.

Similarly, the requirement that all prospective bidders be informed, coupled with the mandate to award the contract solely on the basis of price, acts to insure that all prospective contractors are afforded equal opportunity.

What this Memorandum attempts to demonstrate, then, is that formal advertising may not be able to guarantee the third of its three goals--bona fide competitive results. To examine this question, it is first necessary to discuss what is meant by "bona fide competitive results."

We may restrict ourselves here to the subject of prices, leaving allocative and efficiency aspects aside. The relevant factor of the competitive result is that as long-run equilibrium in a market is approached, price is equated to the marginal cost of an efficient producer. Since no firm will continue to operate in the long run unless

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*For a discussion of the dangers of favoritism, see E. B. Roberts, "How the U. S. Buys Research," International Science and Technology, No. 33, September 1964.

it is able to cover long-run marginal cost, or the cost of producing the last item, price is at an effective minimum. This minimum price is also a reasonable price from the point of view of sellers, since it is sufficient to hold them in the industry.

The competitive result also assures that in the short run, price will be equated with short-run marginal cost. Inefficient producers may still be operating in the short run, however, since they are driven out of the industry only over time. We will return to the question of the short run below.

Notice that the condition of price being equal to marginal cost describes a performance characteristic. It does not necessarily reflect on the market structure underlying the performance. The equality of price and marginal cost is considered a "competitive" result, because when a market is competitive on the selling side, the equality follows. Under certain conditions, e.g., monopsony, the same result might be obtained even when the seller's side of the market is definitely noncompetitive.

Since the buyer is essentially passive when procurement is obtained by formal advertising, the attainment of competitive results depends crucially on the conditions prevailing on the sellers' side of the market. Thus, performance is unavoidably dependent on market structure. In this connection, it is instructive to note what the Department of Defense considers to be a competitive structure.

According to ASPR 3-807.1, price competition is considered to exist if there are at least two sellers who can satisfy the purchaser's requirements, and whose price offers may be regarded as independent. In other words, a market may be considered competitive if it is free of both pure monopoly and collusive action.

Pure monopoly is virtually nonexistent in the U. S. economy, and collusive pricing is difficult to prove (with a few notable exceptions). As a result, market-structure considerations have been negligible in decisions on whether to employ formally advertised procurement. Rather, the prime consideration has been the nature of the product to be procured. The most important factor has been whether the product could be

specified in sufficient detail so as to obtain two or more bids that are commensurate in terms of final product.*

If the criteria for competition used by the Air Force were satisfactory, this would be an acceptable procedure. Unfortunately, these criteria are inadequate in the light of economic theory.

The conditions for competition, which guarantee a price equal to the marginal cost of an efficient producer, are well-known from economic theory. In brief, they are:

1. Sufficient number of sellers such that no single seller may influence price.

2. Homogeneous product.

3. Factor mobility.

4. Perfect information in regard to production processes, technology, competitors' actions, etc.

Needless to say, these conditions are stringent, and cannot be expected to prevail completely in any sector of the economy. When we speak of competition in a practical sense, therefore, we must refer to an approximation of these conditions, and hope for an approximation of the competitive result.

While it is impossible to say exactly what number of sellers is sufficient, it has been generally concluded from both theoretical and practical considerations that two, three, four, or even five sellers will give oligopolistic price results--that is, prices greater than marginal cost. Hence, most economists would argue that Air Force criteria for competition do not satisfy Condition 1.

The consequence, then, of determining contractor selection on the basis of product in conjunction with the fact that from the economist's point of view, Condition 1 need not be satisfied, is that formally advertised procurement is utilized for several different market structures. What, then, is the likelihood of achieving the competitive price result?

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*See Sec. III for a discussion of a variant of advertising that is used when products are not homogeneous.

Suppose advertising were employed in a perfectly competitive market in equilibrium. That is, suppose the market has made all adjustments to demand and supply conditions, and these conditions remain unchanged. Several things must then be true. First, price must be equal to marginal cost. This is true because any firm selling at a higher price would lose all its customers. Moreover, any inefficient firm would be driven out of the market by its more efficient competitors. Finally, by virtue of perfect information, each firm would be aware that it could sell its product only by pricing at marginal cost.

In such a market, advertising would guarantee the competitive result, because of the structural conditions of the market. Only efficient producers would be present to bid. They would bid at marginal cost both because they ordinarily price at marginal cost, and because they are aware this is what their competitors will do.

Suppose, however, that advertising takes place in a perfect market that is not in long-run equilibrium. In this case, inefficient producers will still be present in the market. Even if we assume that all producers bid at their own marginal cost, the competitive result will be obtained only if the list of bidders includes an efficient producer. In other words, formally advertised procurement will result in theoretically optimum prices in such a market only if great care is taken to include all possible bidders. Otherwise, it may easily happen that the final price will be needlessly high.

Suppose, now, that we drop the assumption of a perfectly competitive market, and consider what is likely to occur when formal advertising is employed in an imperfect market.

We make a generic characterization of such a market by considering the case in which sellers are so few that each may exert a significant effect on price.* In addition, we drop the assumption of a free flow of information. Each seller then faces a downward-sloping demand curve and considerable uncertainty regarding other sellers' demand and costs. For the moment, we will retain the assumption of independent pricing.

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*This characterization covers both oligopoly and monopolistic competition.

Now, suppose that formally advertised procurement is employed in such a market. Since profit-maximizing firms equate marginal cost and marginal revenue, and in such a market marginal revenue is less than price, it must follow that under the assumption of profit maximization, price will be greater than marginal cost. That is, the competitive result will not be obtained.

Several other distorting effects may also enter. Given the lack of good information, firms are likely to be uncertain over both their own and their rivals' cost schedules. The first factor is liable to be reflected in bids adjusted above marginal revenue by an amount calculated to compensate for the risk inherent in own-cost uncertainty. The second factor may lead to similar results for a different reason. Given the uncertainty about rivals' costs, a firm will be unable to assume that its profit-maximizing price is the maximum price that will at the same time, guarantee the winning of the bid.

This requires some detailed explanation. The structure of the formally advertised process implies a peculiar form of demand curve. The amount demanded is given, and will be taken at no matter what price so long as that price is the lowest bid. If a firm knew it were going to be the only bidder, there would be no upper limit to its profit-maximizing price. But, of course, no firm may safely assume it will be sole bidder; if it is to win the contract, its profit-maximizing price must consequently be some increment less than the price of the next lowest bidder. If we consider the Air Force has a certain expectation of price when it formulates its demand, then we may consider an expected demand curve. So long as bidders attempt to take advantage of the possibility that their rivals are more costly producers than themselves, by bidding higher than they would if they assumed other equal-cost producers (a situation we will term "gaming"), price is likely to be even higher than it would be as a simple result of imperfection in the market.

Thus, we see that in the imperfect real world, even with independent pricing, large deviations from the competitive result are possible. Real-world markets are often imperfect also in terms of the number of sellers, and in information. This implies that when no concern is

given to markets, but only to products, in the choice of advertised procurement, then deviations from the competitive result must be expected.

Furthermore, the assumption of independent pricing may no longer hold. In many markets in the U. S. economy, we may expect to encounter forms of price leadership, traditional pricing, or collusion (explicit or implicit). We will characterize these forms as belonging to a general class of price policies that we will term "pattern pricing."

When pattern pricing exists, there are liable to be further distortions of results because it prevents bids from falling below some artificial level.

The above analysis leads to the conclusion that selecting the formal advertising process principally on the basis of product is liable to fail in the aim of achieving competitive results. Section II presents data on formally advertised contracts that allow us to test this conclusion.

II. THE DATA AND EMPIRICAL RESULTS

The advertising process having become highly formalized and systematized, data on the formal bid process are abundantly available to the interested public. Included in the process is the public opening and recording of the essential elements of the bids. These elements include quality, delivery, price information, and data on the extent of the solicitation and the sizes of the firms bidding. All this information is recorded on an abstract of bids; the data presented in the following pages are drawn from a sample of these bid abstracts.

The major sample consists of copies of all the abstracts compiled at Headquarters, Aeronautical Systems Division for the fiscal years 1962-1964, and those compiled at Defense Electronic Supply Center for fiscal year 1964. After the cancellations, no-bids, and no-award bids had been removed, the sample included 2,355 sets of bid information. A set of information includes the number of the IFB (Invitation for Bid) the number of bids invited, the number received, all prices bid, and whether the competition included bids from large or small businesses, or both.* The ASD sample of bids included a wide range of aircraft accessory items, as well as some services and development items. The accessory items included such things as aircraft instruments, radios and radars, tires and wheels, and belting. The DESC data mainly represent common electrical and electronic components the Center purchased for use by all the Armed Services.**

In Table 1, contracts are classified according to the number of bidders, with total dollar amounts listed in each bidder category.

It may be observed from Table 1 that nearly one-third of all expenditures went for items on which there were only one or two bidders. Almost two-thirds went for items on which there were four or fewer bidders.

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*Small business, as defined in ASPR 1-107, includes firms that have fewer than 500 employees and are a small fraction of the industry.

**Although purchased for all services, the procedure used is identical to that for strictly Air Force expenditure.

From almost any definition of "many sellers," it may be concluded that both the majority of contracts let, and dollars expended, were associated either with oligopolistic markets, or with an incomplete potential-bidder survey.*

Table 1

CONTRACT SAMPLE BY NUMBER OF BIDDERS

No. of Bidders	No. of Contracts Awarded	% of Total	Cumulative %	Value of Contracts Awarded	% of Total	Cumulative %
1	147	6	6	14,706,153	8	8
2	501	22	28	46,272,187	24	32
3	369	16	44	25,683,029	13	45
4	287	12	56	32,799,552	17	62
5	210	9	65	13,044,727	7	69
6	142	6	72	8,630,638	4	73
7	142	6	77	6,711,771	3	76
8	85	4	81	3,258,171	2	78
9	99	4	85	2,147,144	1	79
10	58	3	88	1,528,826	0.8	79.8
11	62	3	91	7,186,936	4	83.8
12	52	2	93	478,504	0.2	84
13	30	1	94	2,386,797	1	85
14	48	2	96	21,357,066	11	96
15	36	2	98	246,400	0.1	96.1
16	14	0.6	98.6	1,781,678	0.9	97
17	14	0.6	99.2	92,768	0.05	97.05
18	13	0.6	99.8	3,500,331	2	99.05
Total	2,309[a]	100[b]		191,812,678	100[b]	

[a]The 2,309 contracts represent 2,355 items. Many contracts are for more than one item.

[b]Details do not add exactly, because of rounding errors.

Prima facie, then, the formal advertising procurement process is suspect because it so often takes place in a setting that lacks sufficient conditions for the competitive result. Nevertheless, it

*We were not able to determine from more than half the abstracts the number of bids solicited, so we were unable to use this as a measure of bidder survey. In any event, only where bidders respond is it clear that they are in the industry.

remains to be answered whether nonminimum prices are being paid--and unfortunately, a direct answer to this question is not possible. Such an answer requires a knowledge of what the competitive result would have been for the actual items procured, and this knowledge is, of course, not generally available to the investigator. At best, we may hope for some indications of the truth.

This study attempts to use the available data to cast some light on the problem indirectly, by investigating the dispersion of bids on individual items procured by formal advertising. The dispersion measure adopted is the normalized standard deviation (NSD) for each separate item on which there is bid information. Letting $j = 1, \ldots, n$ represent the individual items procured, and $i = 1, \ldots, m$ be the individual bidders, the measure may be written:

$$NSD_j = \sqrt{\frac{i}{m}\sum_i\left(\frac{x_{ij}}{x_j} - 1\right)^2} = \sqrt{\frac{1}{x_j^2 m}\sum_i (x_{ij}-x_j)^2} = \sqrt{\frac{S_j^2}{x_j^2}} = \frac{S_j}{x_j}$$

where x_{ij} = the i^{th} bid on item j, $x_j = \frac{1}{m}\sum_{i=1}^{m} x_{ij}$, and S_j is the standard deviation of the bids on item j.

In itself, the dispersion of bids is an uncertain indicator of market structure. This is easily seen when we examine the expected relative size of price dispersion under various market conditions.

With perfect competition (with, in addition, zero transportation costs and perfect information), the expected dispersion of prices in equilibrium would be zero. However, the absence of price variation cannot be taken to indicate perfect competition, even if one were willing to make the assumptions appropriate to this perfection. This is so because price collusion in an oligopolistic market could also result in no price variation. In fact, however, this confusion is more apparent than real. Almost any information about the market, taken in conjunction with a zero dispersion of prices, would allow the investigator to distinguish which causal situation is relevant.

For example, price collusion is difficult with more than a handful of firms, while perfect competition must imply a great number of competitors.

The uncertainty is more easily seen in the case of a nonzero variation in prices. Removal of any of the very stringent requirements for perfect competition in equilibrium implies that there will be some variation among firms in price quotations. Since the real world does impose transportation costs, imperfect information and changing costs and tastes make a competitive zero variation of prices virtually impossible.* Somewhat more esoterically, it may be observed that the theory of competition discusses a final price as equal to marginal cost. Asking price is indeterminate. Since there is no rebidding in formal advertised procurement, quoted prices are, in effect, asking prices. Consequently, there is even less reason to expect identical bids even under competitive conditions.

Since price collusion leading to identical prices is but one form of pattern pricing, and since market imperfection may generally be expected to lead to price deviation, nonzero price variation may not be used to make definitive statements concerning the underlying structure of a market.

Despite the ambiguity of the meaning of the measure of dispersion, however, the measure imparts a good deal of useful information.

First, as will be discussed below, the absolute size of the measure has implications of its own. Further, it will be demonstrated that by attempting to explain the variation of the dispersion measure, we can obtain some indication of whether the fewness of bidders does affect the likelihood of achieving the competitive result.

The explanatory variables used here were taken from the abstract of bid information. One explanatory variable examined was the number of bidders; this is a measure of the degree of competition in a market.

The number of bidders, however, does not necessarily indicate the presence of pattern pricing. One factor that partially takes this

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*See Vernon A. Mund, "Identical Bid Prices," Journal of Political Economy, Vol. 68, April 1960, pp. 150-169.

into account is the concentration of output among firms. Pattern pricing is likely when firms are large rather than small. To take account of this, a second variable selected here was the nature of the mix of firms bidding: whether the mix was comprised of small or large business, or a combination of both.

Because it is customarily assumed that the more complex an item is, the greater are the cost uncertainties (and hence the greater the expected price dispersion), the unit cost of items was examined as a proxy for complexity.*

The relationship tested, then, included three independent variables:** (1) number of bidders; (2) unit price of items; and (3) size-mix of firms bidding.

Since there was no a priori restriction on the form of the function to be tested in a regression, various forms were tested. These differed from one another according to whether some, or all, of the variables were taken in log form. The final form was selected on the basis of greatest explanatory power; it was found to be:

$$e^{NSD_j} = e^{(\alpha_1 S_j + \alpha_2 L_j + \alpha_3 M_j)} B_j^{\alpha_4} C_j^{\alpha_5} e^{\epsilon_j}$$

or in log form,

$$NSD_j = \alpha_1 S_j + \alpha_2 L_j + \alpha_3 M_j + \alpha_4 \ln B_j + \alpha_5 \ln C_j + \epsilon_j,$$

where NSD_i is the normalized standard deviation of item i; B_i is the number of bidders on item i; C_i is the cost of item i; and S_i, L_i, and M_i are dummy variables with each taken as equal to zero or unity depending on whether the firms bidding on item i are all small business (S), large business (L), or a combination of both (M).

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*A regression of unit costs on number of bidders gave a virtually zero correlation.

**Ideally, a fourth variable which reflected the nature of the item procured should have been included. The insufficiency of product description on the abstract, however, made this impossible.

The actual regression results were:

$$NSD_i = \underset{(.09299)}{.12446}\, S_i + \underset{(.06118)}{.08184}\, L_i - \underset{(.02609)}{.03485}\, M_i + \underset{(.00762)}{.11320}\, B_i + \underset{(.00188)}{.00162}\, \ln C_i$$

$$t = 1.34 \qquad 1.34 \qquad 1.34 \qquad 14.85 \qquad .86$$

$$R = .363$$

The figures in parentheses are the standard deviations of the estimates, while below these are the t values of the estimates. The R value of .36, while low, is significant at the 5% level.

Before going into the details of the regression results, it is worth noting that the average value of NSD is .26. On the definition of this measure, this means that the standard deviation of a dollar bid is, on average, 26 cents.

Turning to the results of the regression, the t values indicate that of the explanatory variables only the number of bidders is statistically significant. The sign of the regression coefficient of the number of bidders is positive, which means that the more bidders there are on an item, the greater the dispersion of bid prices.

While the sign of the cost variable is positive, and thus consistent with the hypothesis, the variable is not significant at the 10% level.

The size variables are also not significant at the 90% level of confidence, although the relative sizes of the coefficients are consistent with the hypothesis. That is, large business displays less price variation than small business.

Before turning to the principal results of the empirical analysis, it is of some interest to match the regression results with two conceptions of underlying market structure.

One hypothesis is that markets in which items are procured demonstrate different price behavior by firms from what would be expected in competitive markets. Namely, it could then be argued that a positive correlation between the number of bidders, and the measure of dispersion, result from the greater likelihood of pattern pricing

when there are fewer bidders. This pattern pricing could be of several forms -- price leadership or collusion, for example.

Turning to the effect of business size, an explanation in terms of a noncompetitive hypothesis is somewhat more tenuous. Here, one might argue that pattern pricing is less likely in a market characterized by small sellers, rather than large. This could account for the lower measure of dispersion found for large business. The fact that mixed business has an even lower coefficient might be accounted for by the likelihood that small firms in the same market as large firms would tend to be price followers. This, in conjunction with a likelihood of pattern pricing among the large firms, would perhaps account for the lower coefficient of variation.

Finally, concerning the lack of correlation between unit costs and bid variation, it will be remembered that unit cost was intended to serve as a proxy for complexity. Several comments are in order. It may be, first, that unit cost does not serve this function, or that complexity is not mirrored in uncertainty. Alternatively, it is possible that there is simply a compensating effect--namely, that the more expensive an item is, the more likely is some form of pattern pricing.

Repeating that such explanations are speculative at best, it is of some interest to try to explain the results within the context of competitive behavior. The observed results could be taken as consistent with competitive behavior if one were willing to assume first that in a state of disequilibrium, additional bidders are firms whose cost curves are at greater variance with industry average. Unfortunately, the size-effects must be left as an anomaly under this hypothesis.

While the authors are reluctant at best to defend the competitive hypothesis as consistent with the observations, they also find that it cannot be discarded with certainty.

Even though the two hypotheses cannot be distinguished in this manner, the principal conclusions emerging from the empirical analysis spare us the need.

Two major observations are relevant for our purposes. First, the fewer the bidders, the smaller is the price variation. Since the Air Force is interested in the expected minimum price for each item, it must follow that the more price dispersion that can be obtained, the more likely is a lower procurement price. We are led to conclude that the current practice of accepting the results of a procurement when there are only a few bidders makes it likely that prices paid for products procured by formal advertising are often above the best price obtainable.

So far, the meaning of "few bidders" has been left purposefully vague. For policy conclusions, however, it is necessary to be more precise. To this purpose, the following test was performed: the data were broken down into fourteen groups, with each group but the last homogeneous as to number of bidders. The last group consisted of contracts with more than fourteen bidders. For each group, an average of the normalized standard deviations was computed. The results are presented in Table 2.

Table 2

AVERAGE NORMALIZED STANDARD DEVIATIONS BY BID CLASS

No. of Bidders per Contract	No. of Contracts	Average Normalized Standard Deviation
2	486	0.12847
3	383	0.22714
4	302	0.27519
5	223	0.29560
6	146	0.32196
7	146	0.34274
8	100	0.28913
9	124	0.32659
10	68	0.30920
11	82	0.29035
12	71	0.39057
13	31	0.35899
14	84	0.34818
More than 14	107	0.36000

The object was to find out where there ceases to be a significant difference between the mean of a bidder group, and the mean of all items having a greater number of bidders.

By virtue of the Central Limit Theorem, each group is distributed approximately normal. This allows us to form a t statistic to test for a difference of two means. For example, consider the group of contracts with two bidders. We wish to know whether we can reject the hypothesis that the mean of the two-bidder group, μ_2, is equal to the mean of a group composed of all items with three or more bidders, μ_{3+}. The statistic,

$$t_2 = \frac{\mu_{3+} - \mu_2}{\sqrt{\frac{\sigma_2^2}{n_2} + \frac{\sigma_{3+}^2}{n_{3+}}}},$$

where σ_i^2 is the variance of group i, and n_i is the number of items in group i, is distributed according to Student's t. We calculated this statistic for all groups with six or fewer bidders. These statistics are presented in Table 3.

Table 3

STUDENT'S t

Test	t_{HO}
$\mu_6 = \mu_{7+}$	0.54
$\mu_5 = \mu_{6+}$	2.22
$\mu_4 = \mu_{5+}$	3.72
$\mu_3 = \mu_{4+}$	3.82
$\mu_2 = \mu_{3+}$	22.75

$t_{99} = 2.33$

Unfortunately, repeated tests of this sort are not independent. That is, the confidence level of the <u>set</u> of tests is less than that

selected for any single test. By choosing a high level of significance for each test, however, we may obtain a good indication of the truth. Therefore, a 99% level of confidence was chosen.

It may be seen from Table 3 that the hypothesis of equal means cannot be rejected for the group of six bidders, or the group of five bidders. It can be rejected for the groups of four, three, or two bidders. These results are internally consistent, in that rejection of the hypothesis for any group should imply the rejection for any group of fewer bidders.

The results of this test support the conclusion that "few bidders" may be taken to mean four or fewer bidders. That is, this study's criticisms of formally advertised procurement should be taken to apply especially when fewer than five bids are received on an item. In this connection, it should be recalled that the majority of contracts let via formally advertised procurement fall into this category.

Leaving this point, let us turn to the second major observation of the study: the high value of the dispersion measure, coupled with our inability to account for more than 13% of it.

The average variation of .26 occurs on items that may be considered to be better specified than the typical item procured, by virtue of the fact that the advertising process was used. It seems likely that variation would be even higher on the type of item procured by negotiation. This suggests the danger in sole-source negotiation, with reliance on cost estimates as the basis of target cost.

It seems likely that most of the variation in the dependent variable is due to three factors, none of which could be captured satisfactorily. First, there are the true cost differentials represented by various firms in the market. Second, there is the possibility of gaming -- taking a chance on winning a contract with a high bid. Finally, many of the items are noncatalog, implying that they may never have been produced before in accordance with the specifications given by the Air Force; consequently, there may be considerable cost uncertainty, affecting different firms in varying degrees, and with varying effects on prices depending on individual risk preferences.

Our proxy for complexity picks this up only if normalized cost uncertainty is correlated with unit cost -- a proposition that has never been established.

Since none of these three factors is subject to real control by the Air Force, it seems likely that price uncertainties and variations may have to be taken as an immutable fact of life.

III. A VARIANT OF FORMAL ADVERTISING

It was mentioned above there exists a variant method of advertised procurement employed when products are difficult to specify exactly. This method is an amalgam of formally advertised competition and design rivalry; it is of interest to examine the method in the manner employed for normal advertised procurement.

This method, designated as two-step formal advertising, is designed for situations where negotiations would otherwise be necessary because specification inadequacies preclude straight formal advertising. The flexibility of this method permits the consideration of producers who might otherwise be eliminated from the competitive base. It is generally used in the procurement of products requiring technical proposals, and is conducted in two phases.

The first consists of the request, submission, evaluation, and if necessary, discussion of a technical proposal, without pricing, to determine the acceptability of the product offered. The technical evaluation includes, among other things, consideration of the engineering approach, manufacturing processes, test requirements, etc. All technical requirements are resolved in this phase.

The second phase, the formally advertised price competition, is limited to those bidders who submitted acceptable technical proposals. All bidders are notified concerning who is technically qualified, and who is not.

This method of procurement is to be used in preference to negotiation when all the following conditions are present, unless other factors preclude the use of formal advertising:

1. Specifications are not sufficiently definite or complete, or are too restrictive to permit free competition without a technical evaluation.

2. Definite criteria exist for evaluating the technical proposals, such as design, performance, manufacturing, and test requirements.

3. More than one technically qualified source is expected to be available both initially and after the technical evaluation.

4. Sufficient procurement time will be available for both phases of the procedure.

5. A firm fixed price contract will result.

Two-step advertising suffers not only from the defects associated with normal advertised procurement, but also from two additional difficulties.

First, because the items thus procured are complex in function and design, change orders are frequently issued in regard to them. These changes must be costed, of course, but it is often impossible to do so with any accuracy because of the original pricing method. That is, if a subsection of a system is to be replaced by an alternative subsection, it is necessary to ascertain the original component of cost represented by that subsection. Naturally, since no data derived from negotiations exist to allow this, there is no effective limit on the final price paid for the item.

A second difficulty originates from the fact contractors are selected on the basis of price on <u>different</u> items. Needless to say, it must often happen that a far inferior product is chosen for only a few dollars less than a far better one would have cost. Related to this is another difficulty. Contractors specify their own product with the knowledge that it must satisfy certain requirements, and with the knowledge eventual selection is on the basis of price. As a result, they tend to specify a product that is only marginally satisfactory. This allows the product to be considered, and increases the probability of final selection on the basis of price. Again, however, it often implies products that are inferior, or with very little margin for error. Also, of course, it increases the likelihood of future change orders with their related problems.

In addition to the data on normally advertised procurement described in Sec. II, eighty-six two-step advertising abstracts were obtained for this study. The same regression was performed on these data as that performed on the data in Sec. II. The results of that regression are as follows:

$$NSD_i = \underset{(22.504)}{.40508\ S_i} + \underset{(19.195)}{.32631\ L_i} + \underset{(9.1350)}{.16443\ M_i} + \underset{(.05584)}{.11597\ \ln B_i} - \underset{(.01408)}{.01462\ \ln C_i}$$

$t = .018 \qquad .017 \qquad .018 \qquad 2.08 \qquad -1.04$

$R = .348$

The results are nearly indistinguishable from those of the earlier regression. One important difference in the data is that the average value of the dispersion measure for two-step advertising was .32, as opposed to the figure of .26 obtained for the main body of data. This result is to be expected, since products are generally less homogeneous in two-step advertising. All the principal conclusions discussed earlier, however, hold for the two-step variation.

While the conclusions reached in Sec. II may be considered to hold for the two-step case, one point is of some interest. Although the cost coefficient is still not significant, it is negative, whereas it was positive for the normal-advertising case. It was argued there that we would expect a positive coefficient as a result of cost being a proxy for complexity, and complexity being mirrored in uncertainty. One explanation advanced for the virtually zero value for the coefficient was the possibility of greater collusion with a higher price. Yet, for two-step advertising, the coefficient is even lower, while there would appear to be less possibility for collusion since products are markedly different. This result leads us to put somewhat more faith in the alternative explanation that complexity is <u>not necessarily</u> correlated with cost uncertainty.

IV. CONCLUSIONS AND SUGGESTIONS

Two conclusions emerge from this study. First, advertising can be no better than the market environment in which it operates, and hence is no guarantor of the competitive result. Therefore, its use, irrespective of the nature of the market in which an item is produced and sold, may be unwise. Second, the current practice of considering only a few bidders as sufficient is liable to lead to prices above the competitive level, no matter what the a priori feeling may be about the degree of competition in the markets concerned.

It was argued in Sec. I that the prevention of fraud and favoritism, and the affording of equal opportunities, are important goals that advertising is effective in obtaining. Moreover, advertising does present an efficient way to obtain information on the general range of market prices. The process itself, then, does incorporate valuable features.

This study has indicated, however, that when there are four or fewer bidders, using formal advertising may entail a monetary cost out of proportion to the gain. Since the process does, in fact, bring with it desirable safety features and valuable market information, it seems desirable not to discard it. Rather, it would be wise to incorporate some modifications that would preserve the redeeming qualities of the process while preventing its misuse.

To this end, the study has three suggestions to make. First, formal rules should be set out for deciding which products are eligible for formally advertised procurement as currently constituted. These rules could specify some minimum number of producers of the product and/or include a listing of types of products that previous experience has shown to attract a satisfactory number of bidders.

Second, there should be a revision in the existing provisions for cancellation of bids when there is only one bidder. There is clearly a high probability of unsatisfactory results when only a single response is received. However, alternative market information may exist from previous purchases or catalog prices. Moreover, the single bid may conceivably be acceptable. It is, therefore, suggested that

cancellation depend on the discretion of the contracting officer, with a recommendation that his decision be based on whether or not supplementary information exists.

Finally, for the cases of two, three, or four bidders, there should exist some method by which contracting officers might more easily use the price information generated by the bidding without being committed to the results of the bid opening. As currently written, ASPR 3-215, which provides for negotiation after advertising, requires a secretarial finding that the bids were unreasonable, or were not independently reached in open competition. The authors suggest that postbid negotiation be facilitated. One possibility would be to make negotiation mandatory for four or fewer bidders. A less costly method would be to allow the contracting officer to decide when postbid negotiation should be used. The process used might be one of making all bids public, and calling for new offers. In addition to its other effects, such a practice would greatly reduce the danger of "gaming."

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10. ABSTRACT

An examination of advertised bidding in military procurement. The data are based on 2300 contracts let under formal advertised procedures. The authors discuss the advantages, which include prevention of fraud and favoritism and the provision of equal opportunity for all prospective suppliers, and the disadvantages, which include higher prices and too few bidders. Several modifications are suggested to improve the process.

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