

Economic Framework for Understanding Collusive Market Behavior: Assessment in Support of VDOT's Antitrust Monitoring and Detection Unit

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An economic framework for understanding collusive market behavior is presented in this paper. It was prepared to provide key background information to the Virginia Department of Transportation in support of creating an Antitrust Monitoring and Detection Unit within the Construction Division. Although the scope of this paper is confined to economic background and general proposals for hindering collusive behavior in construction markets, an overview of antitrust case law is presented in a paper in this Record by Allen and Culkin, *Legal Aspects of Competitive Construction Market Behavior*. The purpose of this paper is to provide a primer on the nature of collusive markets; thus, this paper is directed toward highway construction program managers, rather than professional economists. In addition, the economic and legal reviews serve as necessary background for undertaking an empirical study of highway construction markets in Virginia. The first section of this paper defines market failure, discusses the origin of collusion, and reviews 10 key market characteristics that affect the likelihood of collusion. The second section surveys various methods that have been proposed for deterring collusive practices in highway construction.

In the fall of 1986, the Commonwealth of Virginia enacted legislation creating a Transportation Trust Fund, an intermodal transportation policy board, and greatly enhanced revenue for airports, seaports, transit, rail, and highways. As a result of the legislation, Virginia embarked on the largest construction program in its history—an average of \$1 billion/yr for 10 years. The large number of highway projects Virginia has planned for the next decade will pressure the construction industry to expand rapidly. As part of an effort to develop and implement effective methods to ensure competitive bidding, the Virginia Department of Transportation (VDOT) has established a small unit within the Construction Division dedicated solely to bid monitoring and collusion detection. In addition, the Virginia Transportation Research Council (VTRC) has undertaken a program of applied research in support of that effort.

PURPOSE AND SCOPE

This paper is focused on a portion of the early work performed as part of VTRC's applied research program. In particular,

an economic framework for understanding collusive market behavior is presented. Key background information in support of creating an Antitrust Monitoring and Protection Unit within the VDOT is provided, and the paper is intended to serve as a primer on the nature of collusive markets. Its audience is, therefore, construction program managers rather than professional economists. The concepts of market failure and contestable markets are presented, the origin of collusion is discussed, and 10 key market characteristics that bear on the likelihood of collusion are reviewed. In the second section of this paper, various methods that have been proposed for deterring collusive practices in highway construction are surveyed. Allen and Culkin, in a separate paper in this Record, *Legal Aspects of Competitive Market Behavior*, present an overview of antitrust case law as it applies to highway construction markets.

ECONOMIC FACTORS AFFECTING COLLUSIVE MARKET BEHAVIOR

The Marketplace and Contestable Markets

When defining a market, one delineates all parameters that compose the market: the buyers, the sellers, the products sold, the geographic limits of competition, the prices, and so on. Defining the market is often critical in antitrust cases because the definition tells the court who is and who is not in competition. In the strictest sense, a market is deemed perfectly competitive when it exhibits the following characteristics: (a) many firms, (b) a homogeneous product, (c) free entry to and exit from the market, (d) perfect knowledge by participants in the market, and (e) independence in the decisions the firms make.

When the conditions for a perfectly competitive market are disrupted, different market types arise, most notably monopolies and oligopolies (1). In the case of a pure monopoly, consumers lose the choices presented by a large number of brands of the commodity in question. Instead, the market has one producer of the good, with barriers to entry that keep other competitors from entering the market. Prices tend to be high and production levels low. In an oligopoly, a similar situation arises because there are only a few sellers. These sellers recognize that they produce substitutable goods and

that they, as well as their rivals, can influence the price of the goods (1). An oligopolist recognizes this "mutual interdependence" among firms and that the maximization of profit depends not only on his or her firm's behavior but on other firms' behavior as well.

In both monopolies and oligopolies, the sellers recognize that their individual output decisions affect price and that they each have some degree of market power that depends not on absolute firm size but rather on the size of a firm relative to the market (1).

Markets need not adhere to an idealized, perfectly competitive schematic to ensure desirable outcomes. The theory of perfectly contestable markets proposes what many view as a more realistic benchmark for assessing the degree to which markets are effectively competitive (2). Although a detailed discussion of the theory is beyond the scope of this paper, elements can be summarized as follows:

- A perfectly contestable market is a market (consisting of any number of firms) that is subject to potential entry by firms that have no disadvantage relative to the firms already comprising the market; such potential entrants make the determination about the profitability of entry by assuming that existing firms will not alter their prices even when new firms enter. Furthermore, whether the market consists of many firms or only a few, it is said to be a sustainable contestable market equilibrium if there are no profitable opportunities for any potential entrant who charges prices no greater than existing firms.
- Industry structure in perfectly contestable markets is determined by the fundamental forces of demand, production technology, and *potential* entry.
- The theory of perfectly contestable markets is a generalization of perfect competition that is applicable regardless of the cost structures faced by firms and, in many instances, produces the same expected outcome as does perfect competition.
- *Potential* competition from *potential* entrants, not active competition of existing rivals, drives perfectly contestable markets to equilibrium where demand and supply are equal, industry costs of production are minimized, and prices equal marginal costs and are at a level that renders further entry unattractive.

Market Failure

Monopolies and oligopolies sometimes lead to what is termed "market failure." The market fails in that productive resources may not be used efficiently (that is, labor, equipment, and other resources are not combined in a fashion that yields minimum costs); however, market failure need not always be the result of market structure alone. Often, it is the product of actions on the part of market participants in conjunction with market structure.

Generally speaking, the type of market failure addressed in this paper falls in the category of cartelization, a form of market failure typically resulting from the actions of sellers. It is "an explicit arrangement among, or on behalf of, enterprises in the same line of business that is designed to limit competition among them" (3). This concept includes conspiracy, price fixing (bid rigging), and explicit collusion.

Collusion

Collusion is a term used to define the actions of firms that coordinate their pricing or production policies in an attempt to increase their profits (4). It is usually a "formal or explicit agreement among competitors" (5) as a means to earn greater-than-competitive returns, but it can take many forms. In some cases, a large group of competitors selling a product that differs among transactions (e.g., construction) may have regularly scheduled formal meetings with or without the aid of a trade association. In other instances, a small group of competitors in a market with a simple product may communicate under less formal circumstances. Sellers in markets with repetitive purchases (such as materials suppliers) may agree on a single list price for an item or draw up a price list for referral with or without customer allocation schemes. Sellers in markets characterized by nonrepetitive purchases may even choose to allocate jobs or territories through complementary bidding (5) or may rotate winning bids and shares of the market (1). One analyst describes the situation as follows (6):

All these schemes and countless others have one thing in common: Regardless of their design, the Sherman Antitrust Act renders illegal any form of agreement (open or secret) designed to fix prices or restrict output. Yet despite its illegality, for many businessmen, firms, and even industries, collusion has been a way of life—an accepted method of doing business.

Why Collude?

The question "why collude?" has a very simple, and perhaps even obvious, answer: the purpose of virtually all collusive arrangements is to attain joint maximization of profits for those firms participating in the conspiracy. Clearly, if the firms can act as a unit, they will effectively operate as a monopoly, enabling them to price and produce as a monopolist.

The necessity of and feasibility for collusion are determined by the structure of the market. Therefore, market structure should be examined as a check on the validity of any concerns regarding collusion. Necessity and feasibility vary in a fashion consistent with the structure of the market. Two examples can be given to demonstrate this relationship. The first example is a market with hundreds of small firms selling a standardized product, such as wheat. A cartel is necessary if firms are to achieve joint maximization of profits (high profits) because the large number of sellers forces prices and costs to be very close, but collusion is infeasible because of market structure, that is, recognized interdependence is too remote, the incentive to cut prices is too great, private enforcement of such a hypothetically large conspiracy is too costly, and the likelihood of detection is too great. A second example is when the market has only two sellers of a simple, standardized product (perhaps asphalt). A cartel is quite feasible in this instance, but collusion is entirely unnecessary. With only two firms in the market, recognized interdependence is unavoidable; there are relatively no incentives to cut prices; the opportunity for price leadership is clear so that conscious parallelism can yield a monopoly outcome; and, because explicit collusion is illegal, tacit collusion will most probably occur instead (7).

Thus, collusion is most likely to be found when it is not only feasible but also necessary in order to maximize profits. If the market's structural conditions are unfavorable, neces-

sity and impossibility will rule collusion out. With extraordinarily favorable conditions, feasibility and lack of necessity will probably lead to tacit collusion (i.e., price leadership) (7). It is in the realm in between—when “feasibility and necessity blend”—that one may find collusion thriving (7). This situation leads one to question which structural aspects of markets affect the feasibility and necessity to collude. It is only after recognizing these factors and their impact that one can analyze a market for its ability to support collusive activity.

Factors Relevant to the Feasibility of Collusion

Number of Firms

The number of firms in a given market plays a significant role in determining whether collusion is likely, because it directly affects the ease with which coordination between the involved firms can be achieved. Simply, the more sellers there are in a given market, the more difficult it is to maintain a price at a level significantly greater than cost (1).

There are several reasons for this. First, as the number of sellers of a product increases and the share of the output contributed by firms in a conspiracy decreases, the more likely firms are to ignore the impact of their behavior and pricing policies on the overall market price structure. Thus, sellers in large markets lose awareness of how their individual pricing decisions hurt (or help) their rivals. As a consequence, collusive agreements in a market with a large number of sellers (greater than 10) tend to dissolve more readily than those markets with fewer participating sellers (1). Second, as the number of firms increases, the chance of having an independent firm with its own pricing policy increases. If such a firm were to supply a significant portion of the market's demand for the good, it would create a major problem for the other colluding firms (1). The fewer firms involved, the less likely there is to be such a maverick in the group. Third, as the number of sellers increases, the more divergent the ideas about the most advantageous price at which to sell the product. Divergent ideas are obstacles to setting prices, yet they are inevitable given the variability of firm size, cost structure, and other aspects of the market (5). However, with fewer firms, this possibility is less likely and agreements are reached more rapidly.

Industry Concentration

The effect of industry concentration (percentage of the market controlled by the four to eight top revenue-earning firms) is still being debated. The conclusion reached in most studies is that profits do rise with increasing concentration (1), and this leaves open the possibility that these firms maintain their profits through collusive activity. However, it is also agreed that highly concentrated industries can collude tacitly (i.e., without formal agreements) by recognizing their interdependence. The resulting behavior, which is called conscious parallelism, is not illegal per se. In such a market, it is argued, there is no need for overt collusion. One might want to reflect, however, on the fact that a high degree of interdependence, if recognized by the participants in the market, might quite

naturally lead to collusion (5). Hay and Kelly found in a study of a sample of 65 cases brought to court that “the preponderance of conspiracies lasting 10 or more years were in markets with high degrees of concentration” (5). This seems to corroborate the theory many economists find most plausible: firms with moderate-to-high four-firm concentration ratios are most prepared to foster collusive activity (5).

Nature of the Product

The nature of a product in a given market can play an integral role in defining the structure of the market and, in turn, can influence the feasibility of collusive activity. Products are generally described as either homogeneous or heterogeneous within their market. If the products are described as homogeneous, it means that in the consumer's mind there is little or no relevant difference among the products. Put simply, the goods are perfect substitutes for one another (1). Economists thus use the term homogeneous to (5)

- Denote that the cross-price elasticity of demand among products is high (i.e., if the price of Good A rises slightly, consumers will increase the quantities purchased of Good B by a significant amount);
- Describe a situation in which the product is not complicated but comes in different grades and types; and
- Denote homogeneous overtime with stable qualities

Each type of homogeneity contributes to the degree to which individuals regard the products as substitutes. In a homogeneous market, though, there is only one dimension along which rivalry can occur: price. Thus it is easier to reach an agreement in a market with homogeneous products, as one must agree only on price (1).

Rate of Technological Change and Industry Growth

The rate of technological change in a given product market can also affect the structure of the market and the probability of collusive activity. Its effect is similar to that of the homogeneity or heterogeneity of the product in that the degree of technological change affects the ease with which an agreement can be brought about between potential conspirators. When a product market is undergoing a large degree of technological change, long-term agreements become more difficult to arrange (3). Ultimately, the costs of maintaining an agreement are increased because terms must be renegotiated with each technological change. If innovations allow the firm to increase its market share, the firm will be an even larger threat (8). Furthermore, the more rapidly a producer's cost functions are altered through innovation, the more unevenly the profits generated by collusion are distributed throughout the industry and the greater the influence on the performance of any price-fixing agreements. Conspiracies depend on the stability of certain market characteristics, and because innovation affects the most significant factor, that is, constancy of members' market shares, one would expect it to have a large impact on the ability to coordinate activities and prices (9).

The rate of growth of an industry can similarly affect market

structure, particularly if the industry is experiencing significant growth. Because firms rely on maintaining a constant share of the market, in an industry with rapid growth, it is difficult to determine shares of the market among colluding firms. It is also difficult to police a collusive arrangement for price cutting in a rapidly expanding market because increases in market share may be a result of increased demand rather than price cuts. A conspiracy favors status quo and, thus, is more likely if market shares are relatively constant over time and demand fluctuations are moderate (9). In the case of the rapidly growing VDOT construction program, the conditions are clearly not procollusive.

Type of Sale

Another factor that can, and usually does, affect the way a product market functions is the size distribution of orders over time. The frequency or infrequency of sales, as well as the "lumpiness" or evenness of the size of sales, affects an industry's ability to coordinate. In this context, collusion is least likely "with large infrequent orders at irregular intervals" (1). A firm that is in a conspiracy constantly weighs the gains and the losses from possible undercut bidding. The gains to a firm from undercutting coconspirators are great on large orders, particularly if the probability of getting such an order is low (irregular). Ultimately, the effect of "lumpy," infrequent orders will be an increase in the cost of policing any conspiracy formed in such an environment, rendering collusion unlikely.

A market is, therefore, more conducive to collusion if it has small, frequent, regular orders. Under these circumstances, the payoff from undercut bidding is not so lucrative; thus, conspirators have few incentives to cheat.

Sealed Bidding

The threat of rival retaliation allows collusive conspiracies to thrive. Secrecy is contrary to the aims of a group involved in collusion. In fact, a collusive arrangement can survive only if there is a mechanism to detect cheaters (price cutters) and subsequently punish them. Thus, the sealed bidding process is the answer to every coconspirator's dream. Conspirators need price information to discover cheating, and the sealed bidding process literally does the work for them. The key to the process for conspirators is that all bids are opened publicly on a set date, with the lowest winning. Because the results are announced publicly, conspirators are provided with an excellent mechanism for detecting those members of the cartel who reduced their price below the agreed-upon level. The process greatly reduces the cost of obtaining this type of enforcement information (8). Because conspirators know that cheating will be detected immediately, the incentive to cheat is greatly reduced (5). Economist Paul Cook said it best, "it would . . . be hard to find a device (that is, sealed bidding) less calculated to foster open and aggressive competition among sellers" (1). The likelihood of collusion depends on the ease with which an agreement can be reached and the means used to monitor cheating. In sealed bid markets, the second issue is eliminated by the announcing of the winning bids, so it is necessary only to reach an agreement (4).

Elasticity of Demand

A market with an inelastic demand for its goods is conducive to collusion. In such markets, if the price of the good goes up or down, the quantities demanded will not be significantly affected. If the demand for an industry's products is relatively inelastic, then any conspiracy to raise prices above the competitive level will simply result in higher revenues because the quantities demanded will not be significantly reduced as prices rise. In such a conspiracy, all suppliers of substitutes would have to be included in the conspiracy so that a potential buyer would not escape the higher-priced product by choosing a suitable substitute (8).

The association of price fixing with industries that have inelastic demand curves is based on the argument that the penalties for failing to fix and raise prices, in terms of lost profits, are high and the rewards of high fixed prices are great (9). Thus, the likelihood of collusion increases markedly with an inelastic demand curve. Once again, this is not to suggest that collusion occurs only in such instances, only that the chance of its occurrence is enhanced by such an environment. Ultimately, an inelastic demand is a major influence on conspiratorial stability. The more inelastic industry demand is, the more profitable the conspiracy and the greater the incentive for its continued life (9). Clearly, departments of transportation run the risk of increasing the probability of collusion in instances where construction advertisements are let in the presence of bids significantly in excess of the engineer's estimate.

Industry Social Structure and Trade Associations

The social structure of an industry affects its conduct; yet, this structure is difficult, if not impossible, to measure in economic terms. The social structure of an industry also affects the market by affecting the ability of competitors or conspirators to coordinate pricing behavior (1). Often, industries are close knit and competitors are friendly with each other, respect each other, and share a spirit of camaraderie. On the other hand, industries with producers from diverse backgrounds with different styles of doing business and different goals will not be likely to participate in collusive arrangements (1). If there is an independent seller in a close-knit group, collusion may be unlikely. In addition, the strength of the industry's leadership may affect the creation of collusive agreements, and a strong leader may be enough of a force to create a conspiratorial ring in an entire product market.

Although one may still wonder how such bonds are formed between apparent rivals, informal social contacts at trade associations have frequently been found to foster tacit or explicit collusion (5). This has led trade associations to come under increasing fire. Trade associations, by the very nature of their concerns and functions, raise serious questions for those seeking to prevent collusion. They present ideal opportunities for conversations about prices under the auspices of performing functions that are within the bounds of the law. Yet, research shows that 30 percent of all cases brought by the government involve trade associations (3). In fact, in a study involving 50 antitrust cases, Kuhlman found that trade associations were named as codefendants in 23 (8). In summary, it is generally

accepted that the "larger the portion of the industry encompassed by trade associations, the more conspiracy you'll expect to find" (9).

Production Costs

Production costs clearly affect the functioning of markets. The "more costs differ from firm to firm (in a product market), the more trouble the firms will have maintaining a common pricing policy" (1). Thus, vastly differing production costs may preclude collusion, as the joint maximization of profits for the individual sellers will be less likely in such a market. "Widely divergent costs across firms breed divergent opinions concerning the optimum price" (3). Although the most efficient means to handle the problem of divergent costs is to shut down inefficient plants and pool the profits to rewardable firms, such behavior is usually obvious to antitrust prosecutors and is not, therefore, undertaken.

High fixed costs present special difficulties for potential colluders. Fixed costs are costs that do not vary as output changes. They include building rent, the capital cost of equipment, insurance, and so on. Industries with high fixed costs (e.g., cement, steel, aluminum) are more susceptible to breakdowns in pricing discipline when demand falls. For example, if demand falls, capital will go unused and firms will find it tempting to reduce price and expand output, sales, and general revenue to offset the effect of the high fixed costs (5). However, if more than a couple of firms choose this course of action, prices will fall rapidly. Thus, agreements in industries characterized by high fixed costs (capital-intensive production processes) become fragile and subject to disintegration with each downward turn of demand (5). In essence, excess capacity functions as a powerful incentive to cheat and can cause a widespread departure from fixed prices. The incentive to cheat is greater for firms with high fixed costs because "individual firms can gain high profits not only from additional business, but from the decrease in cost associated with higher output" (9). The incentive to cheat is less if fixed costs are low. Thus, cost structure can play an integral role in an industry's ability to maintain collusive arrangements.

Barriers to Entry

A barrier to entry is anything that prevents prospective sellers or producers from entering a given market. Barriers to entry play a significant role in determining the complexion of an industry because "the condition of entry into a market determines the possibility for long-term profits" (10). If entry is relatively easy, high profits cannot be sustained, because they will entice new entrants into the market. Therefore, if a market is to enjoy continued high profits generated by collusive arrangements, there must be some barrier to prevent the entry of rivals; otherwise, the degree of pricing discretion for established firms will become quite limited. Many things, however, can function as a barrier to new entrants: absolute cost advantages, economies of scale, product differentiation, or something less categorically specific (10). Absolute cost advantages may arise because of patents, trade secrets, and contracts that prohibit certain factors of production from use or distribution

proximity. Economies of scale can be a barrier to entry if a firm must maintain a large output level to achieve reasonable production costs. Product differentiation is also an effective barrier, as consumer brand loyalty may make buyers reluctant to try a new product. There may also be legal obstacles, licensing requirements, labor contracts, or any number of other factors that may function as an entry barrier (10).

Barriers to entry are particularly important to firms considering collusion because, to the extent that collusion yields high profits, others will try to enter the market; the success of the collusion revolves around the firms being able to keep them out. Therefore, firms in a market with low barriers to entry are less likely to form and be able to maintain collusive agreements than firms in a market with high barriers (8).

Supporting Antitrust Monitoring Programs

The following 10 categories of market characteristics offer a starting point from which to examine construction markets to establish the extent to which, if at all, any markets exhibit characteristics that would facilitate collusion:

- Number of firms;
- Industry concentration;
- Product characteristics;
- Technology change;
- Type of sale;
- Type of bidding;
- Demand elasticity;
- Industry social structure;
- Production cost; and
- Entry barriers.

This information can then become an integral part of a construction antitrust monitoring and detection program. Highway construction markets appear to exhibit several characteristics that have been shown to facilitate collusion. The industry produces fairly standardized products (e.g., asphalt), appears to have relatively high barriers to entry because of capital costs, and has firms likely to experience similar production costs throughout a given market. Technological innovation appears to be slow in the construction industry, and the sealed bidding process enhances the opportunity for collusion. It is this type of information that needs to be empirically verified so that one may determine if such a list of factors could be helpful in identifying any markets in which collusion may be likely.

Thus, there are several logical steps that can serve to help develop an effective antitrust monitoring program:

1. Define the major highway construction markets in terms of number of sellers, concentration ratios, rate of growth, geographical boundaries, number and size of contracts, and so on;
2. Analyze each market for conduciveness to collusion on the basis of the factors listed in the previous paragraph; and
3. Analyze tests for collusion available to the states in the AASHTO Bid Analysis System (BAMS) on the basis of these factors.

REFLECTIONS ON DETERRING COLLUSION

Various methods have been proposed for deterring collusive bidding. Some are intended to reduce the impact of collusion by increasing competition in the particular market or by making a successful conspiracy more difficult to coordinate. Other suggestions are geared to improving detection techniques. Because bidding procedures are governed by state law, the implementation of certain ideas may be difficult. The purpose here is to summarize the various techniques and discuss some of the positive and negative aspects of each.

Improving Competition in the Marketplace

The most obvious way to increase the competitiveness of a sealed bid market is to encourage more firms to bid. State procurement agencies can provide incentives for firms to bid by reviewing prequalification requirements, on-site inspection policies, and other overhead-related items to ensure that the benefits derived from such requirements are not outweighed by the burdens placed on the contractors.

Overhead-related items such as prequalification requirements serve a beneficial purpose because they improve the monitoring capability of state procurement agencies. However, they may deter firms from bidding if the requirements are overly burdensome. The policy of debarment of firms has a similar double-edged effect. The threat of debarment is a strong deterrent to firms that might consider rigging bids. On the other hand, debarment of firms tends to hinder competition by reducing the number of potential bidders. It is not possible to propose general guidelines for setting prequalification and debarment policies that will work in all markets all the time. The policies should be the subject of continuous review by state officials who are intimately familiar with the relevant markets and who are in touch with the contractors and trade associations involved. Detailed recommendations for prequalification requirements are prescribed by Welsch and Furth (11) and in the *Report of the Task Force for Strengthening Bidding and Contract Procedures* (12).

Another approach to increasing competition in sealed-bid markets is to gear the work to the existing capacity of the market. For example, it may be advantageous to split the work into relatively small portions, thereby encouraging smaller firms to bid. On the other hand, by dividing the work into several smaller contracts, economy of scale advantages may be lost. Also, it has been argued that clustering projects into large contracts will induce at least one firm to violate cartel prices and win awards with a competitive bid.

North Carolina has proposed two techniques for clustering projects into large contracts without discouraging the smaller firms from bidding (13). One technique is to cluster several smaller projects into a large bid package. Firms are allowed to choose whether to bid on one project or on the whole package. The system may encourage more firms to bid by allowing them to tailor their bidding choices to their available capacity. A disadvantage may be that large firms will be unsure about which jobs may go to smaller firms and therefore will be unable to take full advantage of all production efficiencies.

The other approach proposed by North Carolina is referred to as "sequential bidding." With this system, the bidder sub-

mits a bid on the condition that the total award will not exceed a specified level. The bids on the various projects are opened sequentially. Once a firm's specified limit is reached, its bids are not considered on the remaining projects. Sequential bidding provides incentives for firms to bid on more projects without having to worry about taking on more work than they can handle.

In summary, the competitiveness of a sealed-bid market can be improved by increasing the number of bidders. Firms can be encouraged to bid through relaxing requirements on overhead items such as prequalification requirements and by matching the work load to the available capacity. The implementation of these competition-enhancing measures requires judgment on the part of procurement officials and intimate familiarity with the relevant markets.

Hindering Collusive Practices

In an oligopolistic market, that is, one in which a few firms are dominant, a successful conspiracy must accomplish two tasks: (a) establish a mutual understanding of the price or output level to be used by the conspirators and (b) promote mutual confidence that the terms of the understanding will be honored by the participants. Standard bidding procedures often facilitate the accomplishment of the first task by disseminating certain information in connection with the bidding process. The most important piece of information is the list of potential bidders. Bid riggers use this list to identify and contact the other potential bidders in order to ensure that no one will underbid the firm chosen by the conspiracy to win the contract award. By keeping this list secret until after the bid letting, the state could create uncertainty among the conspirators about whether a newcomer may decide to bid competitively. The effectiveness of keeping the list secret will probably be limited in those markets where the cost of entry is high and the existing firms have a long-standing working relationship with each other. Even so, the slight uncertainty could discourage some firms from colluding.

The state engineer's estimate is another useful piece of information for conspirators. If bidders know what the state thinks a job is worth, they will have a basis from which to start their job allocation negotiations. The rigged price will then exceed the engineer's estimate but not by so much that the bids will be rejected. If the contractors are unsure of the state's valuation of a project, they will be uncertain about how high to bid and they could be inclined to bid close to competitive prices.

Another method for hindering the establishment of mutual understanding among conspirators is to have frequent advertisements. Frequent bid lettings force potential conspirators to communicate often to set up jobs, thus raising the cost and complexity of the conspiracy.

The accomplishment of the conspirators' second main task, promoting confidence that the participants will adhere to the terms of the conspiracy, is not difficult in the typical bidding scenario. The conspirators can easily detect competitive bidding because the identity of the bidder and the amount of the bid are announced after the bid letting. Firms will be hesitant to violate the terms of the conspiracy because their actions will be immediately detected and the competing firms would

be able to retaliate effectively by submitting competitive bids on subsequent projects. The renegade firm would win the first contract but would forgo the large profits that would be gained by rigging future projects. The confidence of the conspirators would be significantly undermined if the identity of the low bidder and the quantity of his or her bid were kept secret. Obviously, keeping the identity of the low bidder secret is not possible. Although keeping the quantity of the low bid secret may be desirable, as a practical matter, the low bid must be disclosed to avoid the appearance of impropriety in the contract award process.

Another avenue for creating uncertainty among potential conspirators is occasionally to award projects to randomly selected bidders, rather than to the low bidder. If the bids are clustered closely, the state could award the contract to someone other than the low bidder without paying an excessively high price. If one bid was much lower than the others, the state would award the contract to that bidder. If the bids on the project were kept secret, the conspirators would be unsure whether anyone violated their agreement. This uncertainty will provide an incentive for firms to violate the terms of collusive agreements. The main problem with the proposal is that it does not provide an incentive to bid below the collusive price because, in a random selection process, a low bid will not ensure a firm's winning the contract. The scheme may, however, deter firms from submitting complementary bids on projects they are not prepared to complete. If a firm is awarded a contract it is unable to fulfill, it would be forced to subcontract the job to other contractors. In this manner, the conspiracy would become more complex and therefore more expensive and prone to detection.

The use of a random selection process may not be effective unless it is used on a regular basis. The problem with the frequent use of the system is that, in order for it to work, the bids must be kept secret. This secrecy would likely present the appearance of impropriety and would probably be unacceptable to the contractors and the public.

The well-established practice of requiring bidders to submit affidavits of noncollusion should be continued because it can have an impact on a conspirator's willingness to adhere to the terms of the conspiracy. The affidavit requirements remind the contractors of the seriousness of antitrust violations. Also, by signing false affidavits, collusive bidders would risk committing a separate offense they might be unwilling to bear.

Detecting Collusion

The best way to "detect" collusion among bidders is to obtain direct testimony from witnesses to the illegal agreement. Because such testimony is generally not available, investigators must be able to draw inferences from the circumstantial evidence that is available. Numerous methods have been proposed for using the available information to detect collusion. Generally, these methods rely on common sense analysis of bidding patterns (14). Other methods use sophisticated statistical tests to detect collusion (15). Although the proposals vary in sophistication, they all depend on an intimate familiarity with the relevant firms and markets. There is no "automated" collusion-detection system, and there is not likely to be.

Procurement officials can improve their understanding of construction markets by gathering information about construction firms and their affiliations. Generally, some information of this nature is obtained through the prequalification process. However, timely updates of this information and the detailed assessment of the need for more complete information should be an ongoing process within any transportation agency.

A sophisticated cost-estimating system like that used by VDOT (BAMS) is also essential to a thorough analysis of bids. The estimating system must be sufficiently detailed to identify all factors affecting project cost including such variables as transportation costs. A detailed, objective cost estimate will allow bid analysis to identify line item costs in bids that do not reflect rational business decisions on the part of bidders. In this regard, it is also important that the state continue to require detailed line item bids. By breaking the project costs into easily analyzed cost items, the state will make it more difficult for contractors to submit irregular bids.

Once procurement officials are armed with comprehensive data on the relevant firms and a sophisticated cost estimate, the bids can be analyzed to identify irregular patterns that may indicate collusion. Four source documents (11, 12, 16, 17) provide a comprehensive compilation of possible indicators of anticompetitive behavior that states may wish to use in moving forward to implement an antitrust monitoring and detection effort.

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