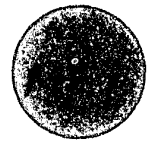
Forthcoming: Internationale Forschungsergebnisse Auf Dem Gebiet Der Wirtschaftskriminalität (International Results of Research in Economic Crime)



THE EFFECTIVENESS OF RECENT U.S. GOVERNMENT CRIMINAL ANTITRUST ENFORCEMENT EFFORTS IN THE CONSTRUCTION INDUSTRY

Michael K. Block
Jonathan S. Feinstein
Frederick C. Nold

This research was funded in part by the National Institute of Justice grant 81-IJ-CX-0062 and 83-IJ-CX-4055. Points of view or opinions stated in this document are those of the authors and do not necessarily represent the official positions or policies of the National Institute of Justice of the U.S. Department of Justice.

ABSTRACT

In this paper, we assess the impact of recent criminal antitrust enforcement in the construction industry. We begin by developing and testing an indicator of collusion in highway construction. Using this indicator, we estimate the effect on bid-rigging of the recent explosion of antitrust activity by DOJ in highway construction. We find that recent efforts designed to suppress the level of bid-rigging did in fact work. Surprisingly, however, it appears as if it was the greatly enhanced penalties for violating the antitrust laws that were most effective in controlling the level of bid-rigging. We were unable to find any consistent evidence that the increase in the number of cases brought was, by itself, a very important factor in reducing collusion in highway construction.

Introduction

Price fixing of any kind has been illegal in the United States for nearly a hundred years. In 1890, the Congress of the United States passed the Sherman Act, which in Section 1 states that:

> Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations, is hereby declared to be illegal.

Moreover, shortly after the passage of the Sherman Act, the Supreme Court determined that horizontal minimum price fixing was so injurious that it should be illegal per se. That is, the courts held that the act of price fixing was a per se violation and, that the government was under no obligation to establish harm in any specific case. As with common law crimes such as robbery, assault and theft, price fixing is considered so serious in the United States that the act itself is considered illegal.

Not only has price fixing been illegal per se for some time in the United States, it has been punishable by both fine and imprisonment since it was declared a crime. In passing the Sherman Act, the Congress decreed that:

> Every person who shall make any such contracts or engage in any such combination or conspiracy, shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished by fine not exceeding five thousand dollars, or by imprisonment not exceeding one year, or by both said punishments, in the discretion of the court.[1]

Interestingly enough, opinions as to the correctness of considering price fixing a crime and the appropriateness of using the criminal sanction for horizontal price fixing has not changed much over the years; nor is it a particularly partisan matter. For while the Reagan Administration has often been accused of ignoring antitrust enforcement, Mr. William F. Baxter, Assistant Attorney General for Antitrust during the first several years of the Reagan Administration, was one of the strongest advocates of using the criminal sanction in price fixing cases. Early in his tenure at the Department of Justice, Baxter stated that:

> Agreements among competitors entered into for the clear purpose of artificially restricting output and raising prices have no redeeming value and merit criminal prosecution. I will urge that responsible company officials serve jail terms in all appropriate cases . . . .

In recent years, price fixing in the construction industry has become a particular concern of the antitrust authorities. Of the 900 criminal indictments filed by the Antitrust Division since 1955, nearly a quarter have been in the construction

---

1. In 1955, the penalty was increased to $50,000. In 1974, violation of the Sherman Act was made a felony, and the maximum prison sentence raised to 3 years, and the maximum fine raised to $1,000,000 for corporations and $100,000 for individuals.

industry. Perhaps more striking is the fact that since 1978, over 60% of all criminal indictments filed by the Division were against firms in the construction industry. As the data in Table 1 makes abundantly clear, recently there were some years where the construction industry was almost the exclusive concern of the Division as far as criminal cases were concerned.[2] In addition, since most of the recent cases in construction have been brought under the 1974 penalties, fines and imprisonment rates are quite high by historical standards.[3]

Undoubtedly, part of the reason for the Antitrust Division's concentration on collusion in the construction industry is the success the Division has had in identifying violations in the industry. Virtually all of the price fixing alleged by the government in these cases has involved bid-rigging, i.e. the collusive setting of prices by contractors on projects put out to public bid.[4] Early on in the present wave of

---

2. Of course since indictments for price fixing in construction are usually for bid-rigging and these are ordinarily more narrowly drawn than other price fixing indictments, the number of indictments in construction may tend to overstate the Division's concentration in the area. For example, the recent indictments in North Carolina for bid-rigging referred to specific contracts, so that bid-rigging incidents in 1976, 1977 and 1978 all had separate indictments.

3. In 1980, the fines levied against construction firms were three times the average of all firms from 1955-1980. Moreover, while from 1955 to 1959 there were 19 cases where jail sentences were imposed and not reversed, in a single year, 1980, in the construction industry there were 24 such cases.

4. According to the Economic Policy Office of the Antitrust Division, of the 154 cases brought against construction firms during the period 1978-1983 that listed a specific violation, (20 listed no specific violation) 150 listed bid-rigging as one of the alleged violations.

TABLE 1

CRIMINAL INDICTMENTS FILED BY THE ANTITRUST DIVISION OF THE U.S. DEPARTMENT OF JUSTICE: 1955-83[1]

	Sherman Act Indictments[2]		
Year(s)	Total	Construction[3]	% Construction
1955-1977	618	42	6.8
1978	44	8	18.2
1979	24	5	21.1
1980	84	67	79.8
1981	38	22	57.9
1982	47	43	91.5
1983	45	26	57.8
1978-1983	282	171	60.6
1955-1983	900	213	23.7

Notes: (1) Source: Clabault and Block (1982) and Economic Policy Office, Antitrust Division, U.S. Department of Justice.

(2) These are indictments for criminal antitrust cases brought under Sections 1, 2 and 3 of the Sherman Act (Public Law No. 190, Ch. 647, 51st Cong., 1st Sess.), filed by the Antitrust Division, Department of Justice subsequent to the 1955 amendment to the Sherman Act. (The Amendment substituted the words "fine not exceeding fifty thousand dollars" for the phrase "fine not exceeding five thousand dollars". In 1974, the Act was further amended and the maximum fine for an individual was raised to $100,000 and the maximum for a corporation was raised to $1,000,000.)

(3) This category includes: SIC 1611 - Highway and Street Construction; SIC 1622 - Bridge, Tunnel and Elevated Highway Construction; SIC 1623 - Water, Sewer and Utility Line Construction; SIC 1629 - Misc. Heavy Construction; SIC 1711 - Plumbing, Heating and Air Conditioning; SIC 1731 - Electrical Work; SIC 1741 - Masonry; SIC 1742 - Plastering; SIC 1752 - Floor Laying; SIC 1761 - Roofing; SIC 1771 - Concrete Work; SIC 1794 - Excavating, and SIC 1799 - Special Trade Contractors.

indictments (1979) the antitrust authorities refined their methods of using the information from one bid-rigging prosecution to unearth additional, often quite geographically distant, bid-rigging violations. By the end of 1980, the scope of the government's activity in highway construction had expanded from a single state, Illinois, in 1979, to seven states including states as remote from Illinois as South Carolina.

The construction industry has clearly been of singular interest to the Antitrust Division in recent years and, at this point we ought to be asking the same questions of the Antitrust Division efforts to enforce the antitrust laws in the construction industry that we would be asking of the efforts of a more mundane criminal justice agency. Specifically, we ought to be asking whether all this activity has had any effect on the crime level, in this case, the amount of bid-rigging. That is, has the bringing of a record number of antitrust actions in a specific industry and the unprecedented widespread use of prison terms as well as large fines had a significant effect on the volume of bid-rigging in construction? After all, the primary reason for bringing these cases and punishing the individuals involved is to dissuade both these and other contractors from rigging bids in the future.

Assessing just how successful the Antitrust Division has been in suppressing bid-rigging should also provide some information on the general question of how effective various enforcement

---

5. From 1977 to 1982, the U.S. government indicted more than 200 highway contractors for bid-rigging, making highway construction the most active antitrust area in federal history.

techniques are likely to be in controlling white collar crime. Most significantly, it may provide some insight into whether it is the certainty or severity of punishment that matters most in this area. After all, it is not clear that the results that we have for 16 year delinquents, that suggest certainty is most important, are applicable to middle-aged chief executive officers.

Measuring the Amount of Bid Rigging

Before we can answer the question of how effective recent efforts by the Antitrust Division to control bid-rigging have been, we have to be able to measure the volume of bid-rigging in the construction industry. Unlike many garden variety crimes such as theft, where the offense may be recorded even though the offender has not been identified, in bid-rigging the offense only comes to light when the offender(s) is(are) identified. Moreover, there is no self report data available for this crime. We simply do not have any self reports by executives on bid-rigging that could be used to analyze the impact of enforcement policy on the volume of this crime. Of course even if we had these, it is not clear that they would be very useful. However, the situation is far from hopeless.

The objective of bid-rigging, after all, is to raise the lowest price available to the purchaser and, hence, increase the profit level of suppliers. A contract or bid that is rigged will have a higher markup or profit level than one that is not. Moreover, there is likely to be a relationship between the time and effort the contractors put into rigging a bid and the profit

level. Consistently high levels of effort devoted to bid-rigging should be associated with higher margins or markup on contracts. Obviously, one way to measure the volume of bid-rigging in the industry is to measure the profit levels on various contracts. Hence, if the Antitrust Division's recent efforts to control bid-rigging in the construction area have been successful, then profit levels in construction contracts put to bid in recent years should have declined. They should have declined both because fewer contracts are rigged and less effort was devoted to those that were rigged.

While the profit or markup on a specific contract is likely to be an unambiguous indicator of the presence of collusion, actually measuring the profit level on a contract is problematic. The most obvious approach would be to estimate costs on each contract and thus derive a direct estimate of profit for each contract.[6] However, in the case of highway construction, estimation of costs requires a detailed listing of the line items on each contract let. Not only is such a listing often large (over 100 itmes) and hence unmanageable and expensive to work with, but the presence of unbalanced bidding makes the relationship between cost estimated and actual costs on

---

6. We have adopted this cost function approach in studies of antitrust enforcement in bread and concrete industries. See M. Block, F. Nold and J. Sidak, "The Deterrent Effect of Antitrust Enforcement," Journal of Political Economy, June 1981.

particular items problematic.[7] There are also serious empirical problems in trying to estimate cost functions for markets where collusion is common. Consequently, we have decided not to attempt direct estimation of cost functions for highway construction. Instead of actually estimating costs, we have chosen to construct an indicator of profit level using the engineer's estimate for a specific project. What we have done is develop a two step procedure that uses the engineer's estimate and the low bid for estimating the profit level on any contract. The procedure is as follows:

First, to calculate the margin indicator on a specific contract we divide the low bid by the engineer's estimate of the project, creating a variable called MARKUP:

$$\text{MARKUP} = \frac{\text{Low Bid}}{\text{Engineer's Estimate}} \qquad (1)$$

The engineer's estimate used in constructing the variable MARKUP is the state highway department's estimate of how much the job that is put out for bid should cost, i.e. it is the low bid expected by the highway department. It is prepared before the contract is put out for bid and is not commonly revealed to the bidders prior to the submission of bids.

---

7. Unbalanced bidding involves making the line items of the bid reflect factors other than the costs of the various items.. Often times, unbalanced bidding is used by contractors to arrange the cash flow from a contract in the most advantageous manner.

While states vary as to the methods they use to construct such estimates, in almost all cases, the estimate reflects, to some degree, past low bids for similar contracts. Our assumption in using MARKUP as an indicator of the profit margin on a contract is, that bid-rigging is not perfectly stable and that the ratio of low bid to engineer's estimate (our variable MARKUP) will vary systematically with the degree of collusion. If this is the case, then increases in MARKUP will on the average be associated with increases in collusion.[8]

Second, we obtain a variable called RESID by correcting MARKUP for economic conditions in the paving industry. This is a particularly important correction for this industry, which is notoriously cyclical. The rationale for this correction is that in "good" times profits of all contractors will rise, and hence truly competitive contracts may appear to have inflated profit margins, and therefore may be incorrectly labelled collusive by a procedure which relies solely on MARKUP. Conversely, in depressed times, collusive contracts may have below average markups (which are nonetheless still above depressed competitive markups) and be incorrectly labelled competitive. The variable RESID is actually the residual of the ordinary least squares regression of MARKUP on a variable that measures economic activity in the construction industry.[9]

---

8. Obviously, if the degree of collusion were stable over time, the variable MARKUP would have no trend.

9. Other corrections could be included, such as dummy variables to measure special jobs (eg. airport construction).

In the empirical section we investigate the relationship between RESID and the indidence of collusion on contracts.

Data

Our empirical work has been carried out with three distinct data sets. The data set we use for actually analyzing profit levels on contracts was provided by the Federal Highway Administration (FHWA) and contains information on the winning contractor, his low bid, the engineer's estimate, data on the project, the state, as well as some other facets of the contract for all 50 states over the years 1975-81. This source does not identify any bidders or their bids other than the low bidder on the contract.

Our second data set, and the one that we use to verify the efficacy of our proxy for collusion, is from the North Carolina Department of Transportation (NCDOT). This data set provides information only for the state of North Carolina, covers the years 1975-81, and includes all bidders on a contract and their bids, as well as much additional information. Nearly all states keep such records, but we chose North Carolina for a very practical reason: NCDOT has identified whether a specific contract represented collusive bidding on the basis of discussions conducted with apprehended bid-riggers. This information provides us with the data for a very direct test of the usefulness of our proxy for collusion, RESID.[10]

---

10. It was also helpful that there were a large number of bid-rigging cases in North Carolina, and NCDOT was able to provide us with detailed data on thesecontracts on computer tape.

Our final data set was provided by the Antitrust Division of the Department of Justice (DOJ) and contains information on all DOJ cases in highway construction over the period 1975-82. For each case, the data set contains the state of indictment, the violation(s), the contractors indicted, and the penalties in terms of fines and jail sentences of the convicted contractors.

Estimating the Level of Bid-Rigging in the Construction Industry

We begin our empirical analysis by estimating the level of bid-rigging in the highway industry over the period 1975-81. As we discussed above, we use as an indicator of collusion the actual profit level on a contract. The higher the profit level, the more likely it is that the contract involves collusion, or in the case of highway construction, bid-rigging.

In theory, the variable MARKUP that we defined in equation 1, is an indicator of the presence of collusion. However, as we pointed out above, there are several practical problems with the variable. Hence, our first step is to correct MARKUP for the level of economic activity. The indicator for economic activity that we actually use in adjusting MARKUP is the percentage of the construction labor force employed, denoted CYCLE. This measure of economic activity is actually the number employed monthly in construction in a state divided by the ratio of annual average employed in that state's construction sector to

one minus the annual unemployment rate.[11] As an example of the volatility of this series and, consequently, its potential utility in adjusting markups, we present a plot of CYCLE over the years 1975-81 for our test state of North Carolina in Figure 1.

Using the national FHWA data set, we obtained the results in Table 2 which show a statistically significant relationship between CYCLE and MARKUP. Apparently, the higher the level of activity in construction vis a vis the recent past, the higher the markup on highway construction jobs.[12] Also, included in the regression reported in Table 2 are dummy variables for each state. These are included because differences amongst state engineers' methods of estimating contracts, as well as differences in both conventions regarding accounting profits and in historical levels of collusion, are likely to introduce systematic differences across states in the ratio of low bid to the engineer's estimate.

Now, the adjustment of MARKUP for systematic differences across states and the level of economic activity is accomplished by calculating the residuals from the regression in Table 1.

---

11. Several different series could be used as measures of economic activity. The series we chose is employment in the construction industry by state. This series is a compilation of several Bureau of Labor Statistics publications, and is monthly employed (by state and industry) divided by the annual average labor force (state and industry).

12. We used several other specifications which considered lagged as well as contemporaneous values of CYCLE. The results were essentially the same.

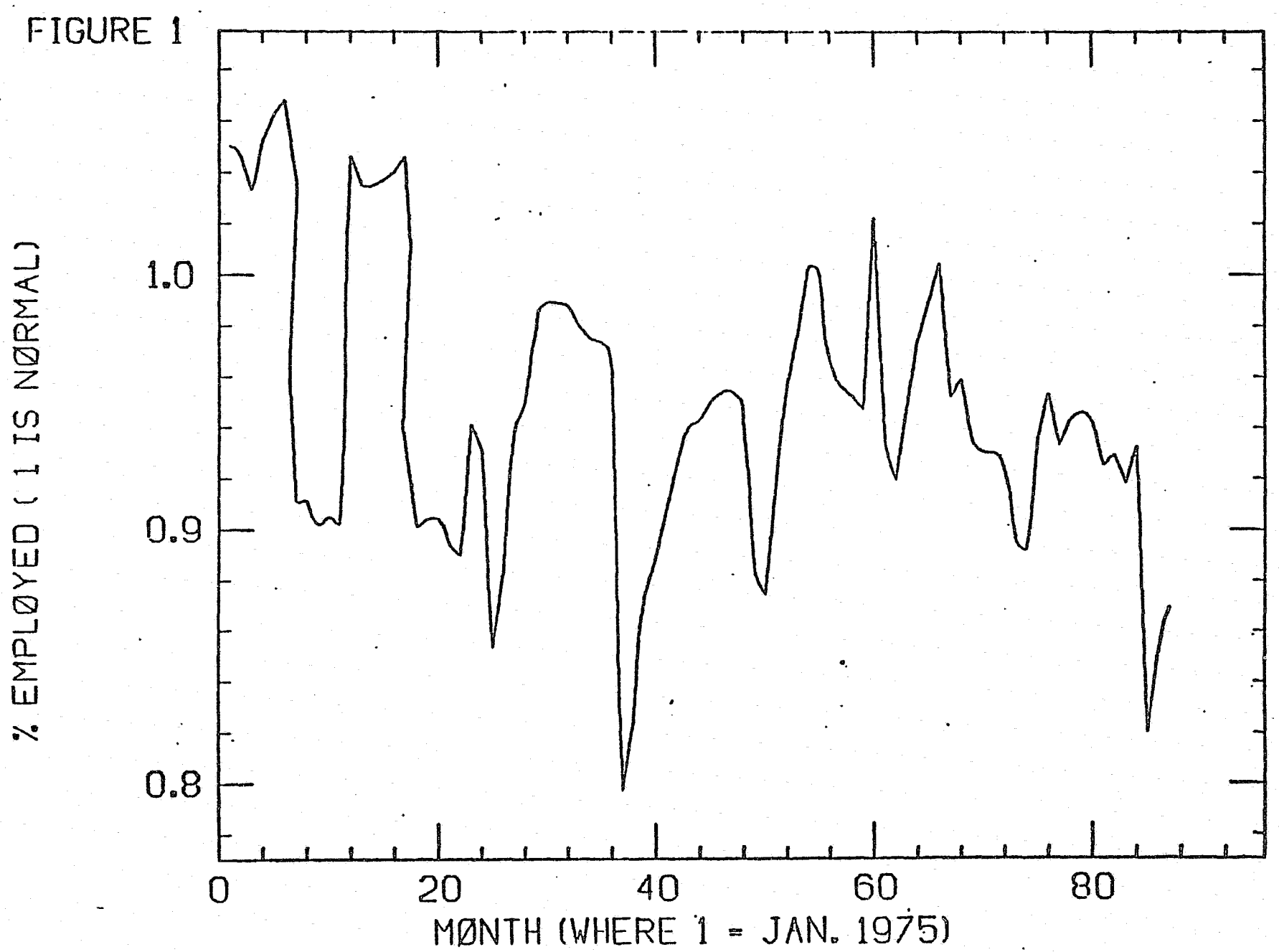

EMPLØYMENT IN NC CØNSTRUCTIØN
% EMPLØYED (1 IS NØRMAL)
1.0
0.9
0.8
0
20
40
60
80
MØNTH (WHERE 1 = JAN. 1975)

FIGURE 1

TABLE 2

REGRESSION OF MARKUP ON ACTIVITY

Estimate of CYCLE Test Statistic	.138 (5.57)
Estimates of State Dummies	Alaska .778; Connecticut .685; Delaware .729; Florida .826; Georgia .856; Illinois .818; Indiana .737; Kentucky .800; Louisiana .818; Maine .820; Maryland .742; Massachusetts .776; Michigan .774; Mississippi .898; New Hampshire .743; New Jersey .791; New York .750; North Carolina .775; Ohio .713; Pennsylvania .841; Rhode Island .750; South Carolina .851; Vermont .824; Tennessee .814; Virginia .790; Wisconsin .704; West Virginia .804; Washington, DC .688; Alaska .729; Arizona .766; Arkansas .889; Hawaii .756; California .817; Colorado .799; Iowa .807; Idaho .750; Kansas .754; Minnesota .806; Montana .804; Missouri .796; Nebraska .776; New Mexico .797; Oregon .739; South Dakota .834; Utah .824; Texas .854; Washington .777; Wyoming .777; North Dakota .862; Oklahoma .833.
Sum of Squares	3399.9
R^2	.075
MARKUP Mean	.928
Number of Observations	3940

For each contract we create the variable RESID which represents that part of MARKUP which cannot be explained by the systematic state differences or variations in CYCLE, our indicator of general construction activity. As noted above, RESID provides us with a way of assessing the extent that the low bid on the contract reflects extraordinary profits for the winning contractor.[13]

While RESID may be an imperfect measure of profitability, it does provide us with an operational indicator of collusion. A test of the ability of RESID to actually serve as an indicator of collusion is presented in Table 3 for a random sample of our national data. Roughly 4,000 observations were selected from the more than 13,000 available to us.[14] The COLLUDE variable was constructed by using the list of firms named in DOJ bid-rigging cases. We assumed that if the low bidder was

---

13. Although an improvement over MARKUP, RESID suffers from a number of problems as an accurate measure of highway contractor's profits. The most important of these arises because engineers' estimates are based on bids for previous contracts. In this case, when collusion has occurred in the past, past jobs will contain inflated profit margins which will tend to inflate the engineer's estimate above a project's true competitive cost. Hence, RESID may systematically understate contractors' profits, and so may less accurately indicate collusion. Another difficulty with RESID is the heteroscedasticity which might arise if engineer's estimates vary in accuracy across states. We have not been able to devise a way to correct for these potential errors in the RESID variable. Development of reliable and independent cost estimation techniques would seem to be the best approach for solving this problem.

14. We could of course enhance the statistical significance of any of the results we present for RESID by merely drawing a larger random sample from the FHWA data.

TABLE 3

LOGIT REGRESSION OF COLLUDE ON RESID

	Dependent Variable
Independent Variable	COLLUDE
RESID	.765 (1.660)*
Intercept	-2.830 (40.600)
Number of Observations	3940

*The number in parenthesis is the t-statistic, which is the coefficient divided by the standard error. The t-statistic is signed identically to its coefficient.

on the list, the contract was rigged. The relationship with RESID came through despite the biases inherent in our COLLUDE variable towards masking the relationship.[15]

Table 4 contains results of a similar LOGIT analysis which used only the North Carolina data.[16] We test RESID against both COLLUDE and an alternative measure of collusion, which we call NCCOLLUDE. NCCOLLUDE is the indicator of collusion compiled by NCDOT and is based on interviews with apprehended bid-riggers.[17] Essentially, NCCOLLUDE = 1 when the

---

15. The procedure used to define COLLUDE would tend to bias our results in two ways. First, it is quite unlikely that firms collude on all contracts, especially since they cannot control who will bid. In addition, a group of firms might collude but accidentally lose the contract to a non-colluding bidder. Consequently, our procedure will incorrectly indicate collusion on occasions where the bid was actually competitive and erroneously indicate competition when the collusive group misjudge the level of bids entered by non-cartel member. Second, not all collusive groups have been uncovered by DOJ investigations. Furthermore, not all members of uncovered groups are mentioned on indictments. Therefore, some contracts placed in the non-collusive category may in fact be collusive. All of these effects bias our results towards finding no relationship between COLLUDE and RESID.

16. There is an important point that concerns the utility of the simple estimated model presented in Table 3 as a way of predicting collusion. There have been no bid-rigging cases in a large number of states so the nationwide incidence of highway collusion appears low. This is a reflection of the weakness of COLLUDE as a variable which results in a large negative intercept in the LOGIT model and, vis a vis the results presented in Table 4, a low coefficient for RESID. Consequently, forecasts from the national model will give estimates of the probability of a contract being collusive which are misscaled for North Carolina. The results of Table 3 should be viewed as a summary of all states which understates the power of RESID to identify collusive contracts and the incidence of collusion in general.

17. COLLUDE and NCCOLLUDE differ on approximately one-third of the North Carolina contracts.

TABLE 4

LOGIT RESULTS
STATE OF NORTH CAROLINA

Independent Variable	Dependent Variable	
	COLLUDE	NCCOLLUDE
RESID	1.09 (3.01)*	4.77 (10.40)
Intercept	-.203 (3.32)	0.531 (7.78)
Sample Size	1237	1237

*The t-statistic for each coefficient is given in parenthesis and is signed identically.

contract was labelled as collusive on the basis of these interviews. The results of RESID against NCCOLLUDE are particularly encouraging. The relationship between our measure of profits (RESID) and instances of collusion actually identified by bid-rigging (NCCOLLUDE) is highly significant.

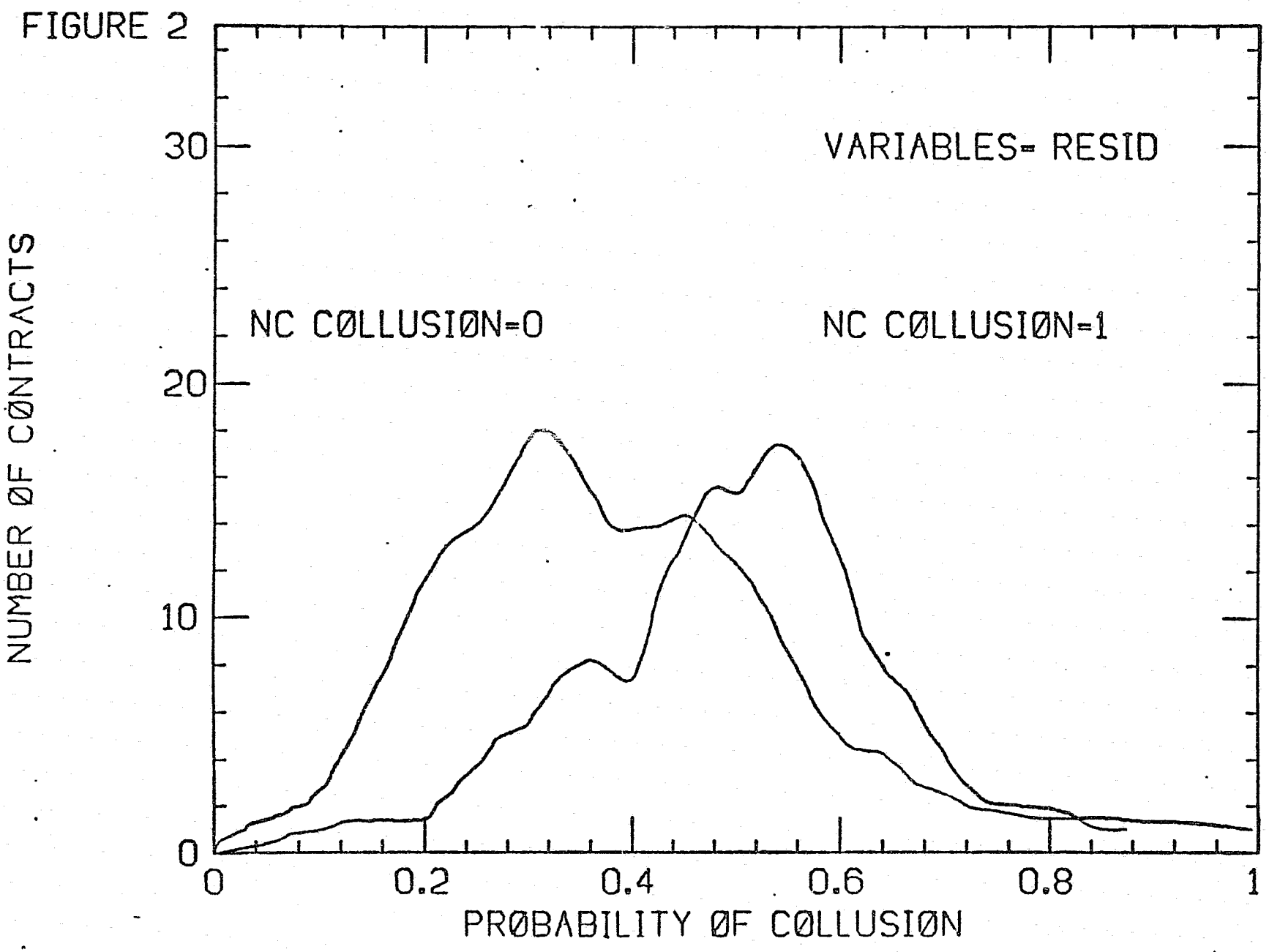
As a final test of the utility of our indicator of collusion, we assign each contract in North Carolina a probability of being collusive based on the results of Table 4 for NCCOLLUDE. We then calculate two probability densities, one for those contracts known to be collusive (according to NCCOLLUDE), and one for those not suspected of being collusive. The two densities are presented in Figure 2. Note that the two densities do differ, indicating that RESID itself can be reliably used as an indicator of bid-rigging.

Measuring Federal Bid-Rigging Enforcement Efforts

Having developed an empirical measure of bid-rigging, we now turn our attention to the problem of constructing relevant measures of enforcement activity. In order to test the deterrent effect of recent efforts to suppress bid-rigging, we need to construct a set of enforcement variables that reflect the contractor's perception of DOJ enforcement efforts.

As the data in Table 1 clearly indicates, the number of cases brought by DOJ in the construction industry has increased dramatically in recent years. Even more striking is the recent increase in highway construction cases. In the eighty-five years

FIGURE 2


PREDICTIØNS ØF NC CØLLUSIØN
VARIABLES= RESID
NC CØLLUSIØN=0
NC CØLLUSIØN=1
NUMBER ØF CØNTRACTS
0
10
20
30
0
0.2
0.4
0.6
0.8
1
PRØBABILITY ØF CØLLUSIØN

prior to 1975, DOJ brought only three cases in highway construction. However, since that date, DOJ has brought nearly 160 such cases. In 1980 alone, DOJ brought 61 cases in highway construction. Translating this increase in the number of cases brought into an empirical measure of the change in the probability of a colluding contractor being apprehended is, however, problematic. In order to construct a measure of the probability of being apprehended for price fixing, we must have, in addition to the number of contractors that are colluding, or contracts that are being colluded upon at any point in time. Since we have no direct measure of the number of contractors actually colluding, we have no immediately available equivalent of the clearance or arrest rate that we have for Index crimes.[18]

In constructing a proxy for the probability of capture or apprehension, what we have had to do is estimate the number of colluders. To approximate the number of contractors likely to be colluding, we have calculated the fraction of contracts in a given year with a positive RESID value, which indicates excess profits and possible collusion, and multiplied this fraction by the number of active contractors in the specified year. This indicator of collusive bidding was then used as the denominator, and the number of contractors named in Department of Justice actions in a particular month was used as the numerator, to produce an estimate of the

---

18. Index crimes refers to the UCR Part I crimes, i.e. murder, rape, robbery, assault, burglary, larceny, motor vehicle theft, and arson.

probability that a colluder might be indicted, PCHARGE.[19]

Along with PCHARGE, we were able to develop a relatively full complement of monthly measures of the level of DOJ antitrust enforcement. The elemental measures that we developed were: CPCONVICT, the conditional probability that a highway construction contractor charged with an antitrust violation will be found guilty; CCPFINE, the conditional probability that a charged contractor will be fined if convicted; CCPJAIL, the conditional probability that an individual charged and convicted will be sentenced to jail;[20] and AVEFINE and AVEJAIL, the average fines and jail sentences levied by the Department of Justice for those fined and/or jailed.[21] More detailed definitions of these enforcement variables are given in the Appendix.

As we indicated in the Introduction, not only have the number of cases been unprecedented in the highway construction area, but so have been the punishments meted out. The recent highway construction cases represent the first time that the U.S. Government has regularly used imprisonment as a sanction for

---

19. Alternatives to PCHARGE might include measures that involved more sophisticated methods of estimating the number of collusion contracts as well as measures that assumed all contracts involved some collusion and simply used the ratio of indictments to contracts as a measure of enforcement.

20. Fines and jail sentences are not mutually exclusive. Both penalties are used quite often.

21. AVEFINE includes fines to both firms and individuals. AVEJAIL includes non-suspended jail sentences to individuals. We do not know how much time individuals actually spend in jail. None of these variables reflect fines, jail sentences, or damage recoveries imposed by state governments.

antitrust violations and they also involve the imposition of fines that are quite high by historical standards. Now, in order to actually measure the overall severity of sanctions for bid-rigging, we constructed the following indicator of the expected punishment:

$$PUNISH = (CCPFINE \cdot AVEFINE + CCPJAIL \cdot AVEJAIL \cdot \$137) \qquad (2)$$

where $137 is the daily rate that monetizes prison time at the rate of $50,000/year. Obviously, any monetization rate is somewhat arbitrary. With this qualification in mind, the variable PUNISH is intended as an indicator of the expected monetary loss imposed by a conviction for bid-rigging.

Combining this measure of expected punishment with our measure of apprehension probability (PCHARGE) and conviction probability (CPCONVICT) yields an overall measure of the expected monetary costs of rigging a bid in highway construction:

$$ELOSS \equiv PCHARGE \cdot CPCONVICT \cdot PUNISH \qquad (3)$$

ELOSS is an indicator of the expected monetary cost of antitrust enforcement facing a contractor that rigs a bid in highway construction. It is intended to represent the expected monetary consequences of bid-rigging that a contractor considers when deciding to collude on a bid. A monthly series for this

variable is given in Table 5.[22] It is interesting to note that in months with enforcement activity in this industry, i.e. months with non-zero entries in the table, our indicator of the expected antitrust costs of bid-rigging ranges from less than $1 to nearly $50,000. That is, according to our indicator, a potential bid-rigger in 1975 would have considered that the expected costs of fixing a bid due to antitrust liability would have been 78¢, while in 1982 the same bid-rigger would have reckoned that rigging a bid now had an expected cost of $48,861. Whatever the problems are with the details of our calculations, one thing is clear: DOJ antitrust enforcement efforts, at least in the bid-rigging area, have increased dramatically in the past several years.

During the period that the twelve month moving average is probably most reliable, 1980-82, our indicator of the expected costs of bid-rigging (ELOSS) was growing by over

---

22. Our series suffers from several problems: the first problem relates to the relative scarcity of cases in highway construction over the period 1975-79, as opposed to the larger number of cases from 1980 on. As a result of this disparity, our monthly series are missing values for the majority of months prior to 1980. We have assigned zeroes to enforcement variables in months when there was no federal enforcement activity, but we do not believe this is entirely satisfactory. Presumably, contractors' perceptions of enforcement probabilities do not fall all the way to zero in months of federal inactivity, particularly when antitrust actions have occurred in months immediately preceding the federal inactivity. This is particularly true of certain aspects of antitrust enforcement. For example, the probability of conviction given apprehension for antitrust violations is generally regarded to be near one. A second problem closely related to the first is the erratic behavior of our series prior to 1980. We expect contractors' perceptions to be much less erratic than the actual series. Thus we have smoothed our enforcement series by calculating twelve month moving averages with missing value set to zero.

TABLE 5

ELOSS 1975-82

1975-10	$	0.78	1979-1	$	56.67
11		0.78	2		57.34
12		0.78	3		58.01
			4		57.34
1976-1		18.33	5		86.35
2		18.56	6		89.05
3		19.00	7		80.95
4		19.11	8		82.97
5		0.00	9		63.41
6		0.00	10		74.20
7		0.00	11		71.08
8		0.00	12		57.57
9		0.00			
10		0.00	1980-1		315.13
11		0.00	2		354.04
12		0.00	3		531.05
			4		608.31
1977-1		0.00	5		997.01
2		0.00	6		1,039.29
3		0.00	7		2,568.47
4		0.00	8		3,661.17
5		0.00	9		4,040.24
6		0.00	10		5,434.47
7		0.00	11		8,332.95
8		0.00	12		13,386.95
9		0.00			
10		0.00	1981-1		17,347.46
11		0.00	2		20,809.68
12		0.00	3		27,293.56
			4		29,711.43
1978-1		0.00	5		32,242.64
2		0.00	6		31,518.25
3		0.00	7		37,138.66
4		0.00	8		33,854.24
5		0.00	9		31,916.06
6		0.00	10		37,579.50
7		0.00	11		47,784.79
8		0.00	12		42,282.10
9		0.00			
10		0.00	1982-1		37,260.73
11		14.31	2		47,169.23
12		43.37	3		48,860.95

11% per month. Moreover, as the estimates in Table 6 reveal our indicators of both the certainty (PCHARGE and CPCONVICT) and the severity of punishment (PUNISH) for bid-rigging were growing over the period.

It is significant to note that, in terms of severity, not only did prison terms (which had been very rare prior to 1980) increase from an average of 50 days in the early months of 1980 to over 160 days by mid-1982, but average fines increased from about $23,000 in early 1978 to over $230,000 by mid-1982. In fact, while expected prison terms (CCPJAIL·AVEJAIL) increased by a factor of six between 1980 and 1982, expected fines (CCPFINE·AVEFINE) increased by a factor of eight over the same period. Prison sentences might have been making headlines in the trade journals, but increases in fines were actually somewhat more important in recent years in raising the expected monetary costs of bid-rigging.

There are of course some problems with our enforcement data. As is apparent from the series in Table 5, the density of enforcement activity is not very high prior to 1979.[23] Because we set missing values equal to zero and use twelve month moving averages for non-zero entries, our indicator is really not very reliable prior to 1980. In addition, DOJ enforcement activity has been concentrated in a few states. The states of Georgia, Illinois, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia are what we term <u>active</u> states in that

---

23. See Appendix Tables 2-4 for details on the historical patterns in the components of ELOSS.

TABLE 6

MONTHLY TIME TRENDS IN ENFORCEMENT INDICATORS
1980 - 1982

Enforcement Measure	Estimated Monthly Rate of Growth
PCHARGE	.03 (1.10)*
CPCONVICT	.01 (4.50)
PUNISH	.06 (7.70)
ELOSS	.11 (3.70)

*t-ratio

they account for roughly 90 percent of DOJ highway bid-rigging cases between 1975 and the end of 1981.[24]

To partially overcome these difficulties we have analyzed the effect of our enforcement series on three separate data sets: a random sample of all our contracts, which cover all 50 states, over the time period 1975-82; a random sample, over all 50 states, restricted to post-1979 data; and the post-1979 data restricted to the active states.

Empirical Results

In Table 7, we present the results of estimating the impact of recent enforcement efforts on the amount of bid-rigging in highway construction. Each column represents a slightly different sample: in the first column, the deterrent effect of antitrust enforcement is tested on a random sample of all highway contracts since 1975; the samples in Columns 2 and 3, on the other hand, include only contracts after 1979 and in Column 3, the sample is further restricted to contracts in active states.

When the enforcement measures are combined into an expected loss formulation and we estimate the impact of changes in ELOSS on bid-rigging, the results are clear and quite uniform. In all cases, an increase in the expected costs of rigging a bid due to antitrust liability (ELOSS) reduces the amount of bid-rigging actually going on in the highway construction industry.

---

24. For a more formal treatment of the implications of this concentration in indictments for deterrence, see Block and Feinstein (1984).

TABLE 7

MULTIPLE REGRESSION RESULTS

	Dependent Variable RESID		
	Sample		
Independent[1] Variable	All States Post-1975 (N = 3544)	All States Post-1979 (N = 1263)	Active States Post-1979 (N = 238)
ELOSS	-.188[2] (11.5)[3]	-.055 (2.46)	-.086 (1.86)
R^2	(.036)	.005	.015
PCHARGE	.040 (.615)	.076 (.702)	.169 (.673)
CPCONVICT	-.025 (3.75)	.099 (.734)	.030 (.111)
PUNISH	-.070 (3.70)	-.078 (2.27)	-.122 (1.66)
R^2	.056	.011	.030

Notes: (1) Intercept not reported in these regressions.

(2) Per $100,000.

(3) t-ratio, in parentheses, is signed identically to its associated coefficient.

Our empirical results indicate that enforcement policies that have increased the costs that a potential bid-rigger can expect to incur as the result of fixing a bid have reduced markups in the highway construction industry. Since these markups are adjusted both for the idiosyncratic aspects of each state and the level of economic activity in the construction industry, the reduction in markup levels is likely to be a reliable indicator of a reduction in the amount of collusion in the industry.

Disaggregating the analysis somewhat and inquiring as to the independent effects of increases in the certainty of punishment (PCHARGE and CPCONVICT) and severity of punishment (PUNISH) reveal several quite interesting phenomena. Perhaps most significant is our inability, once we control for severity, to find any evidence that recent increases in apprehension (or discovery rate) had an impact on markups or bid-rigging activity. The fact that the number of cases brought against highway bid-riggers increased dramatically in the late 1970's and early 1980's seems not to have had any independent effect on the level of bid-rigging.[25] The coefficient in PCHARGE is of the wrong sign and statistically insignificant in all of the regressions in Table 7. Only when we fail to control for severity, as in the bi-variate regressions in Table 8, is the relationship between RESID

---

25. The probability of being apprehended for bid-rigging, according to our indicator, increased from less than .10 in 1975 to over .35 in 1982.

and PCHARGE negative and statistically significant. Of course, all of the bi-variate results are significant. This is to be expected since all of the enforcement variables are highly correlated and one variable tends to proxy for all of the enforcement variables, when only it is included in the regression.[26]

In terms of the other measure of certainty of punishment, CPCONVICT, the conditional probability of being convicted for bid-rigging given you are indicted for the crime, the evidence is mixed. Again, if we delete the controls for severity (PUNISH) and certainty of punishment (PCHARGE) as in Table 8 do we obtain unambiguous results. In the more general case, only if we consider the entire period from 1975 on do increases in CPCONVICT appear to reduce bid-rigging activity. The coefficient on CPCONVICT is negative and statistically significant in Column 1 of Table 7. It is, however, neither negative nor significant for the period after 1979.

Our results on CPCONVICT are basically determined by the time period. For example, if we consider active states over the entire period, we get the results in Table 9 (which indicate that for active states CPCONVICT is an important determinant of bid-rigging activity) if we consider the entire period since 1975. The results in Table 7, however, indicate that if we restrict our attention to the period since 1979, CPCONVICT does not influence bid-rigging decisions in active

---

26. See Feinstein et.al. (1983B) for details in the correlation between enforcement measures.

TABLE 8

BIVARIATE REGRESSION RESULTS

Independent[1] Variable	Dependent Variable RESID		
	All States Post-1975	All States Post-1979	Active States Post-1979
PCHARGE	-.227 (12.0)[2]	-.082 (2.93)	-.123 (2.07)
CPCONVICT	-.055 (9.94)	-.134 (2.50)	-.192 (1.73)
PUNISH	-.070 (13.7)	-.035 (3.40)	-.053 (2.47)
N	3544	1263	238

Notes: (1) Estimate of intercept not reported in any of the regression.

(2) The t-ratio, in parentheses, is signed identically to its associated coefficient.

TABLE 9

MULTIPLE REGRESSION RESULTS: ACTIVE STATES

Independent Variable	Dependent Variable RESID Active States (N = 716) (1)	(2)
PCHARGE	.006 (.04)[1]	- -
CPCONVICT	-.020 (1.60)	-.020 (1.72)
PUNISH	-.076[2] (1.96)	-.075 (6.70)
INTERCEPT	.034	.034
R^2	.09	.09

Notes: (1) t-statistic is signed identically to its associated coefficient.

(2) Per $100,000.

states. In active as well as non-active states, CPCONVICT appears to be a significant, independent determinant of bid-rigging activity only if the period is extended back to 1975.

Perhaps the time period is important because CPCONVICT did not vary in the post-1979 period. As the data in Table 10 indicates, this is not strictly true. There was a reasonable degree of variation in the chances of being convicted over the period 1980-82. What seems to be driving our results is not the stability of the conviction rate during the post-1979 period, but the erratic nature of the series before that date. The plot of CPCONVICT in Figure 3 makes this point quite dramatically. Before 1980, our conviction indicator, CPCONVICT, simply oscillates between 0 and 1. It is only in the period since 1980 that CPCONVICT can be considered a reliable indicator for the probibility of conviction. It is precisely during this period of time, when the indicator is at its best, that the conviction rate appears not to be an important determinant of bid-rigging activity. Considered as a whole, the evidence we have been able to adduce fails to indicate that changes in the probability of conviction had an independent effect on the level of bid-rigging in highway construction.

Our empirical results suggest that, contrary to conventional wisdom, it is severity and not certainty that is most important in controlling bid-rigging.[27] We were unable to

---

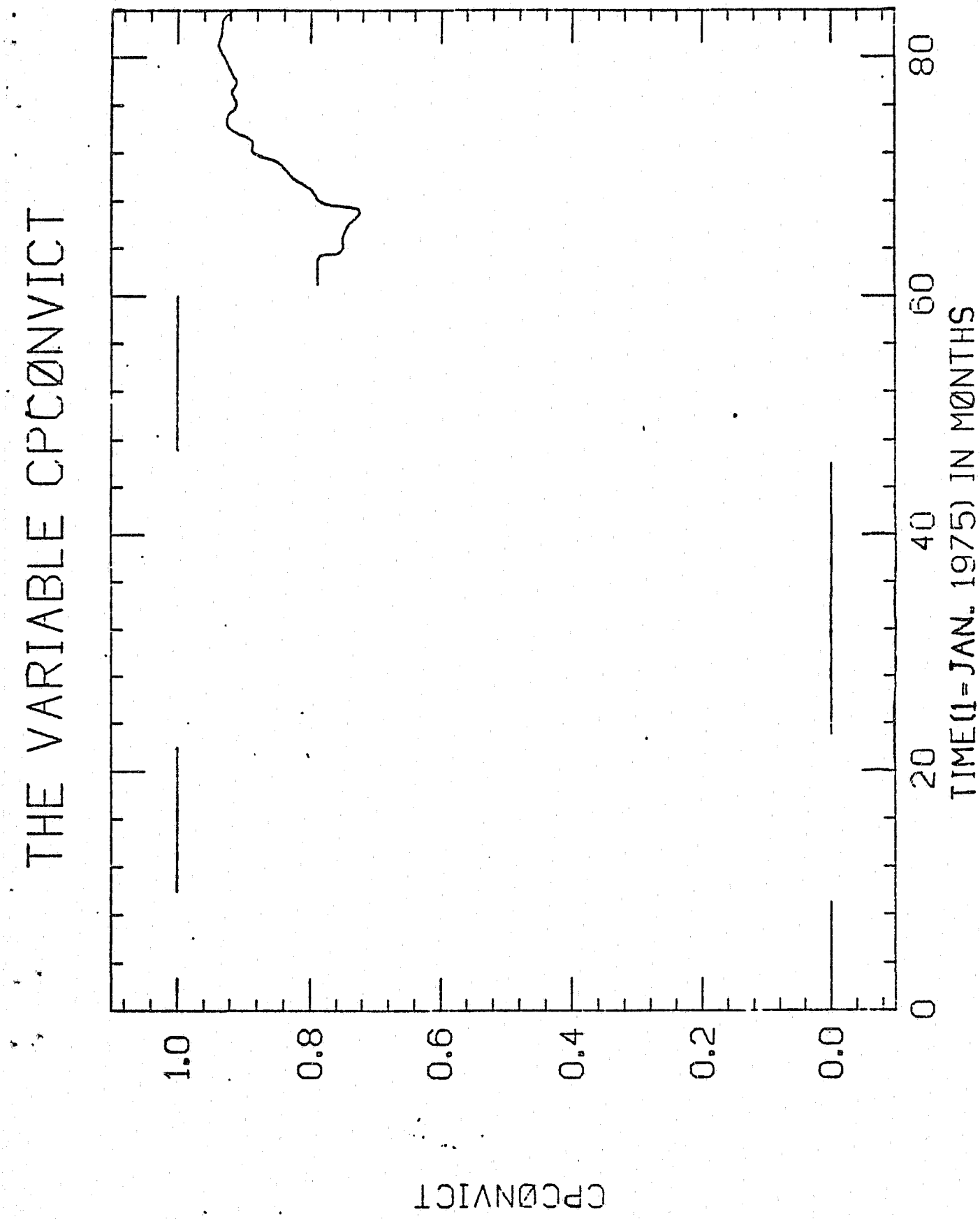
27. It is relevant to note that the results with respect to constraints of punishment (PCHARGE) are basically unaltered if we replace PCHARGE with a variable that assumes all contracts involve some collusion and simply uses the number of contracts as the denominator in constructing the apprehension variable.

TABLE 10

CPCONVICT 1980-82

Year	Month	CPCONVICT
1980	1	0.789
	2	0.789
	3	0.789
	4	0.750
	5	0.750
	6	0.741
	7	0.724
	8	0.787
	9	0.800
	10	0.828
	11	0.844
	12	0.886
1981	1	0.888
	2	0.921
	3	0.925
	4	0.911
	5	0.918
	6	0.912
	7	0.922
	8	0.929
	9	0.938
	10	0.934
	11	0.932
	12	0.913
1982	1	0.899
	2	0.906
	3	0.911
	4	0.868
	5	0.881
	6	0.863
	7	

FIGURE 3


THE VARIABLE CPCØNVICT
CPCØNVICT
1.0
0.8
0.6
0.4
0.2
0.0
0
20
40
60
80
TIME(1=JAN. 1975) IN MØNTHS

find any consistent, independent, deterrent effect of the increase in the number of cases brought in highway construction by DOJ in recent years. There has been an explosion both in terms of the absolute numer of bid-rigging cases brought and in the number of such cases relative to the number of collusive contracts in recent years. Yet there is no consistent evidence that this increase in activity level has, by itself, reduced the level of bid-rigging in the industry. Instead, it appears as if the government action that has been most successful in controlling bid-rigging is the increase in expected penalty for bid-rigging. Recent efforts aimed at increasing the punishment for bid-rigging appear to have been successful at reducing the level of bid-rigging. The evidence is quite consistent on this point. Across all of the samples and over both time periods, the severity of punishment for bid-rigging estimates show a negative and significant relationship between the markup on specific contracts and the level of punishment expected by a convicted bid-rigging.

Our results suggest that the increase in the number of cases brought by DOJ may have been neither as important nor possibly as unanticipated as has often been asserted.[28] The

---

28. Unlikely as it may be, given the level of bid-rigging in the industry, the number of cases, or for that matter the proportion of apprehensions, may have come as no real surprise to those in the industry. However, what is somewhat more likely is that the indicator of probable apprehension tends to reflect more than simply the cases in construction. It is, perhaps, severity that really shifted upward since the widespread use of imprisonment and large fines was rather new for price fixing violations.

dramatic increase, however, in the costs of a conviction for bid-rigging, have proved to be extremely important in controlling the level of bid-rigging. The apparently unanticipated shift in penalties for bid-rigging that began in the late 1970's appear to have had a profound effect on the willingness of contractors to rig bids.

Some caution should, of course, be advised at this point. Our indicators of certainty, especially PCHARGE, are problematic. We have only the crudest method of approximating the number of collusive contracts in any period and our results might be sensitive to this measurement problem.[29] Also, it is quite likely that information other than the number of cases brought in highway construction are important in determining contractors expectations as to their chances of capture. It may be that the explosion in highway cases seriously overstates the increase in expected apprehension rates. However, the movement in the severity of sanctions was really co-incident with the bringing of the highway cases and it may have a much larger information content than the increase in highway construction cases. The punishment meted out in the highway cases may have really been "something new under the sun". Finally, as we have noted before, all of the punishment variables move together and they have all been basically increasing over time. Moreover, our enforcement measures are national variables with no state to state differences. Just how much independent variation we actually have in

---

29. For some indication that this might not be problematic, see footnote 27.

the sample is questionable. For all of these reasons we need to exercise some care in interpreting our results.

Concluding Comments

We set out in this paper to assess the effectiveness of recent DOJ efforts to control bid-rigging in the highway construction industry. In order to accomplish this, we have had to develop a method of measuring bid-rigging as well as a method of translating DOJ enforcement efforts into increases in the measures of risk and costs of antitrust violations as they are perceived by potential bid-riggers. Having had some success at developing a measure of collusion and translating DOJ enforcement efforts, we then proceeded to investigate the impact of DOJ enforcement efforts on the level of bid-rigging. Our results clearly indicate that recent DOJ enforcement efforts have been successful at reducing the level of bid-rigging.

Surprisingly enough, however, we find that it is not the explosion in the number of cases brought in highway construction that is most important in controlling bid-rigging. Rather, we find that it is the very dramatic increase in the penalties that were assessed against convicted bid-riggers that appears to have been the most significant factor in reducing collusion in the highway construction industry.[30]

---

30. This finding that severity is more important than certainty is consistent with risk aversion and may be surprising to criminologists only because they do not usually observe the behavior of corporate executives. One of the major differences between "street criminals" and "suite criminals" may be their attitudes towards risk.

Our results have several important implications. They suggest that getting tough with so called white collar criminals may pay significant dividends. In a sense, there may be an opportunity for, if not a free, at least a cheap lunch here. It would appear from our analysis of the highway construction industry in the United States that raising the penalties and raising them substantially for white collar crimes will, in fact, reduce the level of such crimes. Now, it is a cheap lunch and not a free one because the penalties actually have been meted out before there is any effect. After all, the Congress, in the Antitrust Procedures and Penalties Act, raised the legal penalties for price fixing quite substantially in late 1974, but this did not seem to influence behavior until the new penalties were actually used in highway construction cases in the late 1970's and early 1980's.[31]

The companion implication to this suggestion that we raise penalties substantially is that we ought to go slow on increasing our enforcement efforts. We ought to wait and see if the increased penalties alone are effective, before we rush out and increase our enforcement efforts. If our results in bid-rigging are accurate, then it should be possible to make substantial gains against white collar crime without actually increasing greatly the number of violators apprehended. Our initial efforts should be directed towards getting substantially enhanced penalties meted out for those violators that

---

31. For a discussion of the impact of The 1974 Penalties Act, see Block, Nold and Sidak (1978).

we presently apprehend and convict. For as long as increasing punishment remains cheap relative to increasing detection and conviction probabilities, we ought to concentrate on increasing punishment. We ought not go out and substantially increase the number of white collar criminals that we apprehend or convict until we have exhausted all of the economies of substantially raising the punishment for these crimes.

References

Block, M.K., and Feinstein, J.S., "The Spillover Effect of Antitrust Enforcement", Working Paper, University of Arizona.

Block, M.K., Nold, F.C., and Sidak, J.S., "The Deterrent Effect of Antitrust Enforcement", Journal of Political Economy, June 1981.

_____,"The Deterrent Effect of Antitrust Enforcement: A Theoretical and Empirical Analysis", Technical Report No. ISDDE-1-78, Center for Econometric Studies of the Justice System, Hoover Institution, Stanford University, 1978.

Clabault, J.D., and Block, M.K., Sherman Act Indictments: 1955-1980, New York: Federal Legal Publications, 1981.

Elzinga, K.G., and Breit, W., The Antitrust Penalties: A Study in Law and Economics, New Haven, Yale University Press, 1971.

Erickson, M.L., Gibbs, J.P., and Jensen, G.F., "The Deterrence Doctrine and the Perceived Certainty of Legal Punishments", American Sociological Review, April 1977.

Feinberg, R.M., "Antitrust Behavior and Subsequent Price Behavior", Review of Economics and Statistics, November 1980.

Feinstein, J.S., Nold, F.C., and Block, M.K., "The Control of Collusive Bidding in the Highway Construction Industry", Technical Report No. CJRS 6, Rhodes Associates, Palo Alto, 1983.

_____, "The Identification of Collusive Bidding in the Highway Construction Industry", Technical Report No. CJRS 6, Rhodes Associates, Palo Alto, 1983.

Posner, R.A., "A Statistical Study of Antitrust Enforcement", Journal of Law and Economics, 1970

APPENDIX TABLE I

DETERRENCE IN THE HIGHWAY CONSTRUCTION INDUSTRY VARIABLE DEFINITIONS

PCHARGE: the probability a contractor will be charged with an antitrust violation. It is the number of contractors apprehended by open date of the case divided by an indicator of the number of collusive firms. The indicator is the product of the number of active highway contractors times the number of contracts that month with a positive RESID divided by the total number of contracts let that month.

CPCONVICT: the probability of conviction, given apprehension. The number of contractors convicted that month divided by the total number of defendants in cases closed that month.

CCPFINE: the probability a defendant will be fined, given that the defendant is convicted. Number of defendants fined that month divided by total number of defendants in cases closed that month.

CCPJAIL: the probability a defendant who is an individual (as opposed to a firm, which cannot go to jail) is sentenced to jail, given conviction. Number of individuals sentenced to jail that month divided by total number of individuals in cases closed that month.

AVEFINE: the expected value of a defendant's fine, given that the defendant is fined. Average value of the fine for all defendants fined that month.

AVEJAIL: the expected value of an individual's jail sentence, given that the individual is jailed. Average value of the jail sentence for all individuals jailed that month.

APPENDIX TABLE II

PCHARGE 1975-82

1975-10	0.0070
11	0.0070
12	0.0070
1976-1	0.0165
2	0.0167
3	0.0171
4	0.0172
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	0.0000
1977-1	0.0000
2	0.0912
3	0.0849
4	0.0782
5	0.0664
6	0.0607
7	0.0615
8	0.0604
9	0.0611
10	0.0614
11	0.0585
12	0.0589
1978-1	0.0552
2	0.0551
3	0.0000
4	0.0000
5	0.0000
6	0.0064
7	0.0076
8	0.0089
9	0.0087
10	0.0087
11	0.0086
12	0.0085
1979-1	0.0084
2	0.0085
3	0.0086
4	0.0085
5	0.0128
6	0.0132
7	0.0120
8	0.0123
9	0.0094
10	0.0110
11	0.0096
12	0.0097
1980-1	0.0162
2	0.0182
3	0.0273
4	0.0277
5	0.0454
6	0.0512
7	0.0676
8	0.0752
9	0.0866
10	0.1024
11	0.1252
12	0.1744
1981-1	0.2011
2	0.2723
3	0.3173
4	0.3083
5	0.3033
6	0.2980
7	0.3262
8	0.3233
9	0.3197
10	0.3455
11	0.4206
12	0.3970
1982-1	0.3507
2	0.3899
3	0.3714

APPENDIX TABLE III

CPCONVICT 1975-82

1975-10	1.000	1979-1	1.000
11	1.000	2	1.000
12	1.000	3	1.000
		4	1.000
1976-1	1.000	5	1.000
2	1.000	6	1.000
3	1.000	7	1.000
4	1.000	8	1.000
5	1.000	9	1.000
6	1.000	10	1.000
7	1.000	11	1.000
8	1.000	12	1.000
9	1.000		
10	1.000	1980-1	0.789
11	0.000	2	0.789
12	0.000	3	0.789
		4	0.750
1977-1	0.000	5	0.750
2	0.000	6	0.741
3	0.000	7	0.724
4	0.000	8	0.787
5	0.000	9	0.800
6	0.000	10	0.828
7	0.000	11	0.844
8	0.000	12	0.886
9	0.000		
10	0.000	1981-1	0.888
11	0.000	2	0.921
12	0.000	3	0.925
		4	0.911
1978-1	0.000	5	0.918
2	0.000	6	0.912
3	0.000	7	0.922
4	0.000	8	0.929
5	0.000	9	0.938
6	0.000	10	0.934
7	0.000	11	0.932
8	0.000	12	0.913
9	0.000		
10	0.000	1982-1	0.899
11	0.999	2	0.906
12	1.000	3	0.911

APPENDIX TABLE IV

PUNISH 1975-82

1975-10	$ 1,111.10	1979-1	$ 6,745.90
11	1,111.10	2	6,745.90
12	1,111.10	3	6,745.90
		4	6,745.90
1976-1	1,111.10	5	6,745.90
2	1,111.10	6	6,745.90
3	1,111.10	7	6,745.90
4	1,111.10	8	6,745.90
5	1,111.10	9	6,745.90
6	1,111.10	10	6,745.90
7	1,111.10	11	7,454.04
8	1,111.10	12	5,935.40
9	1,111.10		
10	1,111.10	1980-1	24,654.70
11	0.00	2	24,654.70
12	0.00	3	24,654.70
		4	29,280.86
1977-1	0.00	5	29,280.86
2	0.00	6	27,393.44
3	0.00	7	52,479.51
4	0.00	8	61,862.47
5	0.00	9	58,317.51
6	0.00	10	64,095.40
7	0.00	11	78,859.09
8	0.00	12	86,636.63
9	0.00		
10	0.00	1981-1	97,142.86
11	0.00	2	82,977.06
12	0.00	3	92,992.60
		4	105,786.83
1978-1	0.00	5	115,801.85
2	0.00	6	115,971.42
3	0.00	7	123,484.20
4	0.00	8	112,717.58
5	0.00	9	106,429.92
6	0.00	10	116,454.44
7	0.00	11	121,900.23
8	0.00	12	116,652.82
9	0.00		
10	0.00	1982-1	118,183.23
11	1,665.03	2	133,529.55
12	5,101.90	3	144,411.45

APPENDIX TABLE V

REGRESSION RESULTS: SIGNIFICANT VARIABLES ONLY

	Dependent Variable RESID		
	Sample		
Independent[1] Variable	All States Post-1975	All States Post-1979	Active States Post-1979
CPCONVICT	-.040[2] (4.52)[3]	-	-
PUNISH	-.059 (10.33)	-	-
R^2	.056	-	-
PUNISH	-	-.035 (3.46)	-.053 (2.47)
R^2	-	.010	.029

Notes: (1) Intercept not reported in these regressions.

(2) Per $100,000.

(3) t-ratio, in parentheses, is signed identically to its associated coefficient.