

1983

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## Citation of this paper:

Goldberg, Victor P., John E. Erickson. "Long-Term Contracts for Petroleum Coke." Centre for the Economic Analysis of Property Rights. Economics and Law Workshop Papers, 83-02. London, ON: Department of Economics, University of Western Ontario (1983).

7054

ECONOMICS AND LAW WORKSHOP

83-02

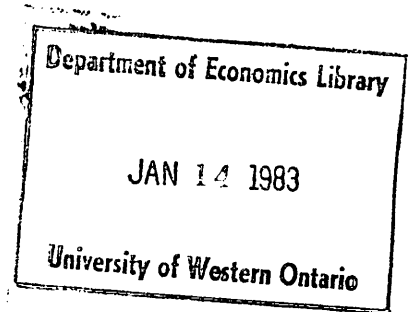
LONG-TERM CONTRACTS FOR PETROLEUM COKE

by

Dr. Victor P. Goldberg

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Thurs. Jan. 20, 1983 Room: 4032SSC 4:00pm



Major funding for the Centre for Economic Analysis of Property Rights has been provided by the Academic Development Fund, The University of Western Ontario. Additional support has come from The Bureau of Policy Coordination, Consumer and Corporate Affairs. The views expressed by individuals associated with the Centre do not reflect official views of the Centre, The Bureau of Policy Coordination, or The University of Western Ontario.

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# Long-Term Contracts for Petroleum Coke

Victor Goldberg and John Erickson

## 1. Introduction

Firms often find it to their advantage to enter into long-term contracts shielding themselves to some degree from the play of market forces. The structure of their contracts will reflect the purposive behavior of the parties given the opportunities and constraints (including the costs of information and enforcement) they confront. While in recent years economists have shown considerable interest in long-term contracts, there has been relatively little empirical work. In this paper we examine in detail the contracts utilized for a particular product—petroleum coke. The analysis does not hinge on attitudes toward risk; it is not necessary to make the assumption that is common in the theoretical literature that at least one of the parties is risk averse.<sup>1</sup> Instead we emphasize the "relational" or "transactions costs" features of exchange.<sup>2</sup>

Section 2 provides some background material on petroleum coke. In Section 3 we begin to consider the determinants of the structure of the contracts prior to 1973.<sup>3</sup> Sections 4 and 5 focus on problems concerning quality and price adjustment. In Section 6 we analyze a set of post-1973 contracts. In Section 7 we present some conclusions and speculations about how these results might generalize.

## 2. Petroleum Coke: Its Production, Processing and Uses

Petroleum coke is the unavoidable by-product of petroleum coking. This is a process which takes the heavy residual oils left over from the initial distillation of crude oil and, through the application of high temperatures, produces gas oil and petroleum coke. The former can be further processed into lighter distillate fuels such as gasoline, turbine and diesel fuels and light fuel oil. Approximately 25% of the residual oil used as a feedstock to coking is reduced to coke while the remainder becomes gas oil.<sup>4</sup> Unless coked, the residual oil would be processed into heavy fuel oil or turned into asphalt.<sup>5</sup> Thus, coking permits a low value residual to be upgraded to more valuable light and middle distillate fuels. The decision to engage in coke

production depends primarily upon the demand for heavy fuel oil in relation to the demand for the refinery's light and middle distillate fuels.<sup>6</sup> During the 1950's growth in the demand for the latter, especially gasoline, and the decline in the demand for fuel oil resulted in a doubling of coke production during the decade. The tighter environmental controls on the sulphur content of heavy fuel oils in the late 1960's caused another burst in the construction of coking capacity because of a decline of the relative cost of coking vis a vis desulphurizing heavy fuel oil. In 1970, 53 cokers were in operation in the United States (see Figure 1 and the Appendix); about 15% of the crude oil refined in the United States was coked.

Upon being removed from the drums in which it is formed, the coke, usually referred to as "green" coke, will vary in size from large blocks several feet long to small granule-like particles. Its principle constituent is carbon which makes up from 82% to 92% of its total weight.<sup>7</sup> It also contains volatile matter, ash, sulphur and trace metals. The amount of sulphur and metals in coke depends directly on the origins of the crude oil from which it comes and determines the use to which it is put. Generally, if petroleum coke has a low sulphur and a low metals content it is used for (1) the production of anodes for the electrolytic cell reduction of alumina to aluminum, (2) the production of graphite electrodes, carbon raisers, titanium pigments and synthetic graphite, or (3) the production of silicon carbide and ferroalloys. Coke with a high sulphur content (currently in excess of 4%-5%) is used for fuel in utility boilers and cement kilns, while coke with a low sulphur, high metals content is used as a substitute for coking coals in iron and steel production.<sup>8</sup> As general rule, the price of petroleum coke varies inversely with its sulphur and metals content, other things equal.<sup>9</sup>

However, green coke cannot be used for any purpose until it is processed in some form. Processing can include grinding, pulverizing sizing and screening or blending with coke of a lower sulphur content.<sup>10</sup> The most important form of petroleum coke

processing is calcining. The production of calcined coke requires premium quality (low sulphur, low metals) green coke. A calciner is a long, inclined cylindrical kiln with refractory bricks much like a lime or cement kiln. Green coke is fed continuously into the calciner at a controlled rate. As the coke moves through the kiln it is heated to temperatures of 1200 to 1350 degrees centigrade.<sup>11</sup> This process converts the coke from a hydrocarbon to a pure carbon eliminating the volatile elements, increasing its hardness and making it an excellent conductor of electricity while, at the same time, reducing its suitability for use as a fuel.<sup>12</sup> Calcining also reduces the weight of coke by 15% to 30%. Calcining raises the value of coke substantially. In 1970 a ton of low sulphur green coke sold for around \$10 while a ton of calcined coke sold for around \$30.<sup>13</sup>

Calcining is a continuous process. Calciners are typically operated twenty-four hours a day and are only shut down for repairs. An unanticipated interruption in the operation of a calciner could result in damage to the refractory lining of the calcining kiln due to a reduction in temperature.<sup>14</sup> The typical calcined coke contains about 97% to 98% carbon, 2% to 3% sulphur and about 0.5% volatile matter with smaller amounts of other impurities.<sup>15</sup>

The primary use of calcined coke is the production of carbon anodes for the aluminum industry. Production of one pound of aluminum requires approximately 0.5 pounds of petroleum coke (or about 0.4 pounds of calcined coke).<sup>16</sup> In the 1970's about 75-80 percent of the calcined coke produced in the United States was used for aluminum anodes, about half of it being sold to foreign users (Table 1). About 40% of all petroleum coke is calcined.<sup>17</sup>

The Great Lakes Carbon Co. (GLC), the largest producer of calcined coke, pioneered the development of the market. Great Lakes began in 1919 as a seller of coal, but in the late 1920's the company began selling petroleum coke as a fuel. By 1932 the purchase and sale of petroleum coke had become its primary business.<sup>18</sup>

Prior to the activity of Great Lakes, there had been no significant market for petroleum coke. During the late 1920's and early 30's small quantities of petroleum coke were used by the aluminum industry to produce carbon anodes. But the high cost of transporting green coke and the uneven quality of coke calcined in vertical kilns made coal coke the preferred input to the production of carbon anodes for the production of aluminum.<sup>19</sup> As a result, most coking refineries found it difficult if not impossible to market their coke. Instead they were forced to store it on or near refinery property creating the large and numerous coke piles associated with coke-producing refineries during this period.<sup>20</sup> Because coke is expensive to store, a fire hazard and a source of pollution, most refineries chose not to engage in coking at all.<sup>21</sup>

In 1934 Great Lakes Carbon developed a new method of calcining petroleum coke based on a rotary kiln which produced a much higher quality product than had previously been possible using vertical kiln calciners. Because of the greater efficiency of a rotary calciner as well as the higher quality product it made possible, the aluminum industry began, in the late 1930's, to switch from coal coke to petroleum coke as the primary input to anode production.<sup>22</sup> Great Lakes' calciners, their initial dates of operation, and their capacity as of 1964 are shown in Table 2. Twelve other firms operate twenty-one additional calciners with a total capacity about double that of Great Lakes'. (See Appendix)

Great Lakes served as a middleman, reselling its calcined coke to end users. Other calcining firms also served as middlemen, although, unlike Great Lakes, they typically sold a considerable amount of non-calcined coke. In 1959 Kaiser Aluminum and Chemical Co. became the first aluminum company to build a calciner. In subsequent years Kaiser added five additional calciners, and three other aluminum companies also built calciners. With the exception of Reynolds Aluminum's Baton Rouge plant, all the aluminum company calciners were quite small. Although Alcoa chose not to

integrate backward into calcining it purchased coke from refiners under long-term contracts and had its coke calcined by GLC. The aluminum companies did sell some calcined coke to other final users, although the major part of their calciner output was for their own anode production. While there has been a substantial amount of backward integration into calcining by aluminum companies, there has been very little forward integration by refiners. Continental Oil installed a calciner in 1956 but by 1970 only four of the thirty-five coking refiners had installed calciners.<sup>24</sup>

Transportation costs play a significant role in the economics of coking. There are two major concentrations in the Los Angeles and Gulf Coast regions (See Figure 1). Lesser concentrations in Oklahoma and the northern midwest account for most of the other facilities. Unless cokers have access to ocean ports or have calciners within a radius of 50 miles, shipping by rail was the cheapest alternative. As an indication of the magnitude of these costs we regressed 1968 rail freight rates against distance:<sup>25</sup>

$$F = 5.41 + 0.0038D \quad R^2 = .77$$

(7.6)            N = 85

where F is freight rates per ton mile  
and D is distance in miles.

That is, shipping costs independent of distance were about \$5.00 per ton and shipping coke 1000 miles would cost about \$4 more. At the time high quality coke sold for about \$10 per ton f.o.b. while low quality sold for about half that. Since calcined coke had a considerably higher value per pound, producers had a strong incentive to locate calciners near the source of supply and to transport calcined coke to the location of the end user. Consequently, unless the coker had access to an ocean port, coke was rarely transported between regions. If a coker were located near a calciner, trucking was a reasonably inexpensive alternative. In a number of instances cokers and calciners were physically adjacent so that no transportation (other than to or from the inventory pile) was necessary.<sup>26</sup>

The ability to dispose of coke was an important consideration for the operator of a coker. The production of coke has a "...vast potential to disrupt the entire operation of the refinery due to its rapid accumulation."<sup>27</sup> Because of its bulk, coke can be expensive to store. Coke is a fire hazard and a source of pollution unless it is put in covered storage.<sup>28</sup> The cost of storing coke not only includes the direct costs of preparing land, providing railroad spurs, water sprays, bulldozers and loading equipment, but it also includes the opportunity cost of the land employed for storage. Rapid processing of the coke can reduce the costs of carrying inventory. The location of the inventory depends on the relative costs of storage at the refiner's site versus the costs at the buyer's. The value of rapid removal to the coker and the ability of the buyer to remove and store the coke are significant determinants of the structure of the contracts.

In 1964 the Federal Trade Commission began an investigation of the long-term contracts between Great Lakes Carbon and eight oil refineries. The investigation culminated in a 1973 decision that the contracts violated the antitrust statutes and the remedy limited Great Lakes' contracts to a maximum term of three years. We will not concern ourselves with the antitrust issues here, as these are dealt with elsewhere by one of the authors.<sup>29</sup> The contracts collected by the Commission in its investigation are the primary data source for the following analysis.

### 3. Structure of the contracts

From the record of Great Lakes Carbon and the Federal Trade Commission's non-public files we have collected about 90 contracts which account for about 80% of all the domestic petroleum coke contracts written between 1946 and 1973;<sup>30</sup> in one-third of these contracts the buyer is Great Lakes Carbon. In this section we begin our analysis of the determinants of the structure of these contracts. Consideration of post-1973 GLC contracts is deferred until Section 6.



Long-term contracts enable the coking refiner and the buyer to coordinate behavior while stopping short of full, formal vertical integration. The contracts reflect the human characteristics of the transactors (their limited ability to process information—bounded rationality, their propensity for strategic or opportunistic behavior), the physical characteristics of the subject matter of the transaction (problems with defining and monitoring quality, the production technology, the ease of access to alternative buyers or sellers, the relation-specific nature of the physical plant, and so forth), and the reliability of external enforcement (legal enforcement or good will).

The contracts will embody the particular solutions developed by the contracting parties. Our working assumption is that the solutions are correct—that is, that the contracts are "efficient" adaptations to the problems faced by the contracting parties. We can work backwards and ask why particular contract terms (or patterns of terms) might be efficient.

Two caveats are in order. First, a written contract is at best an imperfect representation of the underlying economic relationship. The written document is typically an incomplete specification of the terms and conditions. Moreover, even the terms and conditions explicitly included in the contract can be changed or suspended temporarily; indeed adjustments to changing conditions are frequently made without consulting the written contracts.<sup>31</sup> The documents will reflect the concerns of the parties as filtered through their lawyers and conditioned by their expectations regarding the reasonableness of the opposite party in adjusting to unspecified contingencies.<sup>32</sup> Second, our working assumption is only a research strategy, not an article of faith. People do stupid things and in some instances the best explanation of why a particular term was adopted is that the parties made a mistake. There are two countervailing forces influencing the likelihood that petroleum coke contracts would embody mistakes. On the one hand, considerable time and effort went into designing the contracts. Contract terms were not simply lifted off the shelf. On the other hand, the long

terms and the infrequent participation in the market by most of the buyers and sellers<sup>33</sup> meant that contract terms were not necessarily "equilibrium" terms—the results of market forces rewarding winners and penalizing losses. That is, the contract terms meet only the weak test of birth, not the stronger test of survival.

Consider a situation in which the value of a coker depends upon the continued operation of the buyer's calciner, and vice versa. The parties have a joint interest in devising a mechanism that allows the coker to rely on the future operation of the calciner while still allowing for "good faith adjustment." The greater the relation-specific investment, the more valuable is the protection of the coker's reliance interest. This protection can be accomplished by imposing exit costs on the calciner—for example with a lengthy contracting period or liquidated damages for unexcused terminations.<sup>34</sup> Likewise, the calciner's reliance interest will require protection of a similar kind.

The parties also face a short-run coordination problem. The coker's costs depend upon the rate at which coke is removed from the refinery. If coke is removed too slowly, the coker is faced with a number of costly options. It could accelerate the search for new customers, reduce the selling price, add to inventory if storage space is available, reduce the production rate, or, in the limit shut down its coking operation. The opportunity cost of refinery products not produced is a significant element of the cost of untimely removal. Since oil companies would substitute output from non-coking refineries, the cost would be related to the difference between the net returns from coking and the refiner's next best alternative.

The buyer also faces costs if the rate of delivery deviates from the optimal. If too much coke arrives the firm would have to store it or otherwise dispose of it. If too little, then the calciner (assuming the buyer is a calciner) must either draw down inventory, acquire coke from an alternative supplier, produce at an inefficiently low rate, or, in the limit, shut down. Moreover, if the buyer had committed the

output to meet obligations to its customers or for its own internal uses, a shortfall in output would entail additional costs.

An integrated firm would face the same problem of balancing these various costs. The problems are compounded, however, when the decisions are to be made by independent firms. To facilitate coordinated, adaptive, sequential decision-making the parties could establish channels for conveying exchange-related information or set up procedures to deal with disputes, e.g. arbitration. Also, they could build incentives into the contract for controlling the costs arising from miscoordination by assigning these costs to the party in the best position to control them. Our primary focus will be on the locus of responsibility and on the incentive structures. In the remainder of this Section we will focus on the means by which the contracts dealt with the long-and short-run coordination problems. We have divided the contracts into four groups—Great Lakes, other middlemen, aluminum companies, and other end users.

3.1. Great Lakes' Contracts. A number of features common to most of the GLC contracts influenced their basic structure. Virtually all the coke contracted for was low sulphur, high quality coke suitable for calcining.<sup>35</sup> The coker's capacity was usually considerably less than GLC's calciner capacity; for example, in 1963 GLC's Port Arthur calciner purchased at least 15,000 tons of coke from eight refiners and the Calumet calciner had similar purchases from six.<sup>36</sup> Moreover, GLC maintained over 250 acres for coke storage at ten different locations. The storage capacity was about three million tons; in 1963 and 1964 its average inventory was about two million tons which was equal to about one year's purchases.<sup>37</sup> Consequently, GLC was not particularly vulnerable to variations in the flow of coke from any single source. Sellers, on the other hand, generally had little storage capacity. High transportation costs made it particularly difficult for refiners in the Kansas-Oklahoma region to count on finding feasible alternative calciners.

Almost all the contracts were full output contracts with GLC bearing all the risks of changes in the rate of coke output. A typical clause read:

Quantity: This Agreement shall cover all Coke produced by seller during the period aforementioned at its refinery at Wichita, Kansas. It is expressly understood that Seller reserves the sole right to determine when and in what quantity coke shall be produced, and that seller shall be obligated hereunder to sell and deliver coke to Purchaser only as, when, and to the extent it is produced. (CX2)

In addition, GLC was usually responsible for immediate removal of the coke:

No intermediate storage, between production and loading of railroad cars, shall be required of Seller: provided, however, that Seller may, for its own convenience, maintain such intermediate storage as it may desire from time to time. (CX9)

The GLC contracts were generally of long duration, especially when a new coker was involved. Nine of the ten contracts written between 1946 and 1961 involving new cokers were for a period of at least ten years.<sup>38</sup> In addition, the parties sometimes increased protection of the cokers' reliance by extending the contracts well before the contract period had expired. For example, the 1955 ten year contract with CRA's Coffeyville, Kansas coker was extended twice; once after the first year of operation for an additional four years and then six years later for an additional five years. (CX4, CX408, CX409).

The full-output contracts obligated the sellers to sell only if they produced. They could terminate without legal obligation if they ceased production of coke at the refinery. Termination for the purpose of selling to another buyer would, however, constitute a breach of contract and the seller would be liable to GLC for damages. The contract was asymmetrical in that GLC did not have the option of ceasing performance without being liable for damages. The asymmetry reflects GLC's lesser need to protect its reliance.

Breach would be excused legally only for specified conditions having to do with changes in the coke's quality or price or for circumstances beyond the parties' control.<sup>39</sup> Since the contracts did not customize remedies, the rules of contract law would apply.

While there are some difficulties in measuring future damages in a long-term, full output, variable price contract, the basic principles are reasonably straightforward. Damages to GLC would be the difference between the contract price and the cost of substitute coke delivered at GLC's calciner. Seller's damages would be the difference between the contract price and the cover price; damages would probably not include costs stemming from shutting down the coker because of an inability to find someone else to provide timely removal of the coke.<sup>40</sup> Application of these rules is not simple, however. If, for example, GLC breached a contract with five years remaining, how does the court determine the quantity, price, and cover price? Indeed, in the one instance in which GLC was sued for breach, its lawyers argued that there would be no damages because the contract was void for a "lack of mutuality." (The court found for GLC on other grounds and found it unnecessary to rule on this defense.<sup>41</sup>) The legal remedy's ambiguity makes the legal costs of premature termination an uncertain sanction. The adverse effects on reputation of an unjustified premature termination are almost certainly the more effective sanction.

A few of the contracts allowed for termination without penalty at specific dates. For example, GLC's twenty year agreement with American Oil provided for termination after ten and fifteen years:

Either party shall have the privilege of terminating this Agreement effective as of January 1, 1970 or January 1, 1975 by notifying the other party in writing at least six (6) months before the effective date of termination. (CX1)

A 1970 contract with Sunray DX was similar, but the periods were much shorter:

The term of this agreement shall be for the period from March 1, 1970 to and including the 28th day of February, 1973, and shall continue in effect thereafter for successive three (3) year terms unless terminated as herein provided. (CX1324)

Two contracts (CX 14, 15) concerning new cokers in the Los Angeles region in the late 1960's have some unusual features. They were the only GLC contracts in our sample that utilized a form of commission pricing. Despite the concentration of coking

and calcining in the Los Angeles region, there was not sufficient calcining capacity available for the new cokers; the coke, although of high quality, had to be shipped out of the region. Each seller could hold up to two months of inventory, so that timely removal, while desirable, was not so critical as for other cokers where storage capacity was much less. Great Lakes, which already had extensive customer contacts in Japan<sup>42</sup> and had ample storage capacity on the West Coast had a great advantage over the other middlemen. Testimony indicated that only GLC was willing to accept a full output contract for these cokers.<sup>43</sup>

The term of these contracts was substantially shorter than the other contracts involving new cokers--three and five years respectively. The shorter term suggests that the cokers were less concerned about the availability of alternative purchasers than if they were dealing with a land-locked calciner. Performance of the contract probably did not give GLC "first mover advantages" vis a vis its competitors.<sup>44</sup> Rather, since information developed by GLC regarding the existence of customers was revealed to the coker,<sup>45</sup> GLC's market development effort was made available to potential competitors. The competitors' ability to compete when the contracts were reopened was quite probably improved.<sup>46</sup>

The price was set at 90% of the net resale price--resale price minus the costs incurred by GLC in reselling the coke if these costs had not been reimbursed by the customer.<sup>47</sup> If in any month the costs of resale were to exceed the selling price, the Seller would credit GLC's account with the amount of the excess. If costs were to exceed resale price for a three month period the coker had the option of terminating the agreement on ninety day notice.

The coke covered by these agreements was either shipped directly to Japan or moved to GLC's storage facilities for subsequent shipment to Japan. If GLC negotiated a sale of coke to a Japanese customer, it had to designate the source for that particular shipment of coke. This presented some obvious difficulties. If all the coke for the

Japanese market were purchased at the same commission rate, GLC would be indifferent as to which coker it designated as the source for each order; the sellers, however, would care since the net prices would differ. If commission rates in the contracts differed or if GLC had purchased some coke at a fixed price, GLC would have an incentive to fill the lower net price orders with coke from the contracts with the lower commission rates. The contracts provided a mechanism for constraining such behavior. If the average net price for a calendar year exceeded the average net price of all "Western Coke"<sup>48</sup> sold by GLC in that year, then GLC would have to repay the excess multiplied by the number of tons delivered under the contract during the year. GLC was responsible for determining the average selling price, but the Seller had the right to require an audit, the cost of the audit being borne equally by the two firms.<sup>49</sup>

3.2 The Middleman Contracts. While the GLC contracts generally dealt with calcinable coke with no convenient alternative buyers, most of the non-GLC middlemen contracts dealt with a very different situation. Coke was often of low quality (high sulphur content), and cokers had ample storage capacity. The resultant contracts differed substantially from those used by GLC. Even those contracts involving calcinable coke differed in significant ways from those used by GLC. We will first discuss the contracts for low quality coke.

The low quality coke contracts often covered the entire coker output, but they differed from GLC's by allowing intermediate storage. Cokers promised to provide in advance an approximate schedule of coke production to facilitate the buyer's planning, but they refused to be bound by the schedule:

Skelly shall give Republic not less than fifteen days notice of its anticipated coke production schedule for each three months period during the term of this contract beginning with the third quarter of 1962. Skelly, however, may change an estimated production schedule at any time and shall give Republic as much notice as possible of any such change. (CX 40)

The contracts were for a much shorter duration than those involving calcinable coke. Contracts typically were for less than five years and termination was not so difficult.

The coke was sold on a commission basis, with the middleman paying about 95% of the resale price, f.o.b. the refinery.<sup>50</sup> It is tempting to explain the commission pricing as "risk sharing". The high ratio of transportation costs to value and the paucity of uses for high sulphur coke make the variance of returns higher than for resellers of calcinable coke. Rather than pay a fixed price and bear the risks of resale price fluctuations, the middlemen utilize commission contracts which share that risk with the coker. While tempting, this explanation is almost certainly inadequate. Commission pricing has a number of desirable properties even if both parties are risk neutral. It is one way of adjusting prices over the life of the agreement. (Price adjustment will be discussed in Section 5, below.) More importantly, the commission price allows the parties to avoid some of the ex ante costs of gathering information. With a fixed price contract, the middleman has an incentive to line up resale contracts before negotiating the initial price; the coker also has an incentive to acquire information on the resale market lest the middleman use the additional information to extract the lion's share of the rewards.<sup>51</sup> The commission contract can also reduce some ex post costs. With a fixed purchase price the middleman has an incentive to search for a high resale price and impose some of the search costs arising from slow removal on the refiner. For example, the refiner might carry a larger inventory of coke or it might have to draft complex contract terms which better control the rate of removal.<sup>52</sup> Commission pricing also can reduce the probability of breach thereby enabling the parties to avoid the costs of termination and renewed search and the costs of protecting themselves from the consequences of breach.<sup>53</sup>

The "risk aversion" explanation suffers further when the commission pricing arrangement is scrutinized more closely. A typical clause reads:<sup>54</sup>



The price Republic shall pay to Great Northern shall be \_\_\_% of the actual price f.o.b. Pine Bend refinery, before cash discount, at which Republic resells the coke. Prior to the beginning of each calendar quarter Great Northern and Republic shall determine by agreement the minimum average price per ton that Great Northern shall charge Republic for the coke sold to Republic under this agreement during the subsequent quarter. Great Northern agrees, if necessary because of extenuating circumstances, to renegotiate a previously agreed minimum average price per ton for any given quarter. In the event that the price paid by Republic to Great Northern for coke delivered during such quarter results in an average price per ton which is less than the minimum average price agreed upon for such quarter, Republic shall pay to Great Northern within fifteen (15) days after the end of such quarter period, an amount equal to such deficiency multiplied by number of tons of coke delivered during such quarter. (CX56)

If the middleman is relatively more risk averse than the oil refiner, why would it accept a risk sharing rule that gave it five percent of the proceeds above the minimum average price and one hundred per cent of the losses below that price? Surely, something aside from risk aversion is at work. The minimum average price can be explained in terms of selling effort. Thus, suppose that the middleman can increase coke sales by either decreasing price or increasing selling effort (negotiating harder or searching more intensively for customers who are close to the plant and would therefore pay a higher f.o.b. price than customers who have to absorb more freight). The middleman would be indifferent between two price/effort combinations that yield the same profit, but the refiner would not; it would prefer the high price/high effort option. Thus, while a firm, fixed price might result in too much selling effort, a fixed minimum price can prevent commission pricing from yielding too little effort.

If the parties could not agree on a minimum price, the contract was terminable on thirty days notice. However, the seller agreed that "it will not offer to sell coke at or below the price Republic offers to pay during that period." (CX 56) Republic, in effect, had the opportunity to match any outside offer.

Middlemen also acted as intermediaries for aluminum companies which would then either calcine the coke or have it calcined for them by another firm. For example, Republic had a long-standing arrangement in which it arranged for sale of

coke from American's refineries at Whiting, Indiana and Sugar Creek, Missouri to the Aluminum Company of Canada; Whiting coke was also delivered to Kaiser. Republic's contract with American was on a year-to-year basis, but as an officer of American made clear the relationship was of a more permanent character:<sup>55</sup>

Republic Coal & Coke's one year basis involved a somewhat unusual circumstance, as this concern has been our representative for about twenty-eight years. They have worked as an extension of American's Marketing Department; being located in the Chicago area and meeting with manufacturing and sales personnel monthly to work out minor details on quality and customer complaints. Because of their rapport and the way this arrangement has evolved, this type of an agreement would most likely not work satisfactorily with any other concern.

Republic would, subject to American's approval, agree to sell specific quantities of coke to the Aluminum Company of Canada for five years at a specific price (subject to escalation); from this price it would subtract its standard commission.<sup>56</sup> While the quantities and prices were contractually fixed, they served more as a planning device, since they were routinely revised, as can be seen in Table 3.

In the 1950's Union Oil and Collier entered into two contracts to provide coke for new calciners to be constructed by Collier in proximity to Union cokers. (CX 43, CX 66) The contracts were similar in a number of respects. Both were for the full output of the coker and gave Union Oil the option of suspending, reducing, or discontinuing production of coke. Union maintained ownership of the coke stockpiles.<sup>57</sup> Both were for long periods--the Oleum contract was for ten years<sup>58</sup> and the Santa Maria contract for twelve. However, they adopted very different mechanisms for protecting reliance.

At Oleum, the contract imposed a ceiling on inventory of 50,000 tons--approximately three months output. If the inventory exceeded that amount, Union could dispose of the excess or insist that Collier remove it.

We...agree that should we make sales, we will offer an equal quantity to you and that price of the product so offered to you shall be ten percent less than the ex tax price at which we offer to others. You shall have ten days after receipt of such offer within which to accept. Failure to accept the offer within that time will not relieve you of your obligation to purchase coke to the extent that it is not sold to others. It is further agreed that we may, at our option, require you to remove such excess coke within sixty (60) days after notice to you to that effect, and you agree to remove the same within such time at your expense and to pay us 50% of the price for coke determined under the provisions of the pricing clause. (CX 43)

The contract also specified a minimum obligation:

It is agreed that prior to June 30, 1964, we will supply and you will lift hereunder a minimum of one million tons of coke, and that the minimum quantity we will supply and you will lift hereunder during any contract year shall be an amount determined by subtracting the number of tons delivered to the stockpiling area up to the beginning of such year from 1,000,000 and dividing the result by the number of contract years then remaining prior to June 30, 1964.

It is further agreed that we may, at our option, at any time discontinue, suspend or reduce our Oleum coke production, and that if such should occur prior to June 30, 1964, and we have not by that time made available to you such minimum of one million tons, we will, to the extent necessary, make available to you an amount of coke of similar quality, equal to such deficiency prior to June 30, 1964 from sources of our own choosing. Any such coke not produced at Oleum will be delivered f.o.b. your Santa Clara plant and the price you will pay will be the contract price...plus an amount equal to the cost of transportation of such coke from Oleum to your Santa Clara plant. (CX 43)

The minimum obligation was approximately forty percent of the coker's capacity for the ten years. Collier therefore received more assurance of supply (and gave less assurance of removal) than did GLC. Whereas GLC would usually agree to pay the contract price for all the output, Collier agreed to pay contract price for the minimum obligation plus half the contract price for coke in excess of the ceiling. Put differently, the marginal price of coke above the minimum quantity was half the contract price. Furthermore, while GLC typically allowed the supplier the unconditional right to cease production, Collier could require Union to provide it with one million tons from some other source.

At the Santa Maria site, the main device for protecting Collier's reliance was maintenance of a very large inventory.

To protect yourselves against...reduction, suspension or discontinuance of production of coke by us, you may allow inventory of coke in the stockpiling area to build up to any quantity but not more than 500,000 tons. (CX 66)

This maximum was approximately two years output. Collier's calciner was to be built on land owned by Union adjacent to the coker. As part of the agreement Union sold 39 acres to Collier at \$500/acre for a plant site; it also leased sixty additional acres at \$1 per acre per year for storage and waste products disposal. Collier could sell the plant site, but the contract gave Union an option to purchase at the price offered by a financially responsible third party. If, however, Collier remained the owner, nothing in the contract prevented Collier from switching suppliers at the end of the contract period. The term of the lease for the land for stockpiling was coextensive with the contract term; if the contract were terminated Collier would bear costs arising from termination of that lease:

Upon termination of the lease, we will notify you of the facilities we desire removed from the land leased to you, and you agree to remove all such facilities within six months from and after termination of the lease period. In the event that you fail to remove such facilities within the time stated, title thereto, at our option, shall pass to us, or at our further option, we may remove such facilities at your expense. (CX 66)

Since, however, the stockpile was owned by Union, the costs imposed on Collier by terminating the lease were modest.

3.3. The Aluminum Contracts. Ten contracts between refiners and aluminum producers were included in the record. Some significant features of the context of these agreements are summarized in Table 4. Only the LaGloria-Alcoa contracts (4,6) did not concern construction of either a new coker or calciner; these agreements, not surprisingly, were for a much shorter period than the others. At three locations the contracting parties were engaged in the simultaneous construction of an adjacent new coker and calciner. All the contracts reflected the aluminum companies' desire for assured supplies.

Whereas in the Great Lakes Carbon contracts the refiner was responsible for determining whether, and how much, coke should be produced, in the aluminum contracts the decision was in the hands of the buyer. All the contracts specified a minimum level of output. In no case did the buyer agree to take all the coker's output, although in all but two instances the contract quantity was close to the coker's capacity.<sup>59</sup> Moreover, in nine of the agreements the coking refiner could not refuse to produce coke without being liable for damages.<sup>60</sup>

The one exception was the Humble-Kaiser agreement (CX 68). Humble's coker at Billings produced a high sulphur (6%) coke. Coke from the refinery was stockpiled by Humble and at the time it entered into the agreement with Kaiser the stockpile was approximately 200,000 tons. Kaiser constructed a special calciner in Mead, Washington that could utilize the high sulphur coke as feedstock. The contract stated:

It is understood that the coke is a by-product of petroleum refining at the Billings Refinery and that Humble may at any time on its sole discretion reduce or suspend the production of coke.

. . .

After two hundred thousand (200,000) tons have been delivered if by reason of any such reduction or suspension of such coke production, Humble is unable to produce and sell to Kaiser said fifty thousand (50,000) short tons in any given contract year, either from current production or stockpile..., Humble may on at least six (6) months' prior written notice to Kaiser to that effect reduce its deliveries to the extent required by such reduction or suspension. The notice shall state the amount of reduction in deliveries.

The initial inventory assured supplies for the first four years. Further, Kaiser would receive six months' formal notice and much more informal notice since in the four years required to deplete the initial stockpile Kaiser should be able to revise its forecasts regarding Humble's ability to produce new coke.

Another device for providing protection of buyer reliance was utilized in the Cities Service-Swiss Aluminum contract (CX 25):

At the end of the original term, this Contract shall be renewed automatically for successive twenty-four (24) month periods unless either party gives two years notice .... If CITIES shall notify BUYER of its termination of this Contract..., BUYER shall have the exclusive right for

one (1) year thereafter to negotiate a new contract with CITIES, to be effective on the expiration date of this Contract, for the purchase of a minimum quantity of one hundred ten thousand (110,000) tons of Coke per annum of the quality to be produced at the Lake Charles Refinery.

Four of the contracts included explicit damage rules if the buyer took less than the contract quantity. A fifth, Cities Service-Swiss Aluminum (CX 25) included an explicit statement of the standard damage rule of the common law and Uniform Commercial Code:<sup>61</sup>

If such default by BUYER occurs, CITIES may sell Coke in the open market, as produced, at the best price obtainable and BUYER shall pay CITIES at the end of said month in which such default occurred, as liquidated damages and not as a penalty, the excess (if any) of the base price or base price as escalated over the selling price for such ton of Coke sold by CITIES in the open market.

The damage rule in the Humble-Kaiser (CX 68) agreement is less binding than the UCC. Since Humble built its coker without relying on anybody to remove the coke, and since ample inexpensive land was available for storage, little protection was necessary. The contract allowed Kaiser to reduce its purchases at short notice:

If at any time or times Kaiser's primary aluminum production at its various aluminum plants for any reason is reduced, suspended, cut back, or rescheduled, Kaiser may at any time, on ten (10) days' prior written notice to Humble to that effect, reduce its purchase hereunder to an amount deemed necessary by Kaiser in its sole opinion.

If Kaiser took less than 40,000 tons for two consecutive years, then Humble's future obligations to sell to Kaiser were reduced. In the subsequent year it could sell to others  $N(50,000 - A/2)$ , where N is the number of years remaining in the contract and A is the actual sales to Kaiser in the two years. In the remaining years of the agreement, Humble's obligation to Kaiser would be reduced to A/2. To make the sanction even weaker, Kaiser could, within 60 days of receipt of

Humble's notification of intent to exercise the option,...notify Humble in writing of its election to be bound for the remaining term of this Agreement to purchase and accept delivery of coke at an annual rate per contract year as specified in... the contract , which notification shall cause the option right in Humble to be void and of no effect.

The other three agreements recognized the refiner's reliance and established damages greater than standard contract law. If Alcoa did not accept delivery of coke from Gulf, it would still have to pay and the coke would be held by Gulf for Alcoa. If the inventory rose to 5,000 tons (about ten day's output)

Gulf may make sales...for Alcoa's account at not less than 90% of the then current spot market price. Within thirty (30) days after receipt of the proceeds from each such sale, Gulf shall deduct therefrom the sum of One Dollar (\$1.00) per net ton and pay the balance to Alcoa.

If the inventory reached 10,000 tons, Gulf could shut down its coker and Alcoa would have to pay a "stand-by" charge during the shutdown period at the rate of \$75,000 per month. This works out to about \$5 per ton of coke not produced; since the contract price without escalation was \$12, the stand-by charge was nearly half the price of coke. Alcoa, in effect, faced a multi-part pricing rule with the marginal price being \$7 per ton (subject to escalation).<sup>61a</sup>

In January 1960, Reynolds initiated discussions with Humble regarding the possibility of the simultaneous construction of a coker and calciner that would provide all Reynolds' calcined coke requirements:<sup>62</sup>

Most Gulf Coast refineries have not installed cokers because of periodic peaks in fuel oil prices, which made it more desirable to sell residual oil as fuel oil than to coke. To evaluate today's economics, we retained a leading builder of refineries to make a study of coking in a typical Gulf Coast refinery. Their report shows that such a refinery would obtain, at today's prices, more than a 50 percent annual return on the investment in the coker, after taxes. We recognize that this return is largely dependent on the Gulf Coast price of fuel oil, which has been low for the past two years.

Neither of your two large Gulf Coast refineries, at Baton Rouge, Louisiana, and at Baytown, Texas, have cokers. We would like to discuss with you a long-term coke purchase contract on a basis which would make it attractive for you to install a delayed coker at one of these refineries. We would guarantee to take the entire output of the coker, and we would be willing to share the risk of rising fuel oil prices by providing suitable escalation on the price of coke. From our standpoint, we could make appreciable savings by installing a large calcining plant adjacent to the refinery. From this central location on deep water, we would ship calcined coke to our various aluminum reduction plants both here and abroad.

A contract was entered into in September, 1961, and the coker and calciner were in operation by Spring, 1963.<sup>63</sup> Reynolds agreed to take a minimum of 330,000 tons of coke per year which it would either use itself or resell. Reynolds had the right to reduce its obligation if its estimated domestic aluminum primary ingot production were to fall below 420,000 per year. Since this output level would require only about 210,000 tons of petroleum coke, Reynolds, in effect agreed that in the event of a decline in demand for its aluminum it would be fully responsible for disposing of the 120,000 tons of coke not needed for its own operations. For each ton by which Reynolds' projected aluminum production fell below 420,000 Reynolds was relieved of taking .78 tons.<sup>64</sup> Since its own coke usage would decrease by .5 tons, Reynolds obligation to sell coke on the open market was reduced by .28 tons. But Reynolds still bore a large portion of the financial responsibility for this coke:

With respect to any portion of the difference between 330,000 short tons and the minimum specified in the notice which is sold to others than Reynolds, Reynolds shall pay to Humble one-half of the difference between the contract rate and the selling price if the selling price is smaller. With respect to that portion of such difference which is not sold to purchasers other than Reynolds, and regardless whether or not such portion is actually produced by Humble, Reynolds will pay to Humble one-half of the contract price in effect at that time. (CX 31)

Reynolds could reduce its minimum obligation, then, only if it was prepared to pay a fee of half the contract price per ton for coke not produced—a fee which is very similar to the stand-by charge in the Gulf-Alcoa contract.

In 1967 the contract was revised since "Reynolds, because of the projected need for additional green delayed coke, has requested Humble to increase the quantity of green delayed coke supplied by it to Reynolds." (CX 418)<sup>65</sup> The new agreement was for 600,000 tons. The arrangement for dealing with a reduced demand for Reynolds' aluminum was carried over to the new contract with only minor changes in the numbers. This contract added a new wrinkle by reducing the marginal price faced by Reynolds; the first 430,000 tons each year cost \$12.50 while the price for the remainder was



\$10.50.<sup>66</sup> Since Reynolds' projected coke requirements for the early 1970's were only around 500,000 tons per year, the contract committed Reynolds to becoming a serious marketer of calcined coke.<sup>67</sup> Vertical integration into marketing enabled Reynolds to provide added assurance to Humble that it stood ready to remove Humble's coke. This arrangement enabled Humble to achieve greater scale economies than if Reynolds were the only buyer and had agreed to take a smaller amount that would have been closer to its actual needs or if it had agreed to a requirements contract.<sup>68</sup>

Alternatively, the parties could have utilized a fixed quantity contract and relied upon other middlemen to remove the remaining coke. This is, in effect, what Richfield and Harvey did.<sup>69</sup> While Richfield was engaged in constructing a large coker at its Watson refinery, it sought out potential buyers of coke. Harvey agreed to construct, on land leased from Richfield and adjacent to the refinery, a calciner capable of handling about one-fourth the refinery's output. To assure an adequate flow of coke to keep the calciner operating at capacity, the parties agreed that

[a]n adequate proportion of Richfield's production shall be accumulated by Richfield each month in a storage pile for delivery to Harvey....Richfield will at all times maintain a sufficient inventory of coke, which will provide constant monthly deliveries to Harvey of the quantity of coke Harvey agrees to purchase hereunder. (CX 17)

The contract period was fifteen years; however, under certain circumstances the contract could be terminated after only eight years. Richfield could terminate on 24 months notice in years eight through fifteen if it "is unable to provide coke of the quality and in the quantity required hereunder; Richfield's inability to supply such coke may result from changes in operating conditions of Richfield's refinery or changes in equipment or processes which may occur in the future." If Richfield did terminate, then Harvey, at its option, could:

(a) sell the calcining facilities to Richfield at the then fair market value of such facilities to be mutually agreed upon...or, in the alternative, the depreciated cost of such facilities<sup>70</sup> ..., or

(b) remove the facilities...from the leased site and substantially restore said property to its original conditions, or

(c) continue the operation of the calcining facilities, provided that the lease shall remain and continue in full force and effect to the expiration date of the Agreement in accordance with the terms of the Lease and Agreement.

Harvey could also terminate after eight years if it gave 24 months notice if "Harvey determines, in its sole discretion, for any reason or no reason whatsoever, it cannot use coke of the quality provided for in this Agreement." (CX 17) If Harvey terminated, Richfield had the option of buying the calciner at the fair market price or having the leased land returned to it in restored condition; the lease would automatically be terminated. If the contract were terminated in the fifteenth year, Richfield would have the option of buying the calciner at the fair market price or having the leased land returned to it regardless of which party initiated the termination.

The lease established a schedule of payments for use of the land; in the event of termination, the payment stream would be terminated. Converting these streams to present values, this is equivalent to Harvey paying a fee for usage and, upon termination, receiving a predetermined payment. The two parties might differ on their valuations of the two options because of different expectations regarding the future course of real interest rates and inflation, but that does not detract from the basic similarity of the lease arrangement with a sale plus automatic title transfer (as with the calciner). The lease does, however, mean that Richfield would be in a position to bear the risk of capital losses (or receive gains). If opportunistic behavior by Richfield during the life of the agreement were expected to reduce the future market value of the land, then the lease could raise the cost to Richfield of such behavior. This can, as Coase suggested, frequently explain why firms utilize leasing arrangements.<sup>71</sup> We are not very confident with this explanation, however, since in the one other instance in which a calciner was built on land originally owned by the coker (Union-Collier, CX 66) the land was sold to the firm building the calciner.<sup>72</sup>

The price of land, whether it was leased or sold, was unrelated to the quantity of coke. Thus, by charging one price for the land and a second price per ton of coke, the parties established a two-part pricing system. A divergence of marginal and average price can be utilized to increase the enforcibility of the initial agreement. If the marginal price is below the average, then Harvey would find taking less than the contract amount relatively unattractive. Likewise, if the marginal price exceeded the average, Richfield would be less likely to breach.<sup>73</sup> Since the contract price of \$3.10 per ton was only about one-quarter the current market price of equivalent quality coke, it seems quite certain that the rental fee was above the fair market rate and that the contract was designed to ensure that Harvey would continue to perform.<sup>74</sup>

Richfield had two other buyers of coke from the Watson refinery. Mitsui had a one-year, renewable, fixed-price contract for 50,000 to 70,000 metric tons per year for sale to Japan; Mitsui had the exclusive right to sell Richfield's coke in Japan and it agreed not to sell coke outside Japan without Richfield's consent. (CX 18) Wilson Carbon had an exclusive right under a six-year commission contract to sell Richfield's coke anywhere in the world other than to Harvey or in Japan. Wilson agreed to take a minimum of 200,000 short tons. If it took more than its quota in any year, "such excess shall be credited against the minimum tonnage quota for the following year or any year thereafter. Richfield has the option to cancel this agreement if Wilson is unable to take delivery of the minimum tonnages." (CX 19) Thus, in the three contracts combined, Richfield had firm commitments to remove about two-thirds the coker's capacity. For the remaining third, Wilson had the first option, but Richfield reserved the right to determine whether the additional coke should be produced:

Within the first six months of each calendar year, Wilson shall advise Richfield whether Wilson can only take the minimum tonnage quota or whether Wilson can take the entire tonnage that Richfield has available for sale through Wilson. Should Wilson not be able to take the entire available tonnage, Richfield shall then be free to sell such excess tonnage to Harvey Aluminum Company or for shipment to Japan. (CX 19)

Mitsui and Harvey had lesser claims on coke beyond their contract maximum. "Richfield further agrees to sell to Mitsui such additional quantities as Mitsui may require and Richfield may have available and not otherwise committed." (CX 18) Mitsui would be able to buy such coke at the contract price. Harvey's contract terms did not, however, carry forward to any additional sales:

If Harvey desires to buy additional coke above such quantity, Harvey may so notify Richfield from time to time, and Richfield will use its best efforts to supply all or any portion of the requested additional coke on terms agreeable to both parties. (CX 17)

The other aluminum contract for a small fraction of the coker's output allowed the buyer to take a fraction of the uncontracted coke at a new price. Except for the peculiar fraction specified in the contract, this appears to be a straight-forward procedure:

If CITIES, during any Contract Year, has available quantities of Coke in excess of the maximum quantity of one hundred fifteen thousand five hundred (115,500) tons ... and which are not committed by CITIES under any contracts in existence prior to December 31, 1964 with third parties, CITIES may first satisfy the requirements of its subsidiaries or affiliated corporations (if any) from such excess quantities of Coke, and, thereafter, CITIES shall give BUYER written notice as to the proposed quantity and price for seventy-six and two-thirds ( $76\frac{2}{3}$ ) percent of the remaining balance of said available quantities (if any) of said excess Coke. Within thirty (30) days after receipt of such notice, BUYER shall notify CITIES in writing of the quantity, if any, of said seventy-six and two-thirds ( $76\frac{2}{3}$ ) percent of said excess BUYER elects to accept and purchase. Thereupon, CITIES shall sell and deliver and BUYER shall purchase and accept such Coke at the price agreed upon for such increased quantity. (CX 25)

#### 3.4. Other End Users.

Union Carbide was the single largest user of petroleum coke for graphite products, purchasing over sixty percent.<sup>75</sup> Most of its calcined coke needs were accounted for by two unique arrangements. In 1956 it entered into an agreement with Continental Oil whereby Continental agreed to construct at its Lake Charles, La. refinery both a coker and calciner with a projected capacity of at least 87,000 tons of calcined coke

per year. Continental promised to produce a minimum of 65,000 tons per year and Union Carbide agreed to accept up to 87,000 tons. The contract was for ten years and

(a)t the expiration of this Agreement, Carbide shall be given first opportunity to purchase for a term of five (5) years calcined coke of the quality and quantity produced by Continental at the Lake Charles Plant at as low a price as Continental is willing to sell to any other party. (CX 28)

The second arrangement was extremely complex. Marathon leased land at its Robinson, Illinois refinery to General Carbon to build a calciner. General Carbon contracted to purchase all the output of Mobil's East St. Louis refinery (CX 404)<sup>76</sup> and Union Carbide agreed to purchase all Marathon's output for calcining at General's calciner (CX 36).<sup>77</sup> At the same time, General entered into a fifteen-year agreement to sell all the calcined coke to Carbide: "General will not calcine at the calcining plant any material except that to be calcined for Carbide without first attaining Carbide's written consent thereto." (CX 1225) To further complicate matters General Carbon sold the plant to a wholly owned subsidiary and then leased it back; the subsidiary mortgaged the plant as security for a fifteen year loan and Union Carbide agreed to make quarterly payments to General equal to the mortgage payments; in effect, Carbide guaranteed the loan.

The pricing formula for sales of General's calcined coke to Carbide was essentially cost-plus with General paying a penalty to Carbide if kilns were used below full capacity "due to no fault on the part of Carbide but due to causes within the control of General." (CX 1225) If costs were to decline due to improvements made by General in its operating procedures, the savings would be split equally. In addition,

Carbide shall at all times during usual business hours have access to the books and records of General to determine the accuracy or inaccuracy of cost and quantity information

Carbide shall have access to General's calcining plant at any and all times and shall have the privilege of suggesting changes in calcining operations, material handling, etc., to obtain improved quality of the calcined coke and improved or more economical operations. (CX 1225)

In the event of a default by one party, the other party could terminate on thirty day's notice. If Carbide defaulted, it would have to buy the calciner at a predetermined "condemnation" price; the contract included a schedule establishing that price ex ante on a quarterly basis for the full fifteen years;<sup>78</sup> Carbide's obligation to make mortgage payments to General would be eliminated. If General defaulted, however, Carbide had the option of continuing to pay the mortgage payments or purchasing the plant at the condemnation price. In addition, Carbide has the option of terminating without cause on six month's notice (and buying the calciner) after the fifth year and annually thereafter.

If a carbon product producer was not securing a coke supply for a calciner, it would usually be content to purchase its coke from middlemen. However, in some instances such producers chose to contract directly with a coker. The coker generally had more than one customer for its coke and was capable of carrying a reasonable amount of inventory; it was not purchasing removal services. As a result, the contracts typically gave very little protection to the reliance interest of either the buyer or seller.

The contract would either be a requirements contract or for a fixed quantity.<sup>79</sup> The seller was obligated to deliver coke only if it produced—it had the right to determine whether, and how much, to produce.<sup>80</sup>

It is understood that since CITIES' AFFILIATE will produce such quantities of commodity, if any, and at such times as shall in its sole discretion be advisable, CITIES' obligation for each month hereof shall be limited to obtaining for BUYER such quantity of commodity, if any, as is produced at said refinery during each calendar month hereof up to a quantity which will satisfy BUYER'S monthly commitment. (CX 27)

If the seller did not produce sufficient coke, the buyer would be free to meet its needs elsewhere and would have the option of terminating the contract:

If Seller is unable, in a given month, to furnish to Buyer the quantities of commodity otherwise due to Buyer hereunder, Buyer shall be entirely free to buy its requirements of commodity (over and above what Seller is in a position to supply) from third parties. If, in three successive months, or, on the average, during any six-month period, Seller is unable to supply Buyer with the quantities of commodity which Buyer is entitled to order hereunder, Buyer may terminate the agreement, on not less than thirty (30) days written notice to Seller. (CX 420)

The term of the contracts was short--one to five years. Moreover, in some of the agreements the buyer had the right to shop for a better price:<sup>81</sup>

If, on or after January 1, 1967, Buyer ascertains that it can purchase from a manufacturer in the United States, commodity of the same quality, upon similar terms and conditions, in a quantity substantially equivalent to but not less than the then undelivered quantity herein required for purchase during the remainder of the period for which this contract is then in force, and at a lower price than the then applicable price hereunder, and Buyer furnishes Seller evidence thereof, then if Seller shall not elect to reduce the then applicable price hereunder to such lower price for such undelivered quantity of product, Buyer may terminate this agreement by giving Seller thirty (30) days prior written notice of termination.

The Amoco and Vepco agreement to construct adjacent facilities in Yorktown, Virginia, was the only instance of a coker selling directly to a fuel customer. Amoco's refinery would buy electricity from Vepco and get some of its cooling water from Vepco's surplus. In turn, Amoco would sell coke and refinery gas to Vepco for use as fuel. The contract was for twenty years, but Vepco had the option of terminating after Amoco had delivered the equivalent of  $15 \times 10^6$  million BTU's (about five years production at full capacity) if Amoco's production fell below a specified minimum in a contract year. Vepco agreed to take any amount produced by Amoco up to 230,000 tons per year. If Amoco produced more, Vepco had the option of taking the additional coke at the contract price.<sup>82</sup> If in the first ten years Amoco failed to deliver at least  $15 \times 10^6$  million BTU's it was required to pay liquidated damages to Vepco equal to the shortfall multiplied by 37% of Vepco's average system fuel cost for the ten years (with a ceiling of \$1.8 million).<sup>83</sup> The contract price was calculated by taking Vepco's average system fuel cost per million BTU's for the previous twelve months

(30.3¢ at the time the contract was signed) and multiplying by a constant. For the first  $15 \times 10^6$  million BTU's the constant was 0.53; for additional quantities it rose to 0.79.<sup>84</sup>

The combination of this two-part pricing rule with the liquidated damage clause provided Amoco with an interesting combination of incentives. Suppose the arrangement had not worked out well for Amoco so that it had been producing at below 50% capacity and it was quite possible that it would fail to produce the minimum amount in the ten year period. In that case, for every ton that it produced it would receive the contract price (.53F) and would also avoid paying liquidated damages (.37F\*) where F is the current average fuel cost and F\* is the average fuel cost over the entire life of the contract. If  $F=F^*$ , the effective marginal price for coke is .9F, which is 70% higher than the apparent price. If, however, the project did work out well so that the minimum cumulative constraint was not binding, the pricing rule would give Amoco a somewhat greater incentive to continue producing coke in the later years of the contract than would a constant multiplier. This interpretation is bolstered by a contract amendment in the tenth year (CX 55). The price was .79F; however, in the event of termination, payment for the last 30,000 tons delivered (about 45 days output) would be .53F.

#### 4. Quality

The value of coke depends upon its quality--particularly the sulphur, vanadium, and ash content. When drafting a contract the parties could be silent on quality and simply establish a base price that reflects their expectations regarding quality over the life of the agreement. Since coke quality depends primarily on the characteristics of the crude oil feedstock, and since the choice of a feedstock is essentially independent of coke prices, there is little danger that a contract that left the quality level unspecified would result in a marked deterioration in coke quality.<sup>85</sup> Moreover, since in many instances removal of the coke is of great importance to the seller (particularly



if there exists little or no storage capacity), the seller would presumably be extremely wary of allowing the buyer to make removal of the coke conditional upon coke quality. Nevertheless, many of the contracts did specify quality and could be terminated if the seller failed to meet the quality standards. None of the contracts, however, made removal of coke contingent upon quality. Only buyer acceptance depended upon quality. Cokers shipped first and asked quality questions later. In this Section we will discuss how the contracts specified quality and treated deviations from the quality standard.<sup>86</sup>

Commission-price contracts, especially those for fuel-grade coke, rarely specified quality. The reseller and end user would have to resolve the quality issue in their contract; separate consideration of the issue by the refiner and reseller would be redundant.<sup>87</sup> If, however, the coke was removed from the refinery and commingled with the reseller's inventory, quality measurement would be more likely.<sup>88</sup> A typical fuel-grade coke contract read: "Great Northern makes no commitment or guarantee as to the quality of the coke herein covered and Great Northern shall, as far as possible, notify Republic from time to time of any change or anticipated change in the quality of coke produced or to be produced." (CX 56)

Quality specifications formalize the parties' expectations regarding coke quality during the life of the agreement. In that sense they serve an interorganizational planning function. They can also, however, commit the seller to meet minimum standards, or bear consequences for failure to do so. GLC's 1957 agreement with Texaco provides an example of a contract that does only the former:

Coke shall be run-of-still in size, this meaning that no preparation as to size is required of Seller by Purchaser after Coke is removed from the drums or stills in which it is produced. The average volatile content of Coke during any calendar month shall be not more than 15% by weight, dry basis, and Seller shall exercise reasonable care to produce Coke not exceeding an average ash content of 0.5% during any calendar month, and to avoid contamination of Coke prior to its delivery to Purchaser. Purchaser recognizes that the sulphur content of Coke produced by Seller is dependent on the nature of the crude oils used by Seller at each

refinery, and that the resulting sulphur content of Coke is not a factor in Seller's use of crude oils. However, it is contemplated that the sulphur content of Coke produced at each of Seller's several refineries will continue to be approximately the same during the calendar year 1956. (CX 11)

When this contract was renewed seven year later, GLC's quality concerns were given more recognition:

Seller agrees to cooperate with Purchaser in an effort to improve the characteristics of Coke by changes in processing conditions provided Purchaser clearly defines the nature of the characteristics that it is desirous to improve and the justification of making such improvement for commercial utilization of such Coke, and also provided that any such changes in processing conditions do not interfere with Sellers' refinery operating conditions unless with Seller's consent. Seller agrees to assign such personnel as Seller alone deems desirable to aid in its efforts to improve the characteristics of the Coke as Purchaser indicates is necessary for commercial utilization of such Coke. (CX12)

While some other contracts provided only quality guidelines, the bulk of the agreements provided specific standards. A typical agreement read:

Coke shall be the delayed type, run of still in size, and free of foreign matter, its sulphur content shall not exceed 1.75% by weight on a dry basis. Its volatile content shall not exceed 15% by weight on a dry basis. Its vanadium content shall not exceed 0.025% by weight on a dry basis. Seller shall use reasonable care to produce Coke with an ash content not in excess of 0.50% by weight. (CX2)<sup>89</sup>

A number of legal remedies were available to the buyer for coke that failed to meet contract specifications. We must emphasize, however, that the buyer often did not seek a remedy if the coke was below specifications but usable for the anticipated purpose. A 1947 letter from GLC to a seller regarding the high sulphur content of its coke nicely illustrates this point:<sup>90</sup>

At the moment we are short of coke so that we are glad to get any coke within reasonable limits as to sulphur content.

I cannot at this time say that this would hold true during the entire life of our contract but, as you know, it is the policy of this company to so handle our affairs as to do everything within our power to cause refineries with whom we are doing business to completely forget that they have any such thing as a coke disposal problem when they are under contract with us.

One device for coping with quality deviations was to spell out in the initial agreement a set of prices for coke of different qualities. A price schedule has the

virtue of being automatic, but it has the disadvantage of fixing the relative valuation of differing qualities over the life of the contract.<sup>91</sup> As an example, consider the twenty year agreement entered into by GLC and Amoco in 1959 (CX 1), which established a base price for coke with less than 2.0% sulphur and 0.02% Vanadium. If the sulphur content were to fall below 1.0%, the seller would receive a premium of 20¢ per ton for every tenth of a percent below 1.0%; it would be penalized 12¢ per ton for every tenth of a percent by which the sulphur content exceeded 2.0%. In addition, there would be a further penalty if the vanadium content exceeded 0.02%. Thus, for each 0.01% increase in vanadium content, the seller was penalized a specific amount depending on which of the three sulphur content categories the coke was in. The penalty was \$1.50, \$2.50, or \$3.50 per ton (as sulphur content increased). Only a handful of non-GLC contracts utilized price schedules for varying coke quality. GLC utilized the schedules in less than twenty percent of its contracts prior to 1968; in the next five years, however, such schedules were included in two-thirds of its agreements.

In a long-term contract the quality question takes two forms: (1) what happens if the seller delivers off-quality coke; and (2) what happens if it appears that the seller will continue to deliver off-quality coke? Setting a price schedule for different qualities deals with both questions. Other remedies are more specialized. Thus, if a particular shipment fails to meet the specifications, the buyer could reject the shipment, yet still be required to receive future shipments during the life of the contract. Some contracts explicitly spelled out the buyer's right to reject:

If said sample fails to meet the specifications for sulphur, ash, vanadium and volatile content as listed in Article 1 hereof, BUYER may reject the shipment of Coke represented by the sample and shall be reimbursed for the purchase price thereof, together with all transportation costs, including demurrage, and the cost of work performed by the independent laboratory; if the sample meets specifications, all costs incurred in connection with such laboratory analysis shall be borne by BUYER.

An adjusted price may be negotiated for any off-specification material that can be used by BUYER. (CX 24)<sup>92</sup>

The buyer's right to reject was included in only a few contracts. However, since this would be the normal remedy under contract law in the absence of specific language, this right was implicitly included in most of the contracts that included quality specifications.

Some contracts dealt explicitly with the possibility that future coke might be off-quality. The three options were renegotiation of the prices, termination, or suspension:

In the event Seller determines that it is unable at its Wichita refinery to manufacture Coke meeting the aforementioned specifications, Seller shall be under no obligation to sell, and purchaser shall be under no obligation to buy, such coke under the terms of this agreement. Seller and Purchaser agree to meet to negotiate terms under which such Coke may be sold by Seller and bought by Purchaser. (CX2)

. . .

Should the average sulphur content of the Coke delivered hereunder for a period of sixteen (16) consecutive weeks exceed 1.5% dry basis, Purchaser's sole remedy therefore shall be to give Seller written notice that it desires to terminate this Agreement. Should Purchaser give such notice, then Seller and Purchaser shall work together in good faith for a period of sixty (60) days in an attempt to solve such sulphur quality problem to Purchaser's satisfaction. If at the end of said sixty (60) day period the problem has not been solved, this Agreement shall terminate without prejudice or penalty to either party on a date six (6) months from the end of said sixty (60) day period.<sup>93</sup> (CX 1325)

. . .

In the event that the average sulphur content of coke delivered during any calendar month shall exceed 2% and be less than 2.25% by weight, Mobil agrees upon receipt of notice from General within ten (10) days after the end of such month to discuss a new and lower price covering coke containing sulphur exceeding 2% and less than 2.25% by weight. If a new and lower price is agreed upon then such price shall apply as to all deliveries commencing with the first day of the month within which the notice is given. Failing agreement upon a new price, the price set forth in paragraph 4 hereof shall continue in effect.

In the event that the average sulphur content of coke delivered during any calendar month shall exceed 2.25% by weight, General shall have the right within ten (10) days after the end of such month to give written notice of such fact to Mobil and to request negotiation of a new and lower price covering coke having an average sulphur content exceeding 2.25% by weight delivered during any calendar month after the month in

which the notice is given. Upon agreement as to such price, pricing of deliveries shall be governed accordingly. Failing agreement, Mobil shall be released from its obligation to sell coke to General until such time as its refinery operations may result in resumption of the regular production of coke having an average sulphur content during any calendar month not exceeding 2.25% by weight, and at such time deliveries to General shall be resumed pursuant to all of the terms hereof. The expiration date of the contract shall not be extended by reason of the provisions of this paragraph. (CX 404)

The majority of contracts with quality specifications were silent on remedies and, therefore, incorporated the standard rules of contract law. Two GLC contracts were terminated prematurely ostensibly because quality failed to meet specifications and one of these terminations resulted in a lawsuit that was finally resolved by the Oklahoma Supreme Court.<sup>94</sup> A summary of these two instances will provide a useful picture both of the nature of the legal remedies and of the manner in which the parties attempted to resolve the difficulties before resorting to the legal process.

To put these terminations in context, it is important to note that both took place in 1962, when the coke market was very soft. GLC's attorneys described conditions in the industry in a letter to the FTC:<sup>95</sup>

Great Lakes because of temporary, unforeseeable market conditions, was forced to make distress sales of some of its more costly coke to users in the steel and carbide industries and for fuel purposes. Those transactions were the product of economic conditions then prevailing. As you will recall, in the early sixties two of Great Lakes' major calcined coke customers, Reynolds and Kaiser, had decided to vertically integrate into calcining and had terminated their purchases from Great Lakes. This fact, plus a lower than customary aluminum production, resulted in a reduction of Great Lakes' calcining operations to about 60% of capacity, with a consequent buildup in its coke inventory. In order to cut its losses and recover at least a portion of its cash outlay, Great Lakes managed to sell some of its raw coke to the fuel, carbide and steel industries, even though the prevailing prices in those industries were far below the prices paid by Great Lakes for its coke.

GLC entered into a ten-year, full output contract with Ucan, a predecessor of Sunray DX, in 1957.<sup>96</sup> The maximum sulphur content was 1.75% and for the first four years Sunray succeeded in keeping below that ceiling. However, beginning in August 1961, the sulphur content exceeded 1.75% on a regular basis primarily because

Sunray changed the mix of crude oil at the refinery. In February 1962, GLC wrote a letter of complaint:<sup>97</sup>

Our contract for your production of petroleum coke at Duncan includes a maximum of 1.75% for sulphur content. This maximum has been exceeded on a regular basis during recent months. Our policy is to refrain from small and temporary arguments concerning day to day production of petroleum coke under contract to us. However, the trend to excessive sulphur content in the Duncan production is now so well established that it has become a serious matter to us, and we must call it to your attention.

. . .

We do assure you that it is not our desire to take formal and precipitant action; however, it does seem proper and advisable that we now protect ourselves against the principle of 'silence means consent' by saying that this letter must be considered a formal notification by Great Lakes of a breach of contract.

In August, GLC sent a second letter summarizing Sunray's performance in the intervening six months. In only two weeks did the sulphur content meet the contract specifications.<sup>98</sup> The letter concluded:<sup>99</sup>

This has developed into an intolerable situation which we can no longer ignore. The long and pleasant relations between our two companies will assure you that GLC seeks a mutually fair and satisfactory solution. We hereby notify you that, until such a solution is reached, coke failing to meet the contract specification is being unloaded and held for your account and for your further instructions.

Sunray continued to ship coke and GLC refused to pay. When the coke arrived, a sample was taken for laboratory analysis and the coke was unloaded and commingled with coke from other sources before the laboratory results were received; consequently, once the coke was delivered, Sunray's coke could not be identified.

On November 1, 1962, GLC sent a formal letter of termination citing Sunray's continuing breach as the justification. It also denied liability for all shipments received since August and stated that GLC would be "glad to discuss with you suitable adjustments in respect to invoices heretofore paid by us for deliveries during the period from February 23, 1962 to August 23, 1962. In a second letter on the same day, GLC said: "This in no way changes what I have told you in the past about our readiness and desire to work with you in finding a more satisfactory answer to the problem."<sup>100</sup>

Sunray brought suit against GLC and the matter was in the courts until July, 1970. Throughout the entire period of haggling and litigation, Great Lakes Carbon and Sunray were fulfilling full output contracts at two other refineries at Tulsa and Corpus Christi.<sup>101</sup> Both contracts were renewed in 1970, suggesting that the parties considered the dispute a good faith one which did not taint their overall relationship.<sup>102</sup>

Sunray sued GLC for payment for coke delivered in August, September, and October (about \$300,000) and for damages arising from GLC's premature termination of the agreement (for which Sunray asked about \$3 million). The District Court judge, hearing the case without a jury, found for Sunray on the first point and GLC on the second, and the Oklahoma Supreme Court affirmed on both points. With regard to the first point, the Court based its decision on the fact that GLC commingled the coke with the coke of others and could not restore the original property to Sunray. Proper rejection of non-conforming coke would require GLC to isolate that coke even though doing so might be more expensive than commingling the coke and returning coke of equal or better quality.<sup>103</sup> The Court did not face the question of GLC's liability had it not commingled the coke.<sup>104</sup>

It is unnecessary for us to determine whether or not, in a case of this kind, holding non-conforming merchandise for the account and instructions of the seller, and notifying the seller of the intention to do so, without returning, or offering to return, such merchandise to the seller at the seller's point of delivery under the contract, would be sufficient, under the law, to constitute a rejection of such merchandise which would relieve the buyer of any obligation to pay the contract price for such non-conforming merchandise.

With regard to the second point, the court argued that if the conduct of the seller was such as to justify a reasonable belief on the part of the buyer that the seller intends to continue to deliver off-quality material, then the buyer may terminate the contract. In this instance, the continued failure of Sunray to meet the quality standard constituted sufficient evidence.

In 1958, GLC and Skelly Oil entered into a five year, full-output contract for the coke to be produced by Skelly's new coker. Unlike the Sunray contract, in this

agreement the parties had no obligation to buy or sell non-conforming coke. Instead, "Seller and Purchaser agree to meet to negotiate terms under which such Coke may be sold by Seller and bought by Purchaser." (FTC File 8805-4-2-1-1, p. 30) The sulphur maximum was set at 1.9% and the base price was \$10.50. Production began in August 1959 and, after some quality problems became apparent, the agreement was revised in September 1961. The price for coke conforming to the original specifications remained the same. If sulphur content was between 1.9% and 2.5% the price would be \$6 and if sulphur content was between 2.5-3.5% the price would be \$5. In addition, a new clause was added to the contract:

If either party should become dissatisfied with the prices provided for in this Paragraph 5, such party may, during the month of March 1962, and during the month of March of each year thereafter, give written notice of its dissatisfaction to the other party. (FTC File 8805-4-2-1-1, p. 36)

In the event that agreement on prices was not reached, the contract could be terminated on the following June 1. The parties did fail to agree on new prices and the contract was, therefore, terminated in June 1962.<sup>105</sup>

Following termination, both Sunray and Skelly entered into full output, commission price contracts with Republic. The subsequent price history suggests that the quality problems were not trumped up excuses to enable GLC to terminate an agreement it no longer desired, but were real. Republic's selling price of the Skelly and Sunray coke was considerably below the price in the GLC contracts and well below Republic's price for high quality coke sold to aluminum companies. Thus, Republic's average selling price of Skelly coke in 1964 was \$5.13, while Sunray's coke sold for \$7.50. At the same time, Republic was selling coke to aluminum companies at \$12-14 per ton.<sup>106</sup>

Both Republic contracts eliminated the quality requirement:

It is understood that Skelly shall be under no obligation to furnish coke with a sulphur content of less than 2.0%. . . However, Skelly shall, insofar as it is reasonably feasible, notify Republic from time to time of any change or anticipated change in the analytical quality of the coke produced or to be produced. (CX 40)



Furthermore, both contracts gave the Seller the option to terminate if the inventory accumulated beyond a certain level:

In the event it shall be necessary for Skelly to stockpile or accumulate 40,000 or more tons of coke, then Skelly, in addition to any other remedies it may have, may, at its option, sell as much of said stockpile as it shall elect to another purchaser or cancel this agreement. (CX 40).<sup>107</sup>

##### 5. Price adjustment

The parties to a long-term contract must make some decisions regarding the price during the life of the agreement. While they could simply establish a single price or a schedule of future prices that would be in force for the entire period, they also have the option of providing some mechanism for adjusting prices in light of changed circumstances. Nearly 90% of the pre-1973 contracts provided some price flexibility.

The fact that price adjustment mechanisms were utilized in so many of the agreements raises a number of questions. For what sort of changed circumstances would long-term contracts include price adjustment? What are the possible benefits of allowing for price adjustment? What sort of mechanisms are available? How (and why) did the coke contracts deal with the price adjustment issue? We shall treat each of these questions in turn.

The base price can be adjusted for changes in (a) the aggregate price level, (b) costs, or (c) market conditions—supply and demand. Even if a perfect index were available and could be implemented costlessly, the firms might not want to protect themselves from all (or any) of these changes. A known nominal schedule of payments might, for example, be more attractive to a firm contemplating building a calciner than a schedule that is modified for changes in the overall price level or for fluctuations in the spot price of coke. With costless indexing the firms could lock in the real price embodied in their initial bargain, assure the seller some function of its original

profit margin, or completely index the initial bargain by making the contract price precisely track the market price for the duration of the agreement.

The techniques for price adjustment are not, however, either perfect or implementable without cost. Even if the firms desired to adjust the contract price to the current market price, they might find that the most efficient way of approximating this is to index to production costs. (The more stable the demand curve for coke, the better the approximation.) Thus, the firms might desire to adjust to changing market conditions but use cost or price-level based adjustment rules as proxies. This greatly complicates the analyst's task.

The most obvious reason for incorporating a price adjustment mechanism into the agreement is to alter the distribution of risk. Assume, for convenience, that the only risk was in the aggregate price level and that the quantity taken each period was known with certainty at the time of contracting. Without indexing, the contract would establish a fixed schedule of payments over the life of the agreement, much like a conventional mortgage. The payment schedule would reflect the firms' best guesses at the time the contract was signed regarding the future course of inflation. Indexing the agreement would enable the parties to reduce the variance of the distribution of benefits. Assuming risk aversion, indexing would result in a lower base price. The primary difficulty with this line of argument is that many of the participants in this market are large corporations; the stockholder-owners might be risk averse, but they can satisfy their risk preferences by building a portfolio of stocks with different risk characteristics. The stockholders are harmed, not helped, if the firm is operated as if it were risk averse.<sup>108</sup> It might, of course, be true that the firm would adopt some internal decision rules that would make managers behave in a risk averse manner, but any "risk aversion" of this sort is a byproduct of a deeper cause.<sup>109</sup> In any event, while we will not rule out attitudes toward risk as a possible explanation of the

incidence and characteristics of price adjustment mechanisms, we will explore other lines which are likely to prove more fruitful.

Two other explanations are plausible in general, but not in the present context. First, if the subject matter of a contract is a complex product that will be continuously redefined during the life of the contract, a price adjustment mechanism serves as a device for pricing the "amendments" to the original agreement. Cost-plus pricing for sophisticated defense hardware and complex construction projects are examples; rate-of-return regulation is another.<sup>110</sup> In the present context, however, we have a well-defined good; there could be variations in quality, but, as we have shown above (Section 4) these can be dealt with satisfactorily.

Second, adjusting the price to keep it in line with current market prices gives the parties the proper short-run price signals. If the parties had substantial discretion regarding the short-run quantity of coke this could be important. However, for most coke this was not the case. Coke is a byproduct for the refiner; the buyer--especially Great Lakes Carbon--often bought the coker's entire output. Quantity was determined by the demand for the refiner's lighter distillates, not for coke.<sup>111</sup>

Two alternative reasons appear to be more plausible for explaining the usage of price adjustment mechanisms in petroleum coke contracts: reduction of pre-contract search and of post-agreement incentives to breach or behave opportunistically. A contract establishes some gains to be divided between the parties; a fixed-price contract determines the distribution of these gains. The parties can each attempt to increase their share of the gains before signing the contract by expending resources to improve their information on the future course of costs and prices. The more they each spend, the smaller the pie. They, therefore, have an incentive, ex ante, to incorporate into the initial agreement a device that would discourage this wasteful searching.<sup>112</sup> By reducing the value of special information on future costs and prices, price adjustment mechanisms can do precisely that.

If after the firms enter into a long-term agreement the contract price differs substantially from the market price, the loser will be reluctant to continue performance. It could breach and suffer the legal and reputational consequences, but there can also be a number of less severe alternatives to willing compliance. A buyer could, for example, insist upon strict compliance with the quality standards;<sup>113</sup> it could remove coke from inventory at a slower pace than otherwise; or it could read the contract literally—"working to the rules" as often happens in labor disputes or in centrally planned economies.<sup>114</sup> If the probability of such wasteful behavior increases as the divergence between contract and market price widens, rules which narrow the gap—price adjustment rules—become increasingly attractive.

Indexing is the most obvious price adjustment mechanism, but there exist others as well. The parties could simply agree to renegotiate price either at fixed dates (e.g., quarterly or annually) or at one side's request. A hybrid of indexing and negotiation is to utilize an index with a maximum-minimum limitation. If the indexed price falls outside the predetermined range, the parties can either continue at the ceiling (or floor) price, or renegotiate the agreement. Another way of adjusting to changing market conditions is to allow the parties to solicit outside offers and then permit the other party to match the offer. Commission pricing, by its very nature, automatically links the contract price to external market conditions.

Since changes in costs or in the market price concern changes in nominal values, adjustments for them implicitly involve some adjustment to changes in the overall price level. In this sense, all of the coke contracts that provided some price flexibility contain some mechanism for adjusting, albeit imperfectly, to changes in the overall price level. None, however, was indexed specifically to changes in the aggregate price level. Only five used a broad-based measure of inflation, one contract utilizing the Wholesale Price Index<sup>115</sup> and the other four the Wholesale Price Index for other than farm products and food, and three of these adjusted prices only on an annual basis.<sup>116</sup>

Over half the Great Lakes contracts utilized a price index, and all save two of these had a maximum-minimum limitation. In all but one of the contracts the index was based on the price of the crude oil supplied to the refinery<sup>117</sup> with the price being adjusted either whenever the posted crude price changed or at monthly or quarterly intervals. Four of these contracts supplemented the crude oil index with an index of wages of oil refinery workers and one also included an adjustment for the WPI non-farm component.<sup>118</sup> The actual maximum-minimum limitations were deleted by the FTC in most instances,<sup>119</sup> and all that remains is shown in Table 5. This skimpy evidence suggests that the price could diverge from the base by around 20-50% before reaching the ceiling (or floor).

Prior to 1966 the only GLC contracts that did not employ price indexes were the agreements concerning Mobil's Beaumont, Texas coker (CX 7, MOX 41), the revised Skelly contract,<sup>120</sup> and those relating to the 1950 contract with Pan American Southern.<sup>121</sup> The initial agreement at Beaumont allowed for negotiated price changes at five year intervals; however, in the first five years the agreement was amended with four downward price adjustments. The last amendment (MOX 41) revised the contract so that price would thereafter be renegotiated annually. The Pan American Southern agreement was ostensibly a fixed price contract, with price being firm for ten years. However, it too was frequently amended. An amendment in December, 1955 set the 1956 price at \$3.50 and in addition gave GLC an option to be exercised before July 1, 1956 to accept a price of \$4 for 1957 and a second option to take the 1958 coke output at \$4.50 per ton.<sup>122</sup> In an amendment in June 1956, GLC accepted both options; this new agreement also extended the original term by two years and specified prices for 1959-1962.<sup>123</sup>

From 1966 through 1973, only three of the fourteen contracts included a price index. Of the remainder, two utilized commission pricing (which implicitly indexes to

the market price) and two were for a year or less. In the other seven contracts price adjustment was accomplished by negotiation.

The negotiated agreements typically invoked the intentions of the parties to continue the agreement; negotiations were to be undertaken in "good faith" and in the event that negotiations failed, the current price would continue for a period of time (See Table 6, column 5). For example,

Each party agrees to conduct such price negotiations in good faith with the intention of continuing this agreement for the full period of its initial or extended term; however, should there be no agreement on such price this agreement will terminate 12 months from the last day of the 180 day price renegotiation period. During any such 12 month carry over period, the price in effect for the prior period shall remain in effect. If no such notice for renegotiation of price is given, the then current price will obtain during the next succeeding 2½ year period or the extension period as the case may be. (8805-3-3-2, p. 79)

The period for which the price would be firm declined steadily. This striking regularity is shown in Table 6, column 4.

Prices can be revised even if the contract does not provide for changes as the frequent revisions of the "fixed price" Pan American and Mobil (Beaumont) contracts attest. The record contains numerous examples of price reductions to Great Lakes Carbon (and to others) during the slump in 1962-1965.<sup>124</sup> Letters from two of GLC's suppliers give an indication of the nature of the revisions:

As we explained to you, this price increase to the March 19, 1957, contract level was requested and made only after the most careful consideration of all factors involved. As you know, we have now been on the reduced price basis for two years. We have been happy to work with Great Lakes throughout the years even to the extent of granting price relief when requested by your people. (CX 413)

\* \* \*

This is to confirm our discussion of June 17 at which time we agreed to abrogate the terms of our contract covering petroleum coke produced at our El Dorado Refinery for six months starting July 1, 1965. This is a contract dated June 27, 1956 as amended January 31, 1957 and October 2, 1959.

In order to give you some assistance in your marketing program, we will invoice all shipments of El Dorado coke production between July 1, 1965 and December 31, 1965 at \_\_\_\_\_ per ton, F.O.B. El Dorado. It is understood that this revised price will apply only to the production during the indicated six months and that the other terms and conditions of the basic contract are unchanged. In the absence of any subsequent agreements, the price will revert to the contract schedule of \_\_\_\_\_ per ton, effective January 1, 1966. (CX 53)

Most of the non-GLC middlemen contracts were either commission contracts or utilized a simple price index. In only three instances did the parties explicitly state that price adjustment would be accomplished by negotiation. Amax's 1969 agreement to take the output from Clark Oil's new coker (FTC File 8805-4-99-2) was similar to the GLC agreements with the price being firm for one year and, in the event that negotiations failed, the price would remain constant for one year at which time the contract would expire. The Sohio-Mountaineer contract (CX 41) was not quite an arm's length agreement. Mountaineer was a joint venture between Sohio and Consolidation Coal Company with each owning 50%. (In 1966, Sohio acquired Consolidation's share and Mountaineer became a wholly owned subsidiary.)<sup>125</sup> The common ownership reduced the vulnerability to opportunistic price adjustment. This is reflected in the casual contract language:

The price for such green petroleum coke shall be subject to negotiation on reasonable notice given by either party to the other, at any time during the initial term of this Agreement or any extension. Such alternative price shall be effective from and after a date determined by the parties in such negotiations. It is the intention of the parties that such negotiations shall give recognition, among other things, (a) to the average price, f.o.b. Buyer's plant at which Buyer is selling calcined petroleum coke to the aluminum industry, and (b) to the market price for green petroleum coke of similar quality sold for the manufacture of calcined coke for use by the aluminum industry. (CX 41)

The price adjustment mechanism in the Humble-Wilson agreement (FTC File 8805-3-4) is sufficiently unusual to warrant further discussion. In March 1968, Humble entered into a ten-year agreement with Wilson to take most of the output from the new coker under construction in Benicia, California.<sup>126</sup> The expected quality of the coke was low--the contract noted that a "typical" sample would have a sulphur content

of 5.5%.<sup>127</sup> The coke would be loaded on ships and exported. In such circumstances, commission pricing would seem to be the logical choice, although the small capacity for inventory storage at the refinery and the importance of rapid removal of coke made commission pricing less attractive.<sup>128</sup> Instead, however the contract established a specific price and described a process for modifying that price to conform to changing market conditions:

Six months prior to the estimated beginning of coke production at Benicia, Buyer and Seller shall review the then-current coke market conditions in order to make any adjustment by mutual consent of the price as seems warranted. Thereafter, Buyer and Seller agree to review the price then in effect annually on each anniversary of the effective date of this Agreement and consider such adjustments as seem warranted by competitive market conditions. If in each aforementioned event, either party to this Agreement should deem a price change warranted, the party requesting the price change shall notify the other party to this Agreement of all the facts concerned in order that the coke market prevailing at the time such party deems a price change warranted can be compared with the market conditions prevailing at the time of agreement as to the price then in effect. The failure to agree on a price change shall not affect the obligations of the parties hereunder, except as provided in [the Hardship Clause].

\* \* \*

#### HARDSHIP CLAUSE

If either Buyer or Seller is at any time of the opinion that changes of a technical or commercial nature have occurred in respect to coke, seriously interfering with Seller's ability to produce or Buyer's ability to market profitably the coke specified herein, such party may notify the other in writing of all the facts concerned, whereupon both parties will meet within 30 days of the date of receipt by the party being notified to discuss in good faith, modification of the terms of this Agreement. A maximum period of an additional 30 days after the aforementioned meeting is stipulated in which to mutually modify this Agreement. (FTC File 8805-3-4)

To say that this language is ambiguous is an understatement. It appears that the parties agree that the price should be adjusted annually to reflect current market conditions but that they are under no obligation to make such an adjustment. If, however, the price is so far out of line that the hardship clause could be invoked, the aggrieved party can ask for a modification. The contract is strangely silent on what would happen if the parties fail to agree on the modification. This silence is especially



remarkable when it is juxtaposed with the "Tax Clause" which immediately follows the "Harship Clause": The buyer is liable for all changes in taxes, duties, fees, and other governmental charges, as in all other coke contracts; however, the contract adds a further provision which appears in no other coke contract:

Seller shall give Buyer written notice of any such addition or increase and following receipt of such notice Buyer, however, may refuse by written reply to Seller within sixty days to pay such increase or addition. Seller shall then by notice in writing given to Buyer within sixty days after receipt of Buyer's reply advise Buyer whether or not Seller elects to pay the same without reimbursement from Buyer. If Seller declines to pay aforesaid increases or additions, and Buyer refuses to absorb aforesaid increases or additions, this Agreement shall terminate as to coke remaining undelivered. (FTC File 8805-3-4, emphasis added)

Where aluminum companies constructed new calciners in reliance upon supply by a particular coker, the contract price was typically fixed for a substantial period (see Table 7). The only instance in which this was not so was the first Humble-Reynolds agreement. When that was revised, however, the parties eliminated the elaborate indexing formula (which covered over two pages in the 1961 agreement) and instead fixed the price for ten years. A similar adjustment was made in the arrangement between Mobil and Union Carbide (rows 6 and 7 of Table 7). The parties abandoned monthly indexing and instead agreed upon a fixed price for the duration of the contract.

The substantial length of the period over which prices remain fixed in these contracts stands in sharp contrast to what existed in other petroleum coke contracts. The fixed price agreements all date to the period in which GLC was making the transition from indexing to negotiated price adjustment and most likely is a response to the same underlying factors. The more extreme response in the aluminum contracts probably results from two factors. First, the relative cost of negotiation in aluminum contracts is higher. That is, negotiation works better if the parties have viable alternatives and are disciplined by the effects of their behavior on "good will". The great reliance of the aluminum calciners, which were typically constructed in close proximity to the supplying coker<sup>129</sup> means that their alternatives were generally less

attractive than was the case for other contracts. GLC's past track record with the industry enhanced the coker's confidence that it would negotiate price adjustment in good faith and its continued dealings with a large number of suppliers made maintenance of this good reputation worthwhile. The aluminum companies had neither the track record nor as great an incentive to maintain their reputation for fair dealing. Reynolds and Harvey had no other contracts; Kaiser was a more frequent participant in the market, building six small calciners between 1959 and 1970.

Second, the relative value of price adjustment to the parties was probably lower in these aluminum contracts. The increased isolation from alternative suppliers made close tracking of the current market price relatively unimportant. Moreover, aluminum company purchasers could be viewed as in part buying an assured source of supply for a long period. Part of the price is a one-time payment for the capital value of the commitment (but spread out over the life of the contract), and part is a payment for the current actual use. The greater the importance of the initial commitment, the less important it is that the contract price track the current market price. The extremely low contract price of \$3.10 per ton in the Richfield-Harvey contract<sup>130</sup> is an extreme example of the willingness of the parties to allow the divergence of contract and market prices.<sup>131</sup>

#### 6. The Post-1973 Contracts

The petroleum coke industry was subjected to two major shocks in 1973. On June 5, the Federal Trade Commission handed down its decision finding Great Lakes carbon's long-term contracts in violation of the antitrust laws.<sup>132</sup> The remedy required that GLC amend all its existing contracts so that they would extend for a period no longer than three years and that all new GLC contracts be for a maximum of three years.<sup>133</sup> The remedy also restricted the length of the contracting period for the eight oil company respondents. The restrictions on contract length did not apply to other buyers or sellers of coke. The other shock was supplied by OPEC.

The huge increase in the price of the crude oil input (Table 8) was the most obvious influence on the petroleum coke market. At the same time, the relative scarcity of high quality, low sulphur coke increased, putting additional pressure on the price structure. Thus, while 67% of North American petroleum coke had a sulphur content below 2% in 1972, by 1975 the figure had fallen to 40%.<sup>134</sup> Further, the average sulphur content of coke calcined in the United States rose from 2.0% in 1970 to 2.6% by 1976.<sup>135</sup>

Our ability to trace the impact of the post-1973 changes in the structure of petroleum coke contracts is drastically limited by data availability. We have 29 Great Lakes contracts,<sup>136</sup> but, unfortunately, we have not had access to contracts involving any other buyers. After analyzing the Great Lakes contracts in the first subsection, we will briefly speculate about the changes that might have occurred in the contracts for one other important class of customers—aluminum companies with adjacent calciners.

6.1 Great Lakes. Most of the contracts contained a clause which reflected the restrictions imposed on GLC by the Commission's decision:<sup>137</sup>

4. TERM. The term of this Agreement shall commence on the 1st day of January, 1975 and continue for a period of three years and terminate on the 31st day of December, 1977. The parties agree that six (6) months prior to the termination date they will enter into discussions to negotiate a new agreement. All such negotiations will be conducted in good faith with the intention of entering into a new agreement.

The only contracts that were not for three years were a series of one year contracts with Continental and a one-year contract with Midland in 1974 (which was succeeded by a three-year agreement).<sup>138</sup> In both cases GLC's last contract with the refinery prior to the FTC's decision was for only nine months,<sup>139</sup> so the short term of the post-decision contracts at these refineries was not related to the changed circumstances in the petroleum coke market. It is, therefore, clear that the three year restriction imposed by the Commission was binding.

The three year duration is, however, misleading since almost all the contracts could be terminated on fairly short notice. About two-thirds of the contracts could

be terminated on three to six months notice if the parties failed to agree on a new price. Only two contracts—both with Mobil—allowed for termination without cause by either party (three months notice was required).<sup>140</sup> Since Mobil did not have storage capacity at its Beaumont, Texas refinery, and since the coke from that refinery was generally of low quality, termination on such short notice could have created some disposal problems. The contract protected against this contingency by providing that in the event of termination by either party, Mobil would have the right to store up to 400,000 tons of coke at GLC's Port Arthur facility for one year with the option of a second year as well; prices for handling Mobil's inventory were specified in the contract.

The salient feature of the post-1973 contracts is, not surprisingly, the focus on the problem of price adjustment. The price of high quality coke, which had been in the \$10-12 per ton price range in the years before 1973 soared to over \$60 per ton by the beginning of 1979 (Table 9).<sup>141</sup> The response to the increased variability of prices was a substantial decrease in the period between price changes and an increased ability to terminate the contract if agreement on price could not be reached. The contracts split about evenly between those relying on indexing and those relying on renegotiation. Through the beginning of 1976 the price of crude oil was the basis for indexing.<sup>142</sup> From July 1976 onward, however, the indexing policy changed. If the contract provided for indexing, the only external price utilized was that of calcined coke.

This change from an input-based to an output-based index had some interesting features. There was neither an index produced by a third party nor a mechanism specified in the contract for identifying the appropriate price of calcined coke. In addition, GLC as the largest supplier of non-captive calcined coke could influence the measured price of calcined coke. Nevertheless, the parties apparently believed that this measure of market value, however, imperfect, had come to better serve their

needs than the more accurate, less manipulable measures of input prices.<sup>143</sup> All four contracts utilizing calcined coke for indexation set the change in coke price equal to one quarter of the change in the price of calcined coke. Since coke prices were at that time about half the price of calcined coke, this assured that the price of calcined coke and GLC's margin would be more volatile than the price of raw coke.<sup>144</sup> The most plausible explanation for this sharing rule is that it is a variant on commission pricing. The parties recognize that the price of calcined coke can be influenced by GLC; this price adjustment rule would enable GLC to attain the lion's share of the rewards from extra selling effort that resulted in a higher price while still conveying some of the benefits to the coker.

Indexing was not adopted to ensure automatic price adjustment for the life of the contract. Rather it functioned as part of the renegotiation process. Thus, in half the contracts indexed to crude oil, the contracts established a maximum and minimum (about 15% above and below the base price).<sup>145</sup> If the calculated price fell outside this range, one party could request price renegotiation; and if the parties failed to agree on a new price, the contract would terminate in three months. If the contracts did not have maximum-minimum limits the contract would provide for renegotiation at fixed intervals of three to six months. In either case indexing provided a point of reference for renegotiation. That is, if one party does not accept the calculated price, it could request renegotiation and, if it failed, it could terminate the agreement in three to six months. For example,

Buyer shall purchase the Coke produced and shipped by Seller at said changed price during at least the quarter for which said price has been notified. Either party has the right to give notice to the other by the first day of any calendar quarter in which changed prices are to be charged that the changed price for Coke is not acceptable and that this Agreement is to terminate at the end of the calendar quarter in which the increased prices are to be charged. (FTC File 8805-3-3-2, pp. 14-15)

If the indexed price is generally closer to the market price than the base price, then indexing reduces the rewards to opportunism in renegotiating price.<sup>146</sup>

Another device for linking the contract price to current market conditions was utilized in a number of contracts. If a coker received a bona fide offer above the contract price it could terminate the agreement unless GLC matched the offer:<sup>147</sup>

Texaco shall have the right and option at its sole discretion to terminate this Agreement at any time upon ninety (90) days written notice first given, provided that such notice of termination is accompanied by satisfactory evidence of a bona fide competitive offer made to Texaco by a third party for the purchase of all of the Coke production at the Plant at a higher price than the price payable hereunder pursuant to comparable terms and conditions as set forth in this Agreement provided further, that in such an event Great Lakes shall have the right to continue the Agreement by agreeing to meet such higher price within thirty (30) days from the receipt of Texaco's notice of intent of termination. The right of Texaco to terminate this Agreement upon receipt of a higher offer shall be a continuing right and may be exercised from time to time during the term of this Agreement notwithstanding any previous election of Great Lakes to meet a higher price.

The Texaco contracts illustrate one other price adjustment device—ex post pricing. In 1974 and 1975 Texaco and GLC could not reach an agreement on price by the contractually determined deadline. The parties agreed to extend the negotiating period for a stated period.<sup>148</sup> In the interim, the parties would continue to perform with GLC paying at the preexisting price. When agreement was finally reached, the new price was applied retroactively. Thus, the 1974 Amarillo and Caspar contracts were effective as of January 1 even though they were not signed until August 26.<sup>149</sup>

6.2 Aluminum Producers. In 1973 aluminum producers with calciners adjacent to cokers were performing under minimum quantity, fixed price contracts. We have no direct evidence on the effect of the subsequent price explosion on these contractual relationships. We will conclude this section with some speculations as to how these might have responded to the changed environment.

The fixed price contracts provided the aluminum companies with an unanticipated windfall. Normally, one would anticipate intense pressure by the sellers to renegotiate price to bring it more in line with current market conditions. The pressure in this instance was muted by the concomitant effects of crude oil price changes on the profits of refiners and aluminum producers. That is, while the increased price of crude

oil caused cokers with fixed price contracts to lose money on these contracts, the losses were dwarfed by the gains to the firms from the increased value of their crude oil holdings. In addition, since aluminum production is extremely energy intensive, the aluminum companies' coke windfall was offset, at least in part, by the rising cost of energy.<sup>150</sup> This is not to say that the oil companies did not seek higher prices. Obviously, they did. The point is that the "fairness" argument for an equitable readjustment of the contract price is weakened by the correlations between coke prices and the profits of oil and aluminum producers. The extra-legal sanctions of reputation and good-will would not provide much support for the demand to renegotiate.<sup>151</sup>

Still, a rational aluminum company would recognize that the contract price is not fixed forever.<sup>152</sup> At renewal time most of the changed conditions in the post-1973 period favored the seller. The relative cost to the coker of finding an alternative trading partner were reduced. The value of coke increased relative to transportation costs so the cost advantage of selling to an adjacent calciner was reduced. The increased value of coke reduced the expected cost to a buyer of entering into a full output contract and of bearing the risks of immediate inventory removal. Moreover, the uncertainties regarding oil supply relationships and the increased volatility of the prices of different petroleum products (which influenced the refiner's decision as to whether it should coke) enhanced the value to the seller of not committing to production of a fixed amount of coke.

Rather than simply accept the windfall until the contract expired, the aluminum companies had the option of trading off part of the windfall to enhance their future access. That is, it is likely that an aluminum company would agree to early renegotiation of a higher price in exchange for lengthening of the life of the agreement.<sup>153</sup>

The new agreement, whether renegotiated or entered into after expiration of the earlier agreement, should differ in a number of respects from the old. The major change would involve the establishment of machinery for facilitating future price

adjustment. Because the buyer is considerably more vulnerable to termination than was GLC, it is unlikely that it would accept terms which called for frequent renegotiation and permitted termination on relatively short notice in the absence of agreement on a new price. More likely, the contract would utilize a mechanical rule (e.g., indexing to the price of crude oil) and complement this with a term giving the buyer the right to match outside offers.

The amounts of coke the refiner is willing to produce and the calciner willing to take depend upon conditions in the oil and aluminum markets. In the pre-1973 aluminum contracts the coker promised to produce a minimum quantity and the contract structured the aluminum company's incentives to increase the likelihood that it would accept that minimum. The aluminum company's vulnerability to a cutback in output by the coker following 1973 could have been reduced by acquisition of sufficient storage space for coke supplied by more distant sellers to ensure a timely flow of coke and continuous operation of the calciner.<sup>154</sup> Absent this, the greater vulnerability of the aluminum company would be the driving force in determining the structure of the contract. Since the value to the coker of determining how much, if any, coke should be produced was enhanced by the changed circumstances in the oil market, to maintain an assured supply the calciner would have to sweeten the offer with a premium price. It is conceivable that the parties might choose to stimulate further the coker's incentive to produce by utilizing some variant on multi-part pricing with the marginal price above the average.

The vulnerability of the aluminum company was asymmetrical. If the coker fails to produce enough coke, the untimely arrival of coke at the calciner raises the production costs of calcined coke, and the aluminum company might also have to enter into the spot market for purchases of calcined coke at premium prices to produce the anodes. If, however, the coker produced more coke than the aluminum company could use for its own purposes, the coke would be sold through the calciner's existing market



channels (as in the Humble-Reynolds contract) or through the marketing channels of independent firms (as in the Richfield-Harvey-Wilson-Mitsui arrangement). As long as the marketing channels are reasonably well developed, the losses arising from too much coke production will be less severe than from too little.<sup>155</sup>

The asymmetry means that it is less likely that the calciner's needs will determine the contractual response to the problem of the coker producing more coke than can be used for making anodes for the buyer's own use. The response to the changed post-1973 conditions would therefore be ambiguous. On the one hand, the probability that the coker could not dispose of extra coke declined as did the value to it of protection against this contingency. On the other hand, the cost to the buyer of providing assurance of a market to the seller also declined. The net effect is unclear, although the decreased attractiveness, on other grounds, of pricing rules with a low marginal price make it less likely that the new agreements would use such pricing methods for protecting the seller's reliance.<sup>156</sup>

## 7. Concluding Remarks

The purpose of a detailed case study of this sort is not to prove general results. We begin with the presumption that contracts reflect the intelligent, purposive behavior of individuals and then try to infer how a particular contract structure might be in the parties' best interests. This is rather similar to the biologist attempting to explain why a giraffe's long neck might enhance the survivability of the species. The analogy highlights an important point—the usefulness of a particular contract term, or of a long neck, depends critically on the context. If one were to generalize from the giraffe case, the proper generalization would not be about the survival quality of long necks, but about the robustness of the research strategy.

The petroleum coke industry has two very useful features for a case study. One is that there is considerable variation in the environment both at a single point in time and over time. The other is that the parties are generally large corporations,

which means that there is less reason to fall back on two lazy explanations of contract structure—(a) terms are dictated by powerful big firms, and (b) risk aversion.<sup>157</sup> We have had reasonable success in explaining the structure of the contracts without invoking either of these explanations.

The substantial amount of contractual detail we have provided indicates some of the ingenious solutions parties have devised for resolving some apparently intractable problems of coordination across organizational boundaries. It also indicates the type of tortuous prose with which the researcher will often be confronted, although we have chosen not to impose some of the worst examples on the reader.<sup>158</sup> We will not provide a full summary of all the features of the contracts. Instead, we will confine attention to a few points deserving special emphasis.

A coke producer has to determine how much of its freedom to set its rate of coke output it will have to sacrifice, while a buyer must determine how much responsibility for accepting a given amount of coke it will bear. Since coke is a low value by-product accounting for less than three percent of the value of refined oil, the coker would prefer to have its decisions on how much coke it should produce be determined by conditions in the oil market and not be constrained by contract terms involving disposal of a waste product. Moreover, the less storage capacity available at the refinery, the more the refiner would value a buyer's promise to promptly remove whatever coke the refinery happens to produce. The full output, immediate removal contracts that Great Lakes Carbon usually entered into provided the coker with this assurance. Nevertheless, when a coker entered into a contract in which it would be the sole supplier of a calciner it would almost invariably give up most of its freedom to determine its output rate in order to protect the buyer's reliance. This was especially true if the buyer were an adjacent calciner owned by an aluminum company.

One of the most surprising findings was the frequent use of multi-part, or nonlinear, a motive not heretofore considered in the literature.<sup>159</sup> One reason for

the failure to identify this motive is the focus of most of the research on a monopolist selling to "the market" with contracts being enforced perfectly and costlessly;<sup>160</sup> the assumptions implicit in the modelling exercises direct search away from explanations relying on contracting difficulties. A second reason for the failure is that some effort was necessary to reinterpret the contract language in a manner that would reveal the nonlinear pricing--these were not easily observable facts that cried out for an explanation. We suspect that identification of the motive and of some of the forms that the nonlinear pricing might take will result in the discovery of numerous nonlinear pricing arrangements that had gone unnoticed.

One unusual feature of the contracts that surfaced in the price adjustment discussion was that virtually all the Great Lakes contracts that indexed to crude oil prices imposed maximum--minimum limits. However, while the maximum (minimum) was about 40-50% above (below) the base price in the low-inflation 1960's, it was only about 15% above (below) the base in the high-inflation 1970's. It would seem contrary to intuition that the limits would shrink as the rate of inflation rises. A plausible explanation of why this might have occurred is that the limitations served a totally different function in the two periods. In the former, the index was in force for the life of the contract. The limits would come into play only if some major unanticipated change occurred, at which time the parties could then be forced to renegotiate to take the new circumstances into account. The limits would be reached only under rather extraordinary circumstances. In the latter case, indexing provided a point of reference for renegotiation. Frequent renegotiation to keep the contract price in line with current market conditions could be triggered either by setting fixed dates to renegotiate (for example, at quarterly intervals) or by setting narrow boundaries on an indexed price--boundaries which the parties expected would routinely be reached.

The analysis of price adjustment mechanisms made clear the parties' intent to have the contract price track the market price. The choice of mechanisms depended

upon their accuracy and their susceptibility to manipulation by the parties. We have proposed a rationale for price adjustment that relies primarily on controlling excessive expenditures on obtaining differential information regarding the future course of prices. This argument can, we suspect, go a long way toward increasing our understanding of indexing and other price adjustment devices, and, more generally, of economic behavior under inflationary conditions.

Another extension that is likely to prove fruitful is to the analysis of institutional arrangements concerned with the future course of prices—for example, markets for corporate stock and futures contracts. If the privately efficient level of expenditure on obtaining information on the future cost of a firm's stock price would lead individual investors to oversearch, then it can be in the mutual interest of the investors and the firm to devise a mechanism that reduced the rewards to obtaining differential information. Organized markets for standardized items (stock certificates, futures contracts) can serve this role and thereby increase the size of the pie, net of search costs, to be divided amongst the investors, firm, and the provider of the market. This line of argument has to be developed more in the next draft. The point we want to make is that the oversearching argument might plausibly be extended to the study of organized stock and future markets and that these markets might be analyzed without invoking attitudes of market participants toward risk.<sup>161</sup>