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BETWEEN MARKET SUPPLY AND VERTICAL INTEGRATION:
THE ROLE OF LONG-TERM CONTRACTS IN COAL TRADE

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1. Introduction

Long-term contracts could provide the missing link between market and firm internal procurement of goods as well as between private and government supply. As such, they have recently received increasing attention in the economic literature on the nature of the firm (R. Gordon, 1974; Williamson, 1975) and on government regulation (Demsetz, 1968; Goldberg, 1976; Williamson, 1976). In the following we concentrate on the former issue.¹

Long-term contracts provide a highly inhomogeneous transaction mode. Statements about them may therefore be true for one type and wrong for another. They normally contain clauses specifying (1) buyer and seller, (2) description of the traded commodity, (3) quantity and timing of deliveries, (4) price, (5) limitations on performance (force majeure, default, etc.), (6) damage payments in case of nonperformance, and (7) technical conditions on payment, etc.

Obviously the number of combinations of these items becomes very large even if only simple polar types of clauses are permitted in each category. In order to isolate some peculiarities of specific long-term contracts we shall therefore restrict ourselves to three typical price clauses used in long-term contracts.

The empirical background for this paper comes from the coal market. Here, experience of the author as an international coal trader for several years may help to overcome a lack of quantitative evidence, which seems to be germane to the subject. Data on types of contract clauses used are hard to come by. Fortuitously, Gordon's work (1974, 1975) on this subject is also related to coal. In coal trade, long-term contracts play a paramount role. About 40% of all coal burnt by American electric utilities in 1969 was bought under contracts running for more than 10 years. About another 20% at the same time was procured under contracts running between one and ten years (Gordon, 1974, p. 28). Close to 5% was delivered from mines owned by the electric power industry.

In the vicinity of coal mines both buyers and sellers of coal may exercise market power upon each other due to their small numbers and the high transport cost differential involved in switching to outside partners (= low mobility according to a definition by FitzRoy and Mueller, 1977). I have dealt with this local relationship elsewhere (Vogelsang, 1979b). Due to long-term investments on both sides of the market, it is not surprising to find long-term contracts or vertical integration in such small numbers situations with long-term recurrent deliveries. The special feature of these local markets is a small numbers situation before and after the investments occur. Large national coal markets like that of the U.S. and the international coal trade provide the more intriguing case. Here quite definitely market structures are competitive in terms of concentration ratios for both buyers and sellers. The largest coal buying utility had a share of 9.95% of all coal used in the U.S. in 1969 (Gordon, 1975, p. 47). In 1970 the largest coal mining company provided 11.3% of

all coal produced (Gordon, 1975, p. 67). Clearly, shares in the relevant markets correcting for exports, coking coals, and geographical size may be higher. Even so, at least on the supply side, where entry is comparatively easy, coal markets for the U.S. may be termed quite competitive. This is also true for the international coal trade although on the world market the Polish state export trading company WEGLOKOKS has a share of about 20% and the combined Japanese steel industry as a buyer has a share of about 30%. The competitive assertion for the international trade is backed by the potential that total coal production and consumption have vis-a-vis the international trade.

The choice of a particular price clause depends on the specific situation at the time of concluding the contract. So historical patterns evolve. Between 1950 and 1970, both in the U.S. and internationally, coal was traded long term under pricing rules coming close to fixed prices. The room to adapt prices to a new situation caused by cost or demand conditions was severely limited. Starting with the Coal Mine Health and Safety Act of 1969 the picture changed rapidly and looked entirely different after the 1973/74 oil price shock. Many old contracts were abandoned or renegotiated. These and the new contracts that followed provided much more freedom in adapting to new situations than previously experienced. Today price clauses fall in two broad categories. One is to link the price to other magnitudes related to the seller's production costs and/or the buyer's willingness to pay. The other is to allow to renegotiate the contract price at prespecified dates on the basis of the current market conditions. Such a renegotiation clause must contain some kind of escape formula, because with no mobility on either side there can be no true

negotiations. In the following, I shall concentrate attention on three idealized types of price clauses resembling those found in coal markets.

Section 2 on fixed price contracts shows that their scope is quite limited if applied literally. If expanded to cover index clauses referring to macroeconomic price developments their importance, however, is warranted.

Cost-plus clauses are treated in Section 3. Intentionally, they come close to vertical integration. Among other things ex ante asymmetrically distributed information may help to give a historic explanation why vertical integration does not simply replace cost-plus contracts.

Market price contracts on the other hand closely simulate the working of the spot market. With price flexibility in the actual spot market the existence of long-term contracts using such short-term price clauses is explained in Section 4 by the inhomogeneity of coal, which remains largely hidden to outsiders.

Section 5 deals with some peculiarities of international coal markets. These differences from large national markets help to explain why at least internationally spot and short-term contracting has enough merit to be strongly used side by side with long-term contracts. Furthermore, they indicate why vertical integration could well remain on a low level.

2. Fixed Price Contracts

A fixed price contract may be viewed as a sequence of future contracts all concluded at the same time and between the same partners. The long-term contract carries an advantage over the many single future contracts because it saves on transactions costs. This is especially important if for the reasons developed in Section 4 no organized futures market for coal exists. Both the owners of coal deposits and the potential coal consumers have planning horizons for their investment decisions of roughly 30 years. These decisions all depend substantially on the coal price over this period. Assume that buyers and sellers regard the future market price for coal as a true random variable. This in some way presupposes that they are both price takers. Furthermore assume that they both believe to control all other variables relevant to their own decision making. This means that the coal supplier controls his costs and the buyer controls his costs and final demand for his products. Then risk aversion with respect to prices² implies that the seller be willing to sell coal at a prefixed price that is lower than his market price expectation and the buyer be willing to buy at a prefixed price higher than his market price expectation. Thus, if expectations of both are close enough to each other they can both be made better off by a long-term contract at a fixed price. Therefore a weak sufficient condition for fixed price contracts to be preferred to no contracts is that both partners have the same price expectation and both want to buy a price insurance.

Now, in reality the potential contract partners do not control the other variables with which they are concerned. What effect does this have?

(1) The effect of the uncertainty of the other variables on total income of the decision maker may be positively correlated with the effect of price uncertainty. In this case the incentive to enter into a fixed price contract will be reinforced. It is, however, hard to construct an example from the coal market, where this holds. If profits are high due to the market price it means that they also tend to increase due to other variables and vice versa. Assume that with some probability a new type of regulation banning the use of old coal fired electricity generating plants will be enacted. If it comes through the market price for coal will be low, otherwise high. Now an electric utility with only new coal fired plants and neighbored by others with only old ones can hope to sell surplus electricity to its neighbors in case the new regulation comes through. The reason why this utility will want to enter a long-term fixed price coal contract is that the expected price is low due to the anticipated regulation. So by entering the contract at the expected price the utility shifts part of the gain it could make if the regulation came through to the state of the world where it does not.

(2) The effect of uncertainty of the other variables on total income of the decision maker could be uncorrelated with the effect of price uncertainty. Then a fixed price contract based on the expected price will still be advantageous because it does not affect the mean but lowers the total variance of income of both partners.

(3) A negative correlation between the effect of the other variables and price uncertainty has great importance and works against fixed price contracts.

The importance can be seen both on the demand and supply side. Total demand for coal tends to be high or low depending on whether total demand

for electricity is high or low. Quite probably the individual electric utility's demand is highly correlated with total electricity demand. Furthermore, fuel clauses allow to pass on coal price increases. Then it is in the utility's interest to pay a price for coal that varies with total electricity demand and is not predetermined.

Total coal supply largely depends on marginal mining costs. Again marginal costs of a single mine will be highly correlated with respective industry costs though the absolute levels may differ due to scarcity rents of more advantageous deposits. Particularly the labor cost component is likely to develop proportionally throughout a mine type (underground or surface).

As a consequence of these arguments, conditions for fixed price contracts in the coal market are quite unfavorable.

There is another, more psychological reason working against fixed price agreements. They are based on market price expectations. However, as time unfolds, agents gather new information on future market prices. They may revise their expectations because they are Bayesians or because spot prices are seen to be intercorrelated over time: $P_t = f(P_{t-1}, u)$ where u is a random disturbance term. Unless the quantity weighted average of spot prices over the contract duration equals the quantity weighted average of contract prices the contract always involves some redistribution. Amount and direction of this redistribution is usually revealed before the contract is fully performed. Hence the losing partner will want to abandon the contract. His ability to do that depends on the enforcement properties of the contract. Generally, it is impossible to find contract terms to cover future contingencies in such a way that they are both complete and enforceable. The customary procedure for long-term contracts is to provide

exact and well-enforceable clauses regarding events that are important for at least one of the partners and not extremely unlikely to occur and to be vague with regard to other events. Because long-term contracts are individualistic products they also tend to be incomplete due to lack of imagination and experience of the partners. Therefore they will have to be adapted to situations not covered by their wording. This is normally taken care of by negotiation clauses.

Thus in times of change the possibility of abandoning or altering the contract will arise for the partner who wishes to do so. Also, these changes are most likely to be responsible for such a desire. If this is a correct behavioral description fixed price contracts will contain some price uncertainty. It tends to be lower than the spot price uncertainty because it depends on both desire and possibility of a partner to terminate the old agreement. Costs of litigation and haggling have to be born in order to effect a change of contract term. Furthermore, price uncertainty will be limited by the value attached to the good will at stake which at least larger contract partners (who hold more than one contract) might lose.

Long-term contracts are customarily claimed to cause the spot markets to become more volatile. Quantities traded long-term are no longer available on the spot market. Hence quantity fluctuations on the spot market will tend to increase in relative terms. This again is said to increase the price fluctuation. If this were true there would be a tendency of contracts to increase their own realm via externalities. In EPRI (1978) Gilbert and Stiglitz have advanced against this position that long-term buyers and sellers can (pre - or) retrade on the spot market. The only externality they acknowledge in this respect is that the hedging effected by a contract may foster riskier investment behavior influencing the spot market. However,

the retrading argument presupposes an absence of consumer's and/or producer's surplus. Indeed, without such a surplus (pre- or) retrading would occur whenever the spot market differs from the contract price.³ Otherwise it will only happen if these prices differ by more than the marginal surplus.

3. Cost-Plus Contracts

A long-term contract involving a cost based price clause comes closest to simulating the result of vertical integration. The main difference between the two comes from the inability of the buyer to influence the costs of the supplies (and the inability of the seller to influence the quantity accepted by the buyer). Because the buyer cannot observe the minimum cost locus of the seller there is a moral hazard for the seller strategically to misrepresent his true costs. For this reason pure cost-plus contracts are hardly ever used. They are instead replaced by formulas which give the seller some incentive to produce at minimum costs and thus supply at a lower price than otherwise. The major difficulty of cost based clauses is evident. What are their attractions? On the supply side, there are clearly cost components outside the control of the individual mine. These include wages, costs of strikes, new government regulations, partially costs due to bad weather, accident, change of interest rates, supplies etc. All such costs tend to influence the trend of the spot market, not so much its fluctuation. Hence a cost-based price clause may help to overcome the weakness of a fixed price clause vis-a-vis a negative correlation between price trend and income and at the same time maintain the stability advantage against spotmarket fluctuation.

For the demand side we see the advantages of cost based contracts mainly in the nature of coal mining. Coal is a nonrenewable resource. So cumulative costs of mining a ton of coal increase over time. The rate of this increase has been estimated only in recent years (e.g. Zimmerman, 1977), but such estimates are highly uncertain. Especially, mining costs depend on past consumption rates of coal.

So extrapolation of current costs or current cost increases are unlikely to provide unbiased predictions. Contracts or vertical integration can help to overcome such estimation problems. A special incentive to search for a good partner may be the difficulty to evaluate future industry supply of coal. In stating this above we have related it to the deterioration of the resource base. But this does not suffice. If coal were supplied by a monopolist or a few firms only the problem could become tractable. Although supply is simply the long-run marginal industry cost curve predicting supply becomes quite unmanageable through the large number and independence of potential coal supplying agents. If these base their investment decisions on extrapolating current prices a hog-cycle development is likely to occur. As long as current mining capacity is sufficient, new mining investment will generally look unprofitable. This may induce shortages, if the consumers also invest on the basis of current coal prices and when mines are exhausted. As a result coal prices will go up inducing investments in coal mines and impeding investments in consumption facilities. This will result in excess mining capacity starting a new cycle. But this new cycle will go on at a level different from the previous one. Furthermore, long-run demand elasticities are hardly known outside the neighborhood of current prices. Therefore it will also be difficult to establish more sophisticated price trends on which to base investment decisions. Because of the large number of agents it becomes extremely difficult for both consumers and potential mining companies to make price predictions via keeping track of all the actual investments being carried out and related to this market.

On the other hand, futures contracts as an alternative would have to be entered into simultaneously with the investment decision or would have to

to be made conditional upon reaching such a decision. Both of these conditions make them quite untractable. Thus, while any agent may know his own supply/demand function it is too costly for him to find out the corresponding market (industry) functions.

In this environment cost based contracts can perform two tasks. They can make prices for future transactions predictable (relating them to costs) and they can help to minimize (or maximize for suppliers) these prices as a result of search. This assumes that mining companies have good knowledge of the development and operating costs of their properties and that consumers can well predict their costs and derived demands. Furthermore, both must be in a position credibly to convey this information to each other. The question arises if vertical integration or long-term contracts give better assurance of correct information. Here in my view adverse selection and moral hazard tend to produce opposite results. A long-term contract partly insures against the adverse selection problem. If a partner has provided wrong information about himself the other partner can claim damages. In case of vertical integration this possibility is normally foregone because the outcome depends on both the behaviour of the integrated firm and the properties of the two originally separate entities. Thus proving fraud is extremely difficult (a lemons problem). On the other hand, if after signing the contract one of the partners changes his behavior (moral hazard) this has no effect on the vertically integrated company while under long-term contract there still is only the opportunity to sue for damages (with the chance to lose).

Applying this reasoning to coal, we see that there are very many un-

developed deposits. Most of these are not yet worth developing. To find out the quality of every single one is costly. However, one can assume that the current owner knows the quality in order to be able to decide what to do about it. The willingness of the current owner to open up a mine can be taken as a signal about the deposit quality. Only deposits judged to be profitable will be opened whereas any deposit may be for sale. This means that negotiations on a long-term contract occur after screening, negotiating on buying undeveloped land occurs before. Hence vertical integration may have to overcome high initial information costs as compared to long-term contracts. This is even more likely if one stage coal companies have already established a good will.

It has been established empirically (JCF, 1975) that at low prices the short-run industry supply of coal may be elastic but become quite inelastic above some point. Therefore, any short-run market equilibrium in a booming coal market will place the burden of adjustment on the consumers, cutting away from their surplus. By matching individual suppliers' and consumers' capacities long-term contracts may provide a means of hedging against this price risk.

Furthermore, the consumer himself often sells electricity using a fuel escalation clause. Buying coal in the spot market introduces a lag into the implementation of those clauses whereas cost based long-term contracts are easily manageable both vis-a-vis consumers and utility regulators.

The cost-plus contract is especially tailored to the needs of the sellers. Its symmetric counterpart which I like to call the ability-to-pay-minus contract seems to occur much less often. This could have two reasons. First, the electric utility's ability to pay is highly influenced

by the regulatory process, which again heavily depends on input costs. Hence there is a circular argument contained in the ability-to-pay-minus clause. Regulators would not let it pass (if they notice). Second, measuring ability to pay is very hard. Approximating it by reported profits of the buyer may be the best one can do but certainly will not allow the seller large increases.

4. Market Price Contracts

Fixed price contracts often fail because the partners to the transaction cannot live up to their obligation. Cost-plus (and ability-to-pay-minus) contracts tend to fail because the partners to the transaction cannot monitor each others behavior (moral hazard). Market price contracts generally do not involve either of these, provided the market price can be observed. But what advantages do they exhibit over spot transactions? Our contention is that in cases where the other types of contracts may fail, the market price contract offers advantages over spot contracting in that it improves possibilities for specialization. We shall argue in terms of the buyer only but clearly, for the exact market price solution to result sellers must gather the same advantages from the contract.

Orientation of customers towards specific coal mines (location) and qualities (plant type) turns overall competitive supply and demand balances into imbalanced submarkets ("bilateral monopolistic competition"). A long-term relationship then provides insurance (hedging opportunities) against uncertainties created by such imbalances. All this has to be weighed against the cost of ex post flexibility without specialization. Generally, it can be shown that competitive futures markets are not feasible in this situation. Furthermore, there is the possibility to find a better partner

through search, but such gain can only be fully appropriated in a long-term relationship. Thus contracts establish property rights on information. Let us illustrate the specialization argument for risk neutral agents by a very simple formal model. Assume, there are enough categories of coal to justify that total industry supply is completely flexible at marginal cost $MC = 1$, but that in each category supply capacity is fixed. Thus each category may consist of exactly one mine and industry supply is expanded by adding new mines. Total demand for electricity q^k for each of K equally sized consuming utilities is assumed to be totally inelastic. A choice between specialized coal utilizing plant types is made by a utility i in drawing a lot from an urn with an infinite amount of lots. In this urn the proportion of lots for each category equals the proportion of this category to total coal supply capacity.

This process of randomization is equivalent to saying that the investment decisions of the electric utilities in question are totally uncoordinated and even occur without knowledge of each other. This assumption becomes less restrictive with the distance that separates utilities from each other.

Now, if all utilities specialize and if initially total planned supply capacity equals total demand capacity the likelihood of choosing a plant type, for which demand exceeds supply can be taken as $= 1/2^4$). Assume, the specialized utilities have the production function

$$q_i^S = x_i (1 + \epsilon) + \sum_{i \neq j} x_j \cdot (1 - \epsilon)$$

where i, j are plant respectively coal categories. i is the category chosen by utility i .

An unspecialized plant has the production function $q^U = x$.

This means that electricity output is proportional to coal input. A specialized plant holds an advantage of ϵ units of output per unit of specialized input. The symmetry may be somewhat arbitrary. But the fact that there are comparative disadvantages against the unspecialized plant when it uses the unspecialized input just defines specialization.

$$\text{The cost functions are } C(y_i^S) = \frac{x_i P_i}{1+\epsilon} + \sum_{i \neq j} \frac{x_j P_j}{1-\epsilon}$$

respectively $C(q^U) = x_j P_j$, where P_i, p_j denote coal prices. In the specialized case $x_i = 0$ if $p_i > \frac{1+\epsilon}{1-\epsilon} p_j \forall j \neq i$ and $x_j = 0$ if $p_i < \frac{1+\epsilon}{1-\epsilon} p_j$. We assume that marginal cost of mining coal $MC = 1$ up to output capacity which we assume to be $x_j = \frac{q_k}{1+\epsilon}$. Coal is supplied competitively. Thus, if supply capacity at least matches demand, $p = 1$. If in a submarket demand exceeds supply capacity the price will be bid up so that the utilities are indifferent between buying their special coal or coal from other categories. Then $P_i = \frac{1+\epsilon}{1-\epsilon}$. So, if all firms are specialized, expected unit costs for specialized utilities will be:

$$C^S(1) = \frac{1}{2(1+\epsilon)} + \frac{1}{2(1-\epsilon)} = \frac{1}{1-\epsilon^2} > 1$$

Compared to this, expected unit costs for unspecialized utilities are $C^U(1) = 1$. Therefore with free choice it would be preferable not to specialize, if all other firms specialize. Now assume that no other firm specializes. Then there will be no rationing and the expected unit cost in case of a single specializing firm $C^S(1) = \frac{1}{1+\epsilon} < 1$. Hence it pays to specialize. It is easy to see that in equilibrium the proportion of specialized firms will have to satisfy

$$1 = C^U(1) = C^S(1) = \pi \frac{1}{1+\epsilon} + (1 - \pi) \frac{1}{1-\epsilon}$$

This implies $\pi = \frac{1 + \varepsilon}{2} > \frac{1}{2}$

Clearly, the proportion of specialized firms depends on the potential specialization gain (and equivalent loss). The larger the gain (loss) the smaller the fraction of specialized firms will be. π is the probability that for given i there will be no competing specialized buyer. Denote the total number of specialized buyers by S .

Then $\pi = (1 - 1/K)^S$ and from this $S = \log \pi / [\log (K-1) - \log K]$.

Assume the number of utilities to be $K = 200$, the specialization gain and loss $\varepsilon = 0,05$. Then $\pi = 0,525$ and $S = 128,55$. In this case total output of coal would be $\sum_j x_j = 197$. Compared to this, output without any specialization would have been $\sum_j x_j = 200$ and with full specialization $\sum_j x_j = 190,48$. All this assumes that both buyer and sellers hold rational expectations and that expected excess profits of coal mines are captured in a rent on coal deposits. In this model, a dead weight welfare loss due to excess capacity and operation of unspecialized plants turns up. It produces no invisible hand equilibrium. This, however could be achieved via long-term contracts. Even, if they only lead to congruent investments of mines and utilities the efficient result in terms of capacity and specialization can be reached. Thus, under the conditions just described long-term contracts would contain two main items. One is the promise of both sides to perform exactly matching investments. The second are promises to supply and receive certain coal quantities at specified terms. Thus, there are also two different sets of conditions for failure of contracts. If either of the parties does not keep the investment promise this severely endangers the fulfillment of the second part. Because all kinds of hazards come to bear on large scale in-

vestments, multiplant economies are likely to be important. A large multiplant supplier(buyer) may be more likely to deliver (accept) the promised quantities even if the single investment does not go through.

After the promised investments have been executed there is a built in tendency to fulfil the remainder of the contract as long as the original specialization argument is still valid. Hence, long-term contracts may be viable, although environmental conditions over two or three decades may change to such an extent that renegotiation has to take place. The contract clauses measured against the legal consequences of contract breach form a basis to such renegotiations.

In the situation given by the specialization condition there is no real convincing argument for or against vertical integration as a substitute for long-term contracts. The specialization argument also explains the absence of a complete set of futures markets. In the efficient outcome all futures contracts would have to be made by the same combination of partners as in the initial contracts. Thus, there would only be competition for contracts of the first delivery period. In this sense, contracts are clearly related to franchise bidding. If there is competition for contracts the average price will tend to equal average costs. Thus for such contracts to be incentive compatible, clauses should be found to effectively equalize marginal price with marginal costs. Such nonlinear pricing schemes are used e.g. for optional quantities. On the other hand, all contract complications make the market for contracts less perfect.

Because the gains from specialization depend on the specific partners to the transaction it pays for any mine or consumer to search for a good

match. However by maintaining the value of information over time, contractual arrangements may produce additional benefits for the individuals.

To the extent that contracts reduce the freedom of choice of the agents involved they will reduce the possibility for other firms to find new partners. This again will induce these firms themselves to enter long-term contracts, because the setup costs for spot arrangements may come close to those of long-term contracts.

5. International Coal Markets

5.1 Special Features of International Coal Markets

Hard coal constitutes about two thirds of all fossil fuel reserves but provides only for about one third of today's consumption. With the necessity finally to use up most fossil fuel for energetic and chemical purposes its great future is bound to come. Coal reserves are scattered throughout the world but actual mining is rather concentrated. More than 60% of the world output is supplied by the U.S. the USSR and China. Contrary to the situation with oil, where international trade plays a paramount role, today only 10% of all coal mined is sold internationally.

We want to stress four special features that distinguish international from local coal markets:

- 1) Relative prices and costs may change due to fluctuations in currency exchange rates. Unless currency futures markets permit perfect hedging, there can be no such thing as a fixed price contract.
- 2) Ocean transportation has an important and continuously changing influence on the competitiveness of different coal exporting regions.
- 3) Coal mining is under the jurisdiction of the country in which the coal is mined.
- 4) Imported coal may replace the use of domestic energy resources and give rise to protectionism by domestic governments.

Let us consider these influences separately.

5.2 The Influence of the Currency Exchange Rate on International Coal Trade.

Fluctuations of currency exchange rates cause noise in the price (cost) distribution of traded commodities. Such fluctuations would have rather little influence on the decisions between long-term contracts, spot contracts and vertical integration on international coal markets, if exchange rates only and simultaneously respond to differences in current inflation rates. Speculation and government intervention however may change this picture.

Beliefs on the values of currencies play a role similar to those on the values of stockmarket shares. Thus vertical integration is favored to the extent that the currency of the country where the investment shall take place is believed to be temporarily undervalued. The same reasoning may favor long-term contracts with well defined and enforceable price escalation clauses expressed in the overvalued currency.

On the other hand currency fluctuations (caused by speculation) may encourage spot contracts for reasons of arbitrage. The products of a country with an undervalued currency are a good bargain at the time the currency is undervalued. If there are always some coal supplying nations with undervalued currencies it may be profitable for buyers to switch partners often in order to take advantage of arbitrage opportunities. This plays against long-term contracts. However, long-term contracts do commonly occur in international coal trade. Especially Japan, the largest international buyers by far, holds mostly long-term commitments. These generally tend to be shorter than domestic coal contracts in the U.S. Normally prices are expressed in the seller's currency, stressing a cost oriented approach to pricing. But exports from countries with chronic balance of payments difficulties often involve prices to be quoted and paid in the importer's or some other strong currency.

5.3 The Influence of Ocean Transportation on International Coal Markets.

Bulk shipping can be regarded as a competitive industry for basically the same reasons as oil shipping (for these see Adelman, 1972, Chapter IV). Therefore the opportunism argument certainly does not hold for this transportation stage of the coal trade. However, freight rates fluctuate extensively in a hog cycle manner. This results in uncertainty on international coal markets, the impact of which increases with the distance the coal has to be shipped. The first long-term coal contracts between the U.S. and Germany in the 1950s were signed because customers as a consequence of the Suez Crisis wanted to lessen the risks of fluctuating ocean freight rates and U.S. mining houses were eager to secure their steady employment.

In the shipping business long-term charterparties have traditionally been used as formalized contracts. Therefore international rules on them exist and their fulfilment can be enforced rather well. Vertical integration of shipping could also smooth out rate fluctuations, but economies of scale in shipping would only permit very large customers (suppliers) internally to use their own fleets efficiently.⁵⁾ Furthermore, competition for long-term charterparties insures that the advantages of vertical integration at any moment of time appear to be slight: if a fleet can be bought at a price promising supernormal profits through vertical integration, competition between potential buyers will raise the price of the fleet.

On the other hand vertical integration can look profitable, if because of freight rate uncertainty paired with risk aversion certainty equivalent freight rates on average stay higher than certainty equivalent costs of running a fleet. But this means that it would be rational for anyone who is

not risk averse to invest in shipping (or for risk averters to include shipping in a diversified portfolio) with or without integration. However, integration in itself may lead to risk diversification, if the two stages involved have independent or countercyclical profit expectations. As bulk freight rates are heavily influenced by grain shipments, which may be independent of industrial business cycles, this could induce vertical integration of shipping into coal trade. Furthermore, if electric utilities cannot adjust their prices to current fluctuations of costs they may want to integrate backwards to hedge against freight rate fluctuations.

Empirically, vertical integration of this kind can be found, but does not prevail. Long-term charterparties are the rule to secure basic coal requirements, while spot freight contracts are used to cover peaks. In general it can be said that long-term charterparties go together with either long-term coal contracts or vertical integration between coal mining and consumption.

At long distances there usually exist many combinations of suppliers and customers. As a matter of geography the more distant a customer is from the nearest supply source the more competitive will other supply sources be. Hence, because of distance, the bilateral monopoly situation of local coal markets is changed into a bilateral oligopoly situation in international coal trade. Hog cycle effects on ocean freight rates for coal tend to be simultaneous and of equal relative sizes throughout the world. The latter means that the absolute price difference between bottom and peak of the cycles is roughly proportional to the distance to be shipped. Therefore, the relative competitiveness of coal mining areas with respect to a customer changes during

the course of the cycle. Australian coal will be most competitive against American coal on the European market when freight rates have reached their bottom. This kind of advantage, however, can only be realized for the short or medium term because ship owners tend to be unwilling to enter into very long-term agreements on the bottom of the market. Expected total costs form a lower bound if total expected lifetime of assets is involved. Besides this, the longer the distance involved the more difficult it is to complement a long-term agreement by an equivalent haul back. Return shipping routes, then have to include several steps, increasing complexity and matching problems as to timing, quantities and heterogeneities of freight.

If the number of potential coal exporting and importing countries is sufficiently large both fluctuating currency exchange and ocean freight rates offer arbitrage opportunities that can only be grasped by short-run adaptation. This goes against long-term commitments. On the other hand the more arbitrage opportunities are being used the smaller they become. Hence, there will be an equilibrium that provides for the viability of some portion of long-term contracts.

5.4 The Influence of Coal Exporting Countries' Policies on International Coal Trade.

The willingness and ability of a country to export coal depends on the profitability of such exports and the reserves or capacity in relation to internal needs (user costs as perceived by the country). The profitability is influenced by location and geological conditions of coal sites, the wage level, capital availability and the relation between domestic and world market prices for coal. The only coal-mining country in which exports exceed domestic consumption is Australia. In Canada nearly half of the coal mined is exported but overall there even is a positive net balance in favor of imports (from U.S.) due to the vast geographical distance between mining and consumption areas. Coal is mined in the West and consumed in the East of the country. For all other countries, exports account for less than a third of production. Here domestic consumption has so much importance that short- or medium-term reliability of domestic supply and the long-term availability of reserves are of prime importance⁷.

Consequently, coal exports are generally subject to export licenses being granted⁸. This poses some risks for the importers of coal. Export embargoes could stop coal from being delivered under spot contracts, long-term arrangements or even by vertically integrated subsidiaries. Experience with export embargoes has virtually been limited to miners' strikes and war. There is, however, a remarkable exception: Australia introduced special export licenses in 1974 in order to raise prices. Since then coal from Australia can only be exported if the state agrees to the price contained in private export contracts.

It is not obvious that spot contracts, long-term contracts and vertical integration should be treated in the same manner regarding export licenses. However, the danger that licenses will not be granted cannot be fully extinguished in any of these cases. Hence, there remains supply uncertainty even under long-term contracts and vertical integration. This calls for a diversified portfolio of supply countries, if the causes for export embargoes can be considered to be rather independent for different sources of supply. In case of coal, such independence is quite likely to hold because coal exporting countries are not concentrated in one part of the world and because they belong to different economic and political groupings. A portfolio of mines in different countries tremendously increases the minimum optimal scale for international vertical integration of coal mining and consumption. Consequently, vertical integration of this sort has only been exercised by very large single customers or on an industry wide basis. The prime example is the Japanese steel industry that has financial interests in American, Australian and Canadian coal mines. In all cases they have local partners to share the risks.

On the other hand the potential gain through risk spreading in international coal trade has been noticed by some large international mineral and oil companies, which have started to invest in new coal mining projects in several countries⁹. The alternative diversification of supply sources in long-term contracts offers opportunities both to smaller customers and for trading houses¹⁰ as intermediaries. Long-term contracts lower the risks of export embargoes vis-a-vis vertical integration because payment is deferred until after the delivery and because they can be kept on a smaller scale.

Intermediaries fulfil several functions making the system of long-term contracts workable. They can combine customers and suppliers into portfolios or take over risks. This is the simple insurance aspect. Furthermore, they can become arbitrators (buffer) between the interests of suppliers and customers in case opportunistic difficulties arise. This is of special importance as judicial actions are very costly and quite unsuccessful in international trade. A third point is that international coal trade involves personalities and skills¹ that normally are found only in the higher ranks of the suppliers' and customers' organizational hierarchies, whereas coal buying or selling a functional activity is normally placed in the medium ranks. This involves problems regarding salary and hierarchical position of the necessary personnel. So an outside firm may be used because it interferes less with the functioning of the internal organization.

Diversification of supply sources is limited by quality requirements of consumers. If a consumer can only burn coal from one source he is likely to take a financial interest there even if some supply risks remain. On the other hand dependence of this kind may stimulate technical efforts to combine different qualities of coal. Such an innovative strategy has been successfully followed by the Japanese steel industry that invented techniques to blend different qualities of coal to make coke. This decreased dependence on American coal supplies and shifted imports more to Australian, Canadian and various other sources taking advantage of lower prices. This again narrowed the price spread between coals from different sources and of different qualities.

5.5 Importing Countries Policies' Influence on International Coal Trade.

Policies of countries concerning the import of coal differ mostly between those which want to protect their own coal industry and those that have none to protect. Within countries belonging to the second category there is generally a harmony of interest. Import licences are unnecessary and government even protects the consumer interest by helping the consuming industry to invest in coal projects abroad. Within countries belonging to the first category, tensions between consumers, local coal suppliers and government arise. Consumers want to be able to import cheap coal, while the local mining industry wants to hold this competition down.

There are two main arguments for the protection of a local coal industry against foreign imports. Most straightforward is the employment argument, which states that the importation of coal causes unemployment in mining areas as there are no other equivalent jobs available nearby. This argument can legitimately be brought forward by the mining lobby and local government. It is generally valid to some extent for the short run (but not e.g. for Germany between 1958 and 1973). In the long run, however, money spent for the protection of the coal industry could instead be used to create new jobs elsewhere.

The second argument states that the domestic coal industry has to be protected against imported coal because domestic supplies are reliable and domestic mining capacity is only upheld if there is continuous demand. This argument can only legitimately be brought forward by the Department of Defence and the coal customers. Politicians propagate this argument because

it can be used to make the coal lobby appear more credible and because independence in coal supply increases the freedom of choice for foreign policy. At least in Germany (which besides Britain is the main country in the first category) to my knowledge this argument has been brought forward by coal suppliers and not by the customers. Its validity, therefore, seems to be rather questionable.

In any case the reliability of supply argument in favor of a domestic coal industry can only be used for the short or medium term. Higher current coal output reduces reserves to be consumed in the more distant future.

Protection of the domestic coal industry of Germany for a long period prevented investments of German consumers in foreign coal projects. Coal imports are restricted to a certain annual quantity by a law which customarily is adjusted every five years. The whole import quota of about six million tons p.a. would take care of the output of two full scale mines. However, with a time horizon of five years even those two could not profitably be integrated. Long-term contracts, however, are feasible under the licensing system. Special license clauses make them run longer than the lifetime of existing licenses if it is rather safe to expect a prolongation. Licenses are held by individual importers according to a past performance reference. Licenses of different importers can be combined so that contracts exceeding the license volume of a single importer are possible. Such licenses have some scarcity value but it is held low by the collusive market power of the coal consuming industry.

5.6 Evaluation of International Long-term Coal Contracts

Williamson (1975) discusses long-term contracts, sequential spot contracts and vertical integration for products to be supplied on a semicontinuous basis. He tries to show that incomplete long-term contracts (as distinguished from complete contingent claims contracts) fail in case of unexpected events (i.e. events in respect to which the contract is incompleted) because incentive compatible profit-sharing rules give rise to shirking. Indeed this is the problem of incomplete long-term contracts but this difficulty has to be evaluated against the flaws of vertical integration under the same or other circumstances. Especially the long-term contract may shift risks in a well specified way to the supplier which otherwise would have to be borne by the integrated company. This can be important in case one of the parties is in a comparatively riskless business while the other has to bear substantial risks. This is apt to be so with respect to electric utilities and coal mining. The electric utility may be able to keep its business at low risk by shifting risk to the coal supplier. This can be regarded as irrational because there is a price to it. However, the utility may be in a position to prefer paying a risk premium to its supplier rather than bear the risks itself because of regulatory constraints and auditing practices of regulatory agencies.¹²

A special risk involved in a long-term contract is that circumstances may arise where one of the partners tries to escape from the contract. This can be done successfully if the other partner is unable to defend his rights. To defend one's rights under a long-term international contract can be difficult and risky because contracts tend to be vague in language

and because it is difficult to seek one's right in foreign courts. This last point is balanced to some extent by arbitration clauses calling for arbitrators familiar with the trade and based in a neutral country. Whereas foreign jurisdiction normally cannot be enforced domestically and viceversa, international (private) arbitration is accepted by most countries' authorities. Even if law suits or arbitration could be successful the position of a party may prevent it from disputing a unilateral change of an existing contract. This happens because it can only claim damages in terms of money and not enforce deliveries. If the customer is a utility that is obliged by law to deliver electricity it will have to give priority to the deliveries as such against the favourability of the terms. Therefore, contract terms can only be enforced, if the customer (supplier) is not desperately in the need of contract deliveries. This situation may reduce the expected utility of long-term contracts to both parties.

Such risks are lower with vertical integration. They are restricted to acts of governments (which can also happen to long-term contracts) and special difficulties which the intergated company faces because it is a foreigner¹³. However, we have shown above that international long-term contracts offer better ways of diversification.

From a monitoring point of view, international vertical integration between coal mining and onsumption seems to be difficult. In all cases known to me it is a backward integration, in which local partners are doing joint ventures with the foreign investors. In many countries local participation is required by law (e.g. Australia) but at the same time it seems to be essential from the entrepreneurial point of view. The consumer wants to

integrate backward and the owner of mining land looks for financing and an outlet. It is information impactedness that in this case necessitates joint venture and not full vertical integration.

Long-term contracts have some inherent capability to cope with a changing environment. Still, situations may arise which have not been thought of, when the contract was signed. These will lead to tension if by such an event one of the partners is favored against the other. In international coal trade such situations have to my knowledge always been mastered by adapting contract terms. For the remaining contract duration new agreements have been reached that made it possible for both sides to live up to their obligation. Normally the new terms were such that the partner favored by the original working of the contract kept part of this advantage but gave up a substantial part. This result can only be understood by considering the high risk involved in a law suit (if it is lost, all the advantage of the contract has vanished and lawyer fees have to be added) and by the big role that the goodwill factor plays in the business. In fact, the only case I know of where judicial action was seriously threatened, was by an electric power company that wanted to cease using imported coal and therefore gave no value to its international goodwill as a coal consumer.

A typical example for such an unexpected event is the introduction of the Coal Mine Health and Safety Act in the U.S. in 1970. At that time long-term contracts between U.S. and Germany were running on the basis of price brackets. The price for each year had to be fixed in advance within a range where below the lower level the seller had the right to abandon the contract for a year and above the higher level the buyer had

such right. The price range at that time was roughly between \$10 and \$11 per ton FOB Hampton Roads. Calculating back this gave a FOB mine price of \$5-6 per ton. Now, the Coal Mine Health and Safety Act raised mining costs by \$3-4 per ton, which was well outside the possibilities of the price range. This came as a surprise because mining costs had stayed practically unchanged for about twenty years and long-term contracts with price brackets of less than \$1 had proved to be viable. In 1970 the American sellers asked for price increases corresponding to the full cost increase caused by the new mining legislation and threatened not to deliver if the buyers did not agree. As the situation was, the buyers agreed to new terms because there was no better outside alternative.¹⁸ The new price clause allowed for proven cost increases due to the new legislation.

After 1970 no further long-term coal contracts between the U.S. and Germany were signed on the basis of a fixed price range. The U.S. mining cost situation, and the international market price had become so unstable that new formulas had to be found. Long-term contracts were signed for large quantities under which the prices had to be negotiated on market terms for a shorter period in advance. Within this period the price could be changed with respect to certain cost factors such as rail freight, miners' wages etc. The rather open price clauses allowed the possibility of adapting both prices and quantities (because an agreement pricewise could often only be reached by making quantity concessions). Hence, contracts have become very loose in terms but capable of surviving great disturbances such as the energy crisis in 1973.

6. Conclusion

Our discussion of long-term coal constructs has focused on competitive markets. With respect to domestic coal markets we have evaluated different types of price clauses. Fixed price contracts come in for infeasible competitive futures markets. They however contain a high risk of failure if the situation systematically changes. Cost-plus contracts are specially tailored to the seller's needs, but can as well be of advantage to buyers, if these can share scarcity rents, if mining costs are highly correlated to coal market prices or if cost increases can be passed on to final consumers via fuel escalation clauses. Market price contracts can be the result of the desire for specialization. They are then least vulnerable to opportunistic behavior although they may be hard to enforce in courts.

International differ markedly from domestic coal markets by two aspects. First, there are arbitrage opportunities introduced through currency exchange and ocean freight rate fluctuations. These favour spot contracts. Second, international contract agreements can be disturbed by governments and may be difficult to enforce due to a lack of international government. These aspects call for diversification of both buyers and sellers, making vertical integration more difficult to achieve than long-term contracts.

7. Footnotes

1. The latter issue is treated in Vogelsang (1979a).
2. This is stronger than risk aversion with respect to income, because the firm faced with random price can hedge by adapting quantities
3. Unless excluded by clauses preventing such behavior.
4. Meaning that the probability that demand exactly equals supply is zero.
5. Minimum optimal scales for ocean fleets are both large in comparison to exporting mines and importing consumers. This certainly is different in oil, where oil supplying companies are large by this measure.
6. Part of the arbitrage gain goes to intermediaries who see this opportunity.
7. The direction of this causality may be unclear. However, consider that except in steelmaking the value in use of 1 BTU of coal is lower than 1 BTU of oil or gas. Hence, the price of 1 BTU of coal on the margin has to be lower than the price of 1 BTU of oil. If in general the cost of supplying oil is independent of the availability of coal the share of coal will tend to decrease with the distance (in terms of transportation costs) from mines. From this (and user cost arguments) it follows that heavily industrialized and/or populated areas near mines absorb most of the coal.
8. This is so even for countries with nationalized coal industries, where the export contract is signed by a governmental body.
9. Notably Rio Tinto Zinc Co., Utah Mining, Peabody Coal, Ruhrkohle AG, Shell, BP.
10. Indeed some (especially Japanese) trading houses, however, have become engaged in coal mining.
11. Many of these skills come from learning by doing, which may be very costly if undertaken by the firms themselves.
12. This point is raised in Neuefeind and Vogelsang (1979), p. 6.
13. This, however, may cut both ways. For instance unions can be hostile to the company but the mother company may threaten to invest somewhere else in the future.

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