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ABSTRACT

In "Markets and Hierarchies" (1975) Oliver Williamson has developed a heuristic framework (Organization Failures Framework = OFF) to attack the issue of institutional borderlines between markets and firms. Below we discuss this concept and apply it to local coal markets. Differences in larger domestic and international coal markets then cast some doubts on the practical usefulness of the approach.

1. Organizational Failure

In the absence of a complete set of futures markets, economic theorists have used an array of arguments to explain the prevalence of vertical integration (and simultaneously of long-term contracts) in a competitive situation. These arguments relate to technological interdependencies, externalities, incomplete information and uncertainty. Technological interdependencies tend to create a natural bilateral monopoly situation (Von Weizsäcker, 1978), at least ex post. Externalities on intermediate goods markets can be internalized by more or less sophisticated methods of vertical control (Warren-Boulton, 1978). Finally, incomplete information and uncertainty could come in for at least three different reasons (EPRI, 1978). First, vertical integration may allow agents to convey information which otherwise cannot costlessly be transferred from one side of the market to the other (Arrow, 1975). Secondly, should price rigidity prevent market clearing, vertical integration could come in as a means of assuring input supplies (Green, 1974, Carlton, 1979). This relates to Weitzman's (1974) prices vs. quantities problem: if profits are more sensitive to input quantities than to input prices, it pays to secure such quantities on a long-term basis. This becomes relevant for production techniques of the putty-clay type and then especially for inputs with a low input-output coefficient. Thirdly, securing intermediate input may be a hedging strategy for buyers who face a steady demand of their own output. In this sense Oi and Hurter (1965) have interpreted vertical integration as an insurance. A combination of these arguments for vertical integration is used in the institutionally oriented "Theory of the Firm" literature dating back to Coase (1937). In its latest version represented by Williamson (1975) this

literature offers a package of conditions to explain the superiority of vertical integration over long-term contracts, futures markets and sequential spot contracts. Below in this section we shall briefly introduce Williamson's "Organizational Failures Framework" (OFF). Then we describe the features of local coal markets in its terms in order to demonstrate the limits and possibilities of its empirical applicability. This will result in some qualifications, which Williamson partly makes himself but not so strongly. First, we argue that not only internal organization may be improved in evolutionary and innovative ways but that the same applies to market transactions: new situations call for new contract terms. Second, as shown in the examples below, vertical integration and market contracting may serve different purposes and thus be highly imperfect substitutes for each other. Sometimes they could even be complements. Third, government may interfere with or supplant the result predicted by the OFF, e.g., in order to cure perceived market failures, or effect income redistribution.

The traditional neoclassic approach to explain the choice between transaction modes follows a hierarchy. As a general rule, spot markets are deemed to be optimal. However, if they fail to give the right productive signals futures markets are introduced. If such markets do not work, due to lack of partners or small numbers of transactions, long-term contracts replace them. These contracts are assumed to be allocated using a competitive bidding process. Should threat of breach or incompleteness due to complexity of future events pose problems, vertical integration is the ultimate solution. In terms of neoclassical theory all these failures can potentially be cured also by government intervention as a substitute.

The described hierarchy is only valid if diseconomies of another kind increase as one moves from one step to the next. These diseconomies are

costs of organization or foregone opportunities. They may be explained by the absence of an invisible hand (X-inefficiency, etc.). Only if the costs of using the different transaction modes are fully spelled out, can the failure hierarchy be replaced by a more symmetric treatment. Although Williamson does not consistently succeed in doing so, he makes an important (semantic) step in the right direction by replacing market failure with organizational failure. In my view, on the basis of private costs only, the neoclassical assumption of increasing organizational costs down the hierarchy is based on correct observations even though it does not explicitly incorporate the overall costs of a legal system necessary for the provision of property rights. These are mostly sunk costs (born by past generations) which marginally do not interfere with the hierarchical line. Furthermore, these legal costs stand for a public good, whereas the decision on the transactional mode by individuals is a private one though it usually involves externalities.

We do not fully develop Williamson's OFF here (for this, see Williamson, 1975, passim) but only give a summary. He regards market exchange and internal organization as transaction modes that may substitute for each other. On transactional efficiency grounds, four factors shall determine the choice to integrate vertically instead of using the market. These are:

a) Uncertainty/complexity in combination with bounded human rationality refers to limitations in formulating and executing contracts due to the complexity of problems ("chess") or uncertainty of future events.

Whereas uncertainty and complexity do call for simplification it is not a priori clear that simplification through hierarchy is in general superior

to simplification through contract rules. Williamson (1975, p. 25) observes that adaptive, sequential decision processes economize greatly on bounded rationality. Thus indeed, in this respect they seemingly top off markets. Neither a full set of state contingent markets nor a complete contingent claims contract is feasible. However, such a direct comparison does no justice to the subject. The strength of markets to economize on bounded rationality lies in providing relief ("Entlastung" according to Arnold Gehlen) from complexities. Markets do not always directly solve but circumvent or dissolve problems. Typical indirect market institutions are securities and money, which can be sold at a later date avoiding a decision now.

b) Small numbers problems in combination with opportunism refer to the possibility of self-seeking interest with guile that exists when partners to a transaction are limited in the choice of alternative options.

Opportunism, according to Williamson, arises when an agent can successfully mislead his partner regarding his behavior in future transactions. Hence, it comes close to the more familiar economic term "moral hazard." This possibility is stated to exist in small numbers bargaining situations where there is no market alternative. This point remains vague and therefore is hard to evaluate.[1] Especially, Williamson does not say if he wants to have the argument restricted to certain number configurations. In my view this reasoning, if true, may be applied to all situations where at least on one side of the transaction there is no alternative partner (low mobility). A monopolist (monopsonist) can show opportunistic behavior vis-a-vis any number of customers (suppliers). This most obviously holds for predatory competition, which is defined by a change in behavior before and after someone has become a monopolist (monopsonist). It also is the problem of limit pricing strategies.

A fortiori, the opportunism argument holds in the case of bilateral monopolies. But opportunism is limited even in this case by the possibilities of (fluctual) changes in the situation and by government policy. In a bilateral monopoly situation, market conditions may fluctuate and then long-term strategies will counteract opportunistic ones. Government policies interfering with opportunism are to be found in antitrust or tax policies and the threat of nationalization.

In oligopolistic situations I expect the opportunism argument to be limited by the goodwill factor. If there is perfect competition between sellers, goodwill does not matter. Everyone is free to behave opportunistically within the narrow limits set by competition. If there are but few sellers, however, goodwill is generally a valuable asset that can be lost through opportunistic behavior. Brand names for instance only keep their value as long as certain qualitative promises are kept. Furthermore, the rigid pricing hypothesis (Means, 1935) received its possible strength from the argument that firms with market power smooth out certain kinds of uncertainty. Now, this may also be termed "opportunistic behavior." But in any case, it possibly offsets uncertainty and therefore makes sequential spot contracting viable. Then, small numbers (oligopolies) would not necessarily favor vertical integration and long-term contracts, because existing market power is preferably used for increasing the asset "goodwill" than for boosting short-term profits. We shall examine this argument more extensively with respect to coal markets.

c) Information impactedness "exists when true underlying circumstances relevant to the transaction, or related set of transactions, are known to one or more parties but cannot be costlessly discerned by or displayed for others" (Williamson, 1975, p. 31).

This factor is therefore the combination of uncertainty, opportunism and bounded rationality. A prime example is the moral hazard problem of insurance. But clearly, the new item here is that information impactedness impedes correct decisions even if agents behave faithfully. This is otherwise known as the problem of adverse selection. On markets where only sellers hold the correct information on quality, we thus expect lemons to expel the better quality products, as long as nonmarket alternatives are available to potential sellers.

d) Atmosphere shall take care of the preferences people hold for one or the other transaction mode.

If individual preferences within a society vary, this allows different transaction modes to be used simultaneously for the same kind of transaction but by different people.

Regarding the choice between transactions through vertical integration and through markets, Williamson's principal hypothesis is that the presence of the first three factors implies vertical integration. Two questions are either not dealt with or are left vague. Is the intensity of influence of the factors a quantitative variable and are there trade-offs between the factors?

In trying to apply the OFF to coal markets, we face the problem of matching it with the characteristics of the trade. For local coal markets it is rather easy to show the sheer presence of the factors described by Williamson, but it will be hard to measure them. Furthermore, when turning to long-distance and international coal trade we face the difficulty of weighing them against offsetting factors that favor contracts and are essentially of the same nature.

This, of course, is a necessary condition for the OFF to be more than a disguised market failure framework. If the full set of Williamson's factors explains the replacement of the market by which vertical integration it is either a market failure framework only or it does not explain at all.

2. The Organizational Failures Framework Applied to Local Coal Markets

2.1 Some Hypotheses on the Institutional Choice in Local Coal Markets

Coal trade links the three broad stages: mining (including coal preparation), transportation (including conveyors, railways, barges, dumping, ocean transport) and consumption. The trade may involve the aid of intermediaries. Regarding the consumption stage, we shall restrict ourselves to electricity generation and steel-making. Currently these two types of consumers clearly predominate. Regarding mining and consumption areas we deal separately with local, large domestic, and international markets. In all three types of markets long-term contracts by far outweigh spot transactions in terms of quantities. Vertical integration is found in all three, but in the absence of government intervention dominates long-term contracts on local markets only.

Coal is by no means a homogeneous commodity. Qualities differ at least with respect to coking or blending properties, heating value, and ingredients which influence handling of the coal (properties of the ash, grindability), air pollution (sulphur, volatile matter and ash content), and corrosion (chlorine, phosphorus).

Coal is a nonrenewable resource, but known reserves are large relative to known reserves of other fuels. However, some coal quantities like coking and low sulphur coals are much less abundant than others, giving rise to rents. These are bounded by all coal qualities being substitutes in the sense that alone or in a blend they can be used for the same purposes at some additional costs. Hence, the bulk of all coal deposits may be viewed as a backstop resource for particular coal qualities. Still, unless offset by technical progress, cumulative mining costs in the industry rise over time.

Coal mining technology, except for a comparatively small fringe of readily accessible deposits, involves substantial investment in shafts and/or equipment ranging from $20 million to $2 billion. Expected mine life ranges from 20 to 30 years.[2] Investment decisions have to be made 5 to 10 years in advance to allow for planning, legal permits and construction.

On the consumption side, scale economies call for minimum optimally sized electric power stations as well as steelworks to cost hundreds of million dollars in initial investment. The life expectations and lead times of these facilities do not differ substantially from those of coal mines.[3] Electricity generating firms are often regulated utilities holding a local or regional monopoly position. Otherwise, electricity generation involves wholesale activities in bilateral oligopoly markets which are not necessarily regulated. Here long term sales contracts for electricity prevail. The demand for electricity has grown at quite a steady rate over the past decades, but today an extrapolation of this trend is no longer warranted in highly industrialized Western countries.

Coal-fired power stations can be built flexibly, to burn different quantities of coal or even other fuels such as oil. More flexibility normally means higher investments in storage space, blending facilities, boilers, etc. Furthermore, thermal efficiency has to be sacrificed for flexibility. Because fuel is the only variable input, the competitiveness (or use) of single power stations crucially depends on fuel costs, which again are highly influenced by the transportation factor. Location of coal-fired power stations is therefore either oriented toward specific coal mines or toward having access to cheap transportation modes like rivers or the sea.

Steelworks on the other hand use ore as a second important variable input, but so far are much more dependent on a narrow range of scarce coal

qualities. Even within this range a switch from one supply source to another may create high setup costs and a distinct deterioration in the quality of output. Steel producers face strong market fluctuations for their products, which influence their input procurement behavior.

Government interventions which substantially influence the transaction mode and thus could enter our problem are:

a) regulations on the siting of power stations, steel plants, and on allowed emissions of pollutants.

b) direct restrictions on vertical integration imposed by regulatory agencies. A power company may thus be forbidden to integrate at all into coal mining or only be prevented from selling the coal on the market.

c) fuel clauses in the sale of electricity

d) Averch-Johnson type distortions in the use of capital and fuel as inputs caused by rate of return regulation.

All these factors tend to complicate the empirical testing of hypotheses, but for most of our argument we shall assume them away. It may only be noted that regulation establishes long-term monopoly positions favorable to the Oi and Hurter argument for long-term contracts or vertical integration as an insurance policy.

In order to show the relative merits of long-term transaction modes, it is worthwhile to look first at local coal markets. They are defined to exist where mining and consumption areas coincide. Here historically three transaction modes and combinations thereof dominate the relationship between coal mining and consumption:

a) Vertical integration is found with respect to the American, German and South African steel industries and partly with respect to German[4] and American electricity generation.

b) Public regulation or public ownership of coal mining is found in Germany, the UK, France, and South Africa. In these cases coal is normally bought under long-term contracts or through sequential spot contracting with prices regulated.

c) Coal consumers are publicly owned or regulated. This holds for nearly all electricity generation. It is of special importance in the U.S. because here regulation after 1935 for a long time seemingly has prevented large-scale vertical integration between coal mining and electricity generation. In the U.S., transactions between coal mining houses and power companies were until recently predominantly on a long-term contractual basis.

A first hypothesis from this evidence is that, without regulation or public ownership of either coal mines or coal consumers, vertical integration between the two would generally prevail in local coal markets. This shall be explained using the four factors of the OFF.

2.2 Uncertainty/Complexity on Local Coal Markets

The role that uncertainty can play in coal markets is determined by the amount, duration and specialization of capital investments in coal mining, transportation and consumption facilities. The very fact that both consumer groups may have to evaluate several investment opportunities against each other, and that many issues besides coal procurement have to be taken into consideration, makes it computationally comforting to have low uncertainties in the investment decision, because its complexity rises tremendously

otherwise. One can argue that initially through computerization of investment planning this has even increased. The more accurately investments can be planned from an engineering point of view, the better costs can be evaluated. But this precision is worth little if the prices for inputs and outputs are highly uncertain.

In planning to start a coal mine, a firm faces problems quite different from the capacity investment decisions of coal consumers. Mining investment costs vary considerably depending on geological conditions. An extremely wide spread exists in the U.S., where mines may range from a few hundred thousand to a hundred million dollars in initial investment. Already from this broad range one would expect a variety of contracting modes on the local U.S. coal markets. The importance of long-term relative to spot contracts should be positively related to the size of initial investment and negatively related to the age of a mine.

Furthermore, besides the higher expected mining costs of new mines as compared to existing ones, actual results may differ substantially from those in the engineering models used for cost projection. Costs have generally proven to be higher than planned. This is usually taken care of by applying high discount rates. It does not mean that coal mines cannot be planned. Sample boreholes and knowledge about the general conditions of a mining area may reveal substantial information. Still, natural conditions show a great variety in many details which limits predictability. Mine development also may take much longer than planned because of accidents or unexpected rock formations, and faults can make coal seams partly unworkable.

In a special way, uncertainty of mining investments relates to government. The general public is affected by mining through complementary investments, employment problems, air pollution and energy availability. The first three of these factors make local governments of coal districts

interested in lowering demand uncertainty for coal in general and especially with respect to new coal mining projects. A new mine (especially a surface mine or a preparation plant) that destroys the natural environment can only be defended publicly if the coal will be needed for certain. The same argument holds if the government has to finance new roads, schools, hospitals, etc., as a consequence of the sinking of a mine. Therefore, government will only grant the necessary funds or the licenses to the mining investor if demand uncertainty can be lowered. In particular, it can help for the customers to be the local electric utility, because then both the environmental burdens and the total benefits are spread over the inhabitants of the area.

2.3 Small Numbers Problems and Opportunism on Local Coal Markets

In local markets transportation cost differentials for coal restrict the number of potential partners to transactions. By far the cheapest means of transportation is a direct conveyor belt connection between mine and consumer. This substantially saves both on handling and direct transportation costs. The transportation problem is especially severe for coal with an inferior quality because large quantities of excess ballast have to be transported. In general coal quality can be improved by preparation, but this is a costly procedure and leaves a residuum of coal with even worse quality attributes. Considering the economies of scale in electricity generation and with no other customers left for coal of inferior quality, a mine normally has no choice. It can only serve one or at most very few electric utilities with this residual fraction of its output. On the other hand, the utility may not want to integrate vertically and buy such a mine because it then will have to bear the sales risks with regard to other groups of customers. Unless there are government regulations to prevent it,[5] one can

predict that vertical integration between coal mines and electric utilities will apply to mines that predominantly produce steam coal and long-term coal contracts between power companies and other types of mines.[6] This has to be explained somewhat further: with transportation cost for electricity being lower than for coal over short and medium distances (and within a network) it is worth building electric power stations on top of coal mines. As power stations and coal mines have roughly the same expected lifetimes, then at least the investment planning of both has to be coordinated. This necessitates a contract on the mutual simultaneous investment into a mine and a power station. In theory, sequential spot contracts for single coal purchases could follow afterwards. The price expectations, however, would be highly uncertain because of

a) the existence of alternative outside opportunities (the bilateral monopoly range) and

b) the possibility of bargaining within the bilateral monopoly range generated by these opportunities.

Both kinds of uncertainty[7] give rise to opportunism. They could be narrowed down substantially through a long-term contract specifying prices and quantities to be traded over the lifetime of the mine and the power station. The difficulty is to find contract terms to cover future contingencies in such a way that they are both complete and enforceable.[8] 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 limited 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.

Long-term contracts designed to run for a decade or longer necessarily involve times of tension when situations arise, in which outside opportunities for the remainder of the contract term are deemed to be better for one partner. This partner may therefore try to dishonor the old agreement and either change the terms or abandon it altogether. The economic history of the last hundred years reveals that in each decade unforseeable events occurred which might have caused such desires and could have been used to declare force majeure.[9] The fact that long-term contracts have still proved to be viable shows that ex nunc outside opportunities were not seen generally to provide long run advantages, or that vertical integration was prevented by regulation.

2.4 Information Impactedness

Information impactedness is a factor of importance especially to the mining side of the coal market. The mining company knows much more about the geological conditions of the area where it wants to establish a mine than both its customers and its bankers.[10] It can reveal information to both groups in such a way that they would like to enter contracts. But with high cost to verify the information, they may hesitate to do so. Now, if the customer starts the mining project himself he can prove the information through internal auditing. He can also convince bankers more easily to lend capital to the mine because demand uncertainty for coal produced by the future mine is close to nil and because consumers normally had the choice between several alternatives. So the project has some superiority-by-survival properties. In a weaker way this also holds if the consumer enters a long-term contract and starts an investment project complementary to the

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mine thus indicating that he holds trust in the project.

Vertical integration can be of different types. The revealed preference of an agent for any particular type may be used as a signal by other agents. Consider backward integration: the vast majority of mining properties are not yet developed. An owner may sell mining land to an electric utility and receive a predetermined fixed price. If at the outset he knows the quality of the specific lot whereas the buyer knows the average quality of mining land for sale one arrives at Akerlof's (1969) lemons story. Mining land sold will on average be of lower quality than mining land developed by its owner, because buyers' willingness to pay is based on this expectation. Hence the owner of good mining will want to try forward integration as an alternative strategy. This possibility, however, is limited by the enormous capital required. For the goodwill of a mining company as a borrower suffers from the same kind of information impactedness that make selling a mine or mining land a lemons problem. Another possibility for the land owner is to sell a property partly for cash and partly for a stock option on shares of the buying company. This again is a compromise, because the profits of the acquiring firm depend only in part on the quality of the deposit, in other parts on its management and on risk factors.

In such a situation, how do long-term coal sales contracts compare with vertical integration? First, assume that contracts can always be enforced. Then an unconditional fixed price contract would only be a very simple though unrealistic type of a complete contingent claims contract. However, all contracts do involve some kinds of escape (force majeure) clauses. Even so, the viability of fixed price contracts presupposes either large risk-taking capabilities or stable conditions.

Such stable conditions pertained in the U.S. coal industry throughout

the 50s and 60s, which was the high time of fixed price contracts. If the expectations that originally lead to such contracts are not fulfilled because spot price, and/or costs soar high, sellers tend to threaten not to deliver any more. This was experienced in 1970 after the Coal Mine Health and Safety Act induced mining cost increases and again in 1973/74 in connection with the Arab Oil Embargo. Breach of contract is almost trivial when full damages are paid (see however Diamond-Maskin, 1979), because then after the breach nobody is worse off than before. This, however, is not the normal situation. The breach of contract on the occasion of a crisis occurs, because not all damages can be claimed, litigation is costly, its outcome uncertain and the probability of bankruptcy strictly nonzero.

The risk-taking capabilities in fixed price contracts are probably asymmetrically distributed between suppliers and consumers. If the risk of mining cost is high compared to the risk of electricity demand, one may expect the utility to bear part of the fixed price risk of the mine by paying a risk premium above the expected competitive spot price and vice versa with another risk distribution.

Vagueness of contract clauses creates some necessity to reach a new agreement under some contingencies. Generally, there is a tradeoff between the probability of breach of contract and its overall vagueness, assuming that complete contingent claims contracts are infeasible anyway.[11]

My own experience indicates cyclical movements in people's preferences in favor of well defined contracts with high probability of breach as against vague contracts with low probability. But a case for the general superiority of the latter can be made on the ground that breach makes it extremely difficult to reach a subsequent agreement for continuation even though there may be no better partner.

Hence, even though long-term contracts are often hard to enforce, they will be rather immune to outright breach for at least two reasons: First, the breaching partner loses credibility and reputation needed to conclude other contracts. Such necessity usually increases with the size of the firm. Thus horizontal and vertical integration can be substitutes to enable a vertical transaction. Because goodwill-economies-of-scale ordinarily are linked to the number of customers served (or symmetrically to the number of suppliers needed), horizontal integration will become the preferred alternative for idiosyncratic goods to be transacted only once between the same partners. Nevertheless horizontal size also is important in the context of regularly repeated transactions, because it transforms the limited time horizon of two contract partners into the unlimited horizon of two firms, each having a reputation. However, goodwill is at the same time a source of market power. If potential partners expect to suffer from this, it has to be traded against the probabilities of contract failure.

Secondly, the breaching partner usually will not be able to find a better matching new partner, whenever the old contract relationship has resulted in mutual specialized investment.

Still, renegotiation[12] and outright breach of long-term contracts do occur. At first glance they reveal a severe failure of long-term contracts as an institution. However, compare them to strikes, takeovers, mergers or bankruptcies of vertically integrated firms. They do not shake the institution. Rather the world moves on. Returning to the outset, the willingness to enter a long-term contract signifies confidence by both sides in their own operation. Otherwise they would rather sell out. To the interested outsider it furthermore proves the confidence that the two parties hold in each other by planning subsequent complementary investment. This

becomes especially important to banks and shareholders who will finance the investment projects.

2.5 Atmosphere

Williamson introduces atmosphere as a factor influencing the make or buy decision via the preferences of people for market or hierarchical coordination. In our example this may become more important for the attitudes of executives than for the general employment relation with which Williamson illustrates the point. If the chief executives of coal mines tend to be mining engineers and those of electric utilities electrical engineers, these companies are less likely to merge vertically than in the case where one of them is a lawyer. The prediction from this is that whenever changes in the other factors of the OFF occur, atmosphere will cause a lag in the adjustment process. Assume that vertical integration prevails because it is perceived to be optimal. Then management will not be specialized for one of the production stages. If now a technical change makes disintegration optimal, people working in the industry will at least partly try to resist.

3. Is the OFF Applicable to Large Domestic Coal Markets and International Coal Trade?

3.1 Large Domestic Coal Markets

Large domestic differs from local coal markets mainly by two features. First, the advantage from specializing on a single supplier or customer tends to decrease with an increase of the distance, because that reduces the relative disadvantage of other suppliers. Secondly, due to larger numbers, greater diversity and the distance itself, information about relevant agents in the market becomes smaller for any individual agent as the geographical market size increases.

Thus with geographical market size two of the three relevant economic factors of the OFF move to favor vertical integration: information impactedness and complexity/uncertainty tend to increase with distance. On the other hand the small numbers problem becomes less severe. On balance, this predominates. So vertical integration decreases, at least as far as electric utilities or consumers are concerned. But long-term contracts keep their importance. In this situation they offer two major advantages over vertical integration. Management control becomes more difficult with distance. More important, these are usually many projects to be evaluated for a decision to integrate vertically. Each single evaluation is likely to be more costly than to evaluate a contract proposal, because purchase of a mine occurs now (undiscounted) and is final. Also, there will be more lemons to sort out, whereas the self-selecting decision to enter or continue production already screens potential long-term contract suppliers.

The latter item emphasizes a special feature in institutional analysis related to the information impactedness argument. Information impactedness

is the result of an irreversible historical process. If mining companies already have the relevant information, backward integration by coal users has to overcome the very information barrier that Williamson wants it to eliminate. Expanding the limited amount of vertical integration of Eastern coal in the U.S., thus quite probably would be suboptimal, whereas for Western coal vertical integration comes in quite naturally.

3.2 International Coal Markets

The special features of international coal markets are[13]:

(1) Fluctuations in ocean freight rates and currency exchange rates create shortterm arbitrage opportunities. These tend to limit the scope of long-term commitments both of the contract and of the vertical integration variety.

(2) Governments interfere with markets through special measures like embargos or import restrictions. Neither contracts nor vertical integration can usually prevent this. Only a diversified portfolio of supply sources on the one and of customers on the other side insures against such actions. Compared to the high setup costs and large scale necessary for vertical integration, a diversified contract portfolio is cheaper to build up. Contracts can be split into small enough parcels. If firms are split up, either economies of scale or voting power is lost. In both cases efficiency is being sacrificed.

(3) International enforcement of both property rights and contracts is more difficult than domestically. However, an international reputation can be achieved by both buyers and sellers. This goodwill makes long-term contracts feasible even with no power legally to enforce them.

Although the vertically integrated multinational company without doubt is the most successful example for overcoming international transactional problems it does not seem to provide the germane answer to coal procurement requirements of electric utilities. The main reason for this is that electric utilities are not normal private market oriented companies. They cannot merge horizontally nor vertically across borders. So multinational companies will be restricted to the coal mining and transportation stage, trying to gain a reputation enabling them to conclude long-term contracts.

Thus the main limitation for applying Williamson's OFF to international coal trade comes from the virtual impossibility of excluding state intervention. This violates an implicit assumption of the Williamson analysis.

4. Evaluating the OFF

Wherever the transfer of a good between two stages of production occurs simultaneously through vertical integration, long-term contracts and spot purchases, any explanation for the dominance of one of these transaction modes is likely to be wrong. Hence the choice of an empirical topic to test a theoretical concept like the OFF could already be unfair. This holds against the foregoing illustration but equally well against the examples used by Williamson to discredit long-term contracts. We therefore conclude at a more theoretical level of discussion. In my view, Williamson's OFF indeed contains the main elements of failure for any human institution to achieve efficiency. It clearly names and describes the transactional items that matter. Its main achievements are completeness and simplicity. These attributes gain increasing significance at a time where mathematical institutional economics is progressing rapidly in a manner reminiscent of the discovery of elementary particles in physics. New institutional properties are discovered in large numbers without rendering the basis for a unified approach. Williamson's OFF could prove to be just that.

In its full generality the framework cannot imply anything about the relative superiority of a specific institution. Strange enough, Williamson himself conveys the impression that his framework relates above all to markets. He introduces it using market failure examples. When he comes to discussing hierarchical failures of the firm, the OFF is somehow left aside. Is e.g. ethical behavior among firm employees part of the "atmosphere"? It remains rather unclear how the peculiar failures of the firm relate to the OFF. Taking traditional economic thought as a guideline I submit that the most prominent failure of markets is captured by the small numbers/opportunism argument, whereas the most prominent failure of hierarchies lies in the uncertainty[14]/complexity issue. Both have their share in the information

impactedness problem. Because these shares do not coincide, quite often the firm can be the solution to the information impactedness problem of the market and vice versa.

Should this brief assessment be correct, markets quite generally will be used to relieve hierarchies from uncertainty/complexity. The larger an internal organization becomes the greater is the necessity for such a relief. Hence markets will be used for this purpose even if highly imperfect by pure economic efficiency standards. This could explain both the development of M-form enterprises and a willingness to accept highly imperfect market relationships. Vice versa the firm will typically replace markets in bilateral monopoly situations.

As empirical statements, these and those derived by Williamson still lack the government as a third institution. Government holds power virtually to effect any of the two outcomes of an OFF type analysis: markets or hierarchies. Above all property rights are defined and enforced through the state. With weak property rights on production facilities, the firm is difficult to establish. Furthermore, the state may want to intervene against market or hierarchical failure. But who decides what the government can do? Williamson implicitly always uses a final goods market as a yardstick and self-enforcement vehicle for the efficiency of a (vertical) transaction mode. It is doubtful that voting mechanisms lead governments to pursue a similar path.

5. Conclusion

If coal mining and consumption areas coincide, vertical integration between these two stages is usually efficient but often prevented by government regulation.

Internationally, vertical integration between coal mining and consumption calls for extremely large scale. Otherwise long-term contracts are preferred because they allow for diversification. Contract terms in general can be adapted to cope with new situations, although this involves times of tension between the partners.

The essence of this paper is to show that although vertical integration well be explained by Williamson's OFF, this is also true for long-term contracts. It seems to be indeed difficult to formulate conditions from which one and only one institution follows. For local coal markets, such conditions seem to be fulfilled if government does not interfere directly, whereas on a large national scale and in international coal trade, differing institutional setups coexist. Markets and hierarchies both help to achieve specialization. If this results in many parallel efforts, markets are likely to be optimal. If it requires specific recurrent bilateral transactions among the same partners, the firm will be superior provided the complexity of organization can be handled. To overcome complexity is a learning process which helps to explain why often economies of scale grow over time.

FOOTNOTES

1. It can be made more precise by relating opportunism to mobility (FitzRoy and Mueller, 1977). Opportunism can be interpreted as the production of wrong information in order to receive monopoly rents. Applying the rent transformation argument by Posner (1975) on this topic reveals that the possibility of opportunism may give rise to wasteful expenditures by both partners to a transaction.

2. See Manove (1978) for an endogenous determination of optimal mine life.

3. This could be the result of mutual interdependence already.

4. In Germany forward vertical integration from coal mining into power generation has developed for two reasons: coal mines need electricity and they have to dispose of low grade coal, which is not marketable. The first reason lost its importance through the increase in scale economies for power plants. Today one such plant can supply a sizeable number of coal mines. Hence, today the coal industry sells electricity to the largest German electric utilities (RWE and VEW).

5. Or forbid sales to the market, if vertical integration occurs.

6. There can be economies of multi-plant operation for mines which jointly own power stations (e.g. Ruhrkohle A.G. - Steag in Germany).

7. This corresponds to Radner's (1968) classification of uncertainty relating to the environment and to acts of other agents.

8. "Focal points" (Schelling, 1960) are generally preferred to a complex profit sharing rule.

9. This applies a fortiori to international long-term contracts but in this case also to vertical integration.

10. Quality of coal is easier to prove from samples, although they may be biased. To bankers, however, quality has much less meaning than to customers. Therefore contracts with customers can be used as a signal by bankers.

11. Incompleteness is a special kind of vagueness: the consequence of a certain state of the world that may occur is undefined.

12. In a letter to the author, Richard Gordon stresses the importance of renegotiations. They tend to occur during a crisis of a particular contract type.

13. This is more extensively treated in Vogelsang (1979).

14. Opportunism relates to uncertainty in the sense that from the point of view of others it creates the specific uncertainty of an agent's behavior.

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