Keio Business School

Hold-Up Problem:

Underinvestment in Parts Transactions

Questions

Read the text described in Sections 1 and 2 in order to understand the situation that firms in question are faced with, where the setup of the model is explained. Consider the merger negotiations described in subsection 2.3, which is based on the merger of Fisher body (body supplier) by GM (automaker). The bargaining power of the manufacturer and supplier 1 is known to each other in advance.

1. Let β denote the rate of surplus distribution at which the manufacturer can receive the surplus generated from the trade between the manufacturer and supplier 1. The manufacturer's profit anticipated on Date 1 is then $\beta\alpha x - x^2/2$, where $x^2/2$ represents the manufacturer's expenditure of capital investment and α denotes the asset specificity of the equipment held for supplier 1. What is the optimal asset specificity the manufacturer should choose?

2. Suppose that the manufacturer can receive half of the surplus, i.e., $\beta = 1/2$. Then, is underinvestment resolved?

3. Suppose that the manufacturer acquires some amount of supplier 1's shares before the merger and thus the bargaining power of the manufacturer increases, i.e., the rate β of surplus distribution increases. Then, how is underinvestment improved upon as β increases?

4. Are there any obstacles to the manufacturer's acquisition of supplier's shares before the merger? What can be a barrier? Explain your answer referring to post-merger integrations.

5. Compared to companies in the U.S. and Europe, labor unions are in many cases organized as company unions instead of craft unions in Japan. Discuss the role of labor unions in merger negotiations.

6. More generally, reconsider the merger of Fisher body by GM from the viewpoint of transaction costs described in the Appendix. (Hint: Coase (2000) also argued about this merger.)

The aim of this case

The aim of this case material is (not to study the accounting or personnel aspects but) to clarify some points in the hold-up problem which arises as a major issue in incomplete contracts. We consider a simplified situation based on the merger of Fisher body (body supplier) by GM (automaker). It is difficult to codify every possible contingency in contracts, and thus ambiguous arrangements will remain in the statements about the terms and conditions of transactions. This incompleteness of contracts may cause manufacturer's or supplier's underinvestment in relation-specific equipments or skills in parts transactions. How can we resolve this problem? If it is difficult to resolve it, what should we keep in mind for our management decision? Readers can understand the contents of this case material more easily, if they have knowledge of the differentiation of the function $y = x^2$. The Appendix classifies transaction costs from two different aspects.

1 Introduction

Contracts are classified into two types from the viewpoint of economic theory; complete contract and incomplete contract. When a contract provides for any contingencies that may occur, it is called a **complete contract**, in which the conditions, rights, obligations, and actions to be observed can be described in detail. Actually, it is not likely to specify all of these things in a written contract. Let us imagine, for example, a situation that a certain manufacturer procures parts from a supplier. It is not possible to observe directly the supplier's production technology or level of effort. Even in this case, if an index or a signal that is highly correlated with them is observable, together with evidence that can be proved to a third party, it will be possible to draft a transaction contract that relies on that index. The same is true of responses in the event of default of the terms of the contract. Thus, in complete contracts, no unforeseen contingency exists for any of the parties to the transaction. This is due to the fact that, for example, rules for renegotiation between the contracting parties may be specified in the written contract for the events when contingencies arise that are not specified in the terms of the contract.

However, codifying contract clauses that provide for every contingency generates costs in terms of both time and money. Those costs are called **transaction costs** and grouped into ex-ante costs and ex-post cost in a classification; the costs of investigating a consumer's preference for goods prior to their production and the time and financial costs incurred in the negotiations for agreeing to the contract clauses are ex-ante costs, while the costs of monitoring compliance with the contract and of undertaking renegotiation or litigation are ex-post costs.[1] When ex-ante costs are very high, ambiguous arrangements will remain in the statements about the terms and conditions of the transaction. If it is difficult to substantiate what has occurred in a court of law, then it is easily

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[1]　See the Appendix for the classification of various transaction costs mentioned here.

anticipated that the ex-post costs will be very high. Given these costs, contracts cannot be codified to provide for every possible contingency, leaving ambiguous arrangements, or in other words **imperfect commitment**, in the event of unforeseen contingencies. Such contracts are known as **incomplete contracts**.

If inefficient outcomes may arise in some cases due to imperfect commitment with regard to contract clauses, then the features of incomplete contracts should be analyzed in order to improve those cases.[2] While enforcement legislation may also be applied through the courts in such cases, ex-post negotiations sometimes take place with regard to contract clauses between the parties to the transactions, as do mergers in the case of transactions between firms. In this case material, we deal with the inefficiency of transactions arising due to imperfect commitment.

This case material is organized as follows. In Section 2, the situation in question is first described. As an object of comparison, the case of complete contract is next analyzed in order to clearly show what occurs in the case of incomplete contract. Then, we return to the object of analysis for the case of the incomplete contract. In Section 3 we consider the merger of a supplier by a manufacturer. Questions are given based on the contents in this section. In the Appendix, transaction costs are classified from two different aspects.

2 Manufacturer-Supplier Relationship

Consider the following situation. The manufacturer of a certain product needs to purchase one unit of a special part from one of two suppliers. Both suppliers have already produced the parts, for which the production cost is set to 0 for simplicity of the following analysis. The specifications vary from supplier to supplier, and the manufacturer makes a total capital investment of $x^2/2$ in terms of equipment in order to make such parts operational. The manufacturer pays a transaction price p to the supplier of the part, and obtains earnings of αx when purchasing the part from supplier 1, and of $(1 - \alpha)x$ when purchasing from supplier 2. For the reasons described below, however, it is not possible to determine the supplier or the transaction price at the time of making the capital investment. Therefore, when determining the amount of the capital investment, the manufacturer must also determine how much equipment to allocate to each supplier. The ratio of what is allocated to supplier 1 expressed

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[2] Researchers have not reached a clear consensus regarding the exact definition of incom- plete contract. While it is defined by imperfect commitment in many textbooks, some have advanced the critique that the imperfection of the commitment should be considered to have been resolved if the written contract includes a special note to the effect that prescribed steps should be taken when events occur that are not stipulated in the written contract. On the other hand, others argue that contracts are incomplete when no contract clauses are set that would enable the transaction to lead to efficient outcomes. This would, however, also end up including inefficiencies arising due to asymmetric information within the definition of a contract's incompleteness. Accordingly, it had become mainstream in considerations by economists to impose the constraint that for parties to a transaction, certain events that occur in connection with the transaction are **observable** (i.e., symmetric information) **but unverifiable** in a court of law. However, one cannot deny the feeling that such a convenient framework excludes a number of examples from the category of incomplete contracts. In any case, all of the above definitions hold in common the fact that they regard transaction costs to be the source of the incomplete- ness of the contracts. This case material adopts the definition of incomplete contracts in the broader sense, while defining the property of having symmetric information that is nevertheless difficult to prove in a court of law as characteristic of incomplete contracts in the narrow sense.

as the profit ratio relative to supplier 2 is represented by α, and it may be assumed without loss of generality that $1/2 < \alpha < 1$. Both manufacturer and supplier are risk-neutral.

We can think of variable α as representing the **asset specificity** of the equipment held for supplier 1.[3] The asset specificity α is measured by the loss of surplus (value) that results when it is transferred to another use. Accordingly, the expenditure of capital investment $x^2/2$, which amounts to a sunk cost, is not included in the measurement of asset specificity. When an investment enhances the specificity of a given asset, the investment is known as a **relation-specific investment**.[4] In the setup of the model described here, the capital investment represents a relation-specific investment for the manufacturer.

In what follows, we consider the above relationship from the perspective of the manufacturer, and thus the manufacturer is regarded as the principal and the supplier is regarded as the agent. There is no asymmetric information between the manufacturer and the supplier. Accordingly, in the context of an incomplete contract, a contract that maximizes the expected profit that a principal can obtain assuming a complete contract (as an object of comparison) is called a **first-best contract** and a contract that maximizes it for the incomplete contract (as the object of analysis) is called a **second-beset contract**. In addition, when the joint profit (i.e., the sum of profits) of the manufacturer and supplier 1 is maximized, the transaction is said to be **efficient**.

2.1 Complete Contract

In what follows, we consider the situation described above with 2-period model. First, consider the case of a complete contract in order to confirm the inefficient outcomes in the case of an incomplete contract analyzed in the next subsection.

- Date1: The manufacturer decides the transaction price, p, as well as the supplier from which it purchases the part on Date 2. After that the manufacturer decides x and α, i.e., the level of capital investment ($x^2/2$) and the asset specificity of the equipment held for supplier 1.

- Date 2: The manufacturer purchases the part at transaction price p from the supplier with which it was contracted on Date 1.

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[3] 3A mold or a machine tool for manufacturing special parts required only for a certain manufacturer's product is an asset that has specificity for suppliers that produce such parts. Those assets are particularly referred to as having physical asset specificity.

[4] 4Knowledge and experience regarding interpersonal relationships and procedures within one firm can have little value in other firms. Such knowledge and experience are referred to as **firmspecific skill** and is an asset that has human asset specificity. An employee's investment in firmspecific skills is an example of a relation-specific investment. Other factors that produce specificity in an asset include location and brand name, as well as dedicated assets that enable the production of a considerable number of products in response to orders by specific customers, even for general-purpose products.

Without loss of generality, we can assume that the manufacturer contracted with supplier 1. The profit of the manufacturer including the capital investment is then $\alpha x - p - x^2/2$. The part had already been produced, and thus the profit of supplier 1 is the same as the revenue, p. The efficient outcome is obtained by solving the following joint profit maximization problem for the manufacturer and suppliers 1;

$$\max_{x,\alpha} \left(\alpha x - p - \frac{x^2}{2} \right) + p = \alpha x - \frac{x^2}{2}.$$

Let x^* denote the efficient level of x. We have $x^* = \alpha$ by the first-order condition with respect to x (Differentiating $\alpha x - x^2/2$ with respect to x yields $\alpha = x$.). Let α^* denote the efficient asset specificity. The joint profit is monotonic increasing in α, and thus we have $\alpha^* = 1$ by the assumption $1/2 \leq \alpha \leq 1$. Therefore, $x^* = \alpha^* = 1$ characterizes the efficient result. Namely, the capital investment amount is $(x^*)^2/2 = 1/2$ and the manufacturer allocates the entire amount of the investment for equipment to supplier 1.

On the other hand, the profit maximization problem for the manufacturer anticipated on Date 1 is

$$\max_{x,\alpha} \alpha x - p - \frac{x^2}{2}$$

when the manufacturer trades with supplier 1. Let $\hat{x}$ denote the level of x that maximizes the manufacturer's profit under the complete contract. We have $\hat{x} = \alpha$ by the first-order condition with respect to x (Differentiating $\alpha x - p - x^2/2$ with respect to x yields $\alpha = x$.). Let $\hat{a}$ denote the asset specificity that maximizes the manufacturer's profit under the complete contract. The manufacturer's profit is also monotonic increasing in α, and thus we have $\hat{a} = 1$. Therefore, $\hat{x} = \hat{a} = 1$ holds also in the case of the manufacturer's profit maximization. In other words, regardless of whether the manufacturer's expenditure of capital investment and asset specificity are observable to each supplier or verifiable to the court, efficient outcome can be realized when the contract is complete. The manufacturer's profit is monotonic decreasing in p, and thus the transaction price is set to $\hat{p} = 0$. The above is the first-best contract, and the manufacturer obtains 1/2 as its profit at that time.

2.2 Incomplete Contract

Let us return to our original setup to consider the case of incomplete contract. Suppose that the transaction contract is incomplete on Date 1 due to the following reason; the manufacturer must ship the product on Date 2 but need to make the part purchased from the supplier operational by making capital investment on Date 1 in order to adjust the production equipment as a whole in accordance with its asset specificity. In other words, **investment adjustment costs** have arisen.[5] Moreover, quality

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[5] Here, the investment adjustment costs are not explicitly included in the discussion, and thus they will be assumed to have been accounted for within the capital investment.

inspection by the manufacturer of the part provided by each supplier takes much time, such that holding a competitive bidding on Date 1 will be impossible. The specific part from each supplier cannot be substituted for with a general-purpose part that is available on the market. For the simplicity of our analysis, with the quality inspection conducted on Date 1, the manufacturer was also able to ascertain the absence of any defects in the part from each supplier, so that the information asymmetry was resolved at the beginning of Date 2.

- Date1: The manufacturer decides x and α without being able to determine either the transaction price, p, or the supplier with which it will trade on Date 2.

- Date 2: The transaction price, p, and the supplier are determined by a competitive bidding. The manufacturer purchases the part from the supplier with the lowest bid in the competitive bidding and pays the successful bid tendered by the supplier as the transaction price.

Let $p_i (\geq 0)$ denote the price finally offered by supplier $i (= 1, 2)$ in the competitive bidding. The manufacturer's profit is then $\alpha x - p_i - x^2/2$ when it trades with supplier i. Thus, if $\alpha x - p_1 - x^2/2 \geq (1 - \alpha)x - p_2 - x^2/2$, i.e.,

$$\alpha x - p_1 \geq (1 - \alpha)x - p_2, \tag{1}$$

the manufacturer decides to trade with supplier 1 with trade price p_1. Assume for convenience that the trade is made with supplier 1 in the case of a tie.

Recall that both suppliers have already produced their parts, and thus they do not need to pay any amounts of costs for their production. Thus, supplier 2 can reduce the price to $p_2 = 0$ at which it gains nothing (the profit is zero). As a result of the price reduction in competitive bidding, supplier 1 can receive the order from the manufacturer by offering $p_1 = \alpha x - (1 - \alpha)x$, because $p_1 \leq \alpha x - (1 - \alpha)x$ when $p_2 = 0$ in (1). Note that if the profit is negative, then supplier 1 will not trade with the manufacturer, which depends on the asset specificity α.

Let us proceed assuming that the profit of supplier 1 is not negative. Then, Under an anticipation that the transaction price determined on Date 2 is

$$p_1 = \alpha x - (1 - \alpha)x, \tag{2}$$

the profit maximization problem for the manufacturer anticipated on Date 1 is written as

$$\max_{x,\alpha} \alpha x - p_1 - \frac{x^2}{2} = (1 - \alpha)x - \frac{x^2}{2}$$

Let $\tilde{x}$ denote the level of x that maximizes the manufacturer's profit under the incomplete contract. We have $\tilde{x} = 1 - \alpha$ by the first-order condition with respect to x (Differentiating $(1 - \alpha)x - p - x^2/2$ with respect to x yields $1 - \alpha = x$.). Let $\tilde{\alpha}$ denote the asset specificity that maximizes the manufacturer's profit under the incomplete contract. The manufacturer's profit is monotonic decreasing in α under the incomplete contract, and thus we have $\tilde{\alpha} = 1/2$ by the assumption $1/2 \leq \alpha \leq 1$. Therefore, $\tilde{x} = \tilde{\alpha} = 1/2$. The profit of the manufacturer is then $(1 - \tilde{\alpha})\,\tilde{x} - \tilde{x}^2/2 = 1/8$, and thus the assumption that the profit of supplier 1 is not negative is veried because it is $p_1 = \tilde{\alpha}\tilde{x} - (1 - \tilde{\alpha})\,\tilde{x} = 0$.

As compare to $x^* = \alpha^* = 1$ in the first-best contract or the complete contract, $\tilde{x} = 1/2$ implies the underinvestment, and $\tilde{\alpha} = 1/2$ means that half of the expenditure of capital investment will be lost due to the asset specificity. These inefficient outcomes are derived as in the second-best contract. It is, however, clear that the inefficiency comes from the incompleteness of the contract on Date 1, because the manufacturer does not have to pay anything for the part it purchases ($p_1 = p_2 = 0$).

Let us consider this result more deeply. Suppose that the manufacturer chose $\alpha = 1$, which is the same level of the asset specificity as in the first-best contract. In this case, if the transaction was made with supplier 1, then there would be no wasted capital investment, because the manufacturer's capital investment was entirely specialized for dealing with the part supplier 1 produced. For any $x > 0$, however, even if the offered transaction price is raised to $p_1 = x$, supplier 1 can be guaranteed to receive an order from the manufacturer in the competitive bidding, because $p_1 = x$ satisfies (2). Accordingly, supplier 1 can reap or extract all of the manufacturer's revenue, $\alpha x = x$, generated from their transaction.[6] The portion of the surplus gained by the transaction by a party to the transaction is called the **appropriable quasi-rent** for the party.[7]

As described above, when a relation-specific investment is carried out by the manufacturer, then regardless of the fact that the contract is incomplete, if the manufacturer chose the asset specificity biased to a specific supplier, then the manufacturer would be deprived of any and all revenue generated by its own capital investments by the supplier. The manufacturer who fears this appropriation would reduce asset specificity, namely by making diversified investments.

In fact, in the second-best contract, the manufacturer selects $\tilde{\alpha} = 1/2$, so that the appropriable quasi-rent that can be taken away by either supplier is zero, because $p_1 = p_2 = 0$ holds. Whichever supplier the manufacturer ends up trading with, however, diversified investment means that after the transaction, half of the manufacturer's capital investment will disappear due to its asset specificity. In order to reduce the amount to be lost in this way, the manufacturer will end up refraining from investing in the relation-specific investment itself, choosing $\tilde{x} = 1/2$ in a second-best contract, not choosing $x^* = 1$ that is to be chosen in the first-best contract.

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[6] In general, if the manufacturer chooses $\alpha = 1/2 + e$ ($0 < e \leq 1/2$), then we have $p_1 = 2ex$, and thus the manufacturer will be deprived of $2ex$ by supplier 1 from its profit αx.

[7] In simple terms, quasi-rent is the surplus (value) created by a transaction, which corresponds to the manufacturer's profit in this model. In its definition, however, some ambiguity remains, and thus use of this term in the text has been avoided as much as possible.

Generally, underinvestment arising due to the incompleteness of contracts is known as the **hold-up problem**. In the situation presented in this section, the manufacturer's underinvestment was caused by the absence of an agreement regarding the value of the transaction with a supplier at the point when the relation-specific investment was to be made. Note that the hold-up problem is not resolved only by determining a supplier in advance of Date 2; if the transaction price is determined by supplier 1 on Date 2, the hold-up problem becomes even more serious (an exercise).

3 Mergers

Finally, let us consider a merger of the manufacturer and supplier 1. Is the ineffi-ciency due to the incompleteness of the contract shown subsection 2.2 improved upon? Answer to Questions 1-5, confirming the following setup. The hold-up problem came to be widely recognized as an important issue in economic analysis of organization, following the consideration by Klein et al. (1978) of the circum- stances that led GM (automaker) to acquire Fisher Body (body supplier).[8]

When the manufacturer makes its capital investment of $x^2/2$, the surplus, αx, is generated from the investment in the equipment held for supplier 1. The distribution of the amount to the shareholders and employees of the manufacturer and supplier 1 will represent a matter of contention in merger negotiations. These negotiations are prolonged, and to allow for the product to be shipped on time by Date 2, the manufacturer must carry out its capital investment before the determination of the ratio of surplus distribution, β ($0 < \beta < 1$). In other words, negotiation costs are incurred in addition to investment adjustment costs. In the surplus distribution post-merger, the entire capital investment, $x^2/2$, will be a sunk cost. However, as long as it can receive a positive surplus distribution ($\beta > 0$), a partial recovery of the capital investment is possible, and thus the manufacturer will consent to the merger.

- Date 1: The manufacturer and supplier 1 begin their merger negotiations. The manufacturer decides x and α.

- Date 2: The rate of surplus distribution, β, is determined, and then the merger is made. The surplus generated by the manufacturer's capital investment is distributed according to the ratio determined on Date 1.

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[8] The rigorous formulation as a principal-agent problem was introduced by Hart and Moore (1988), starting with Grout (1984).

Appendix: Classifications of Transaction Costs

If the costs involved in a market transaction are too large, then the market may be lost even when no information asymmetry exists between the parties to the transaction.[9] If the collection of transaction-related information entails large costs for some of the parties to the transaction, asymmetric information will be generated with respect to parties to the transaction who do not face such costs. Generally, costs paid by these parties to carry out transactions are known as transaction costs, which are classified under the following headings.

(i) Information (search, collection, and transmission) costs: The pre- and post- transaction costs of searching for, collecting, and transmitting information not only with regard to the attributes, quality, and price of goods involved in the transaction but also with regard to the possible states of affairs (or events) that may occur. This also includes market research costs relating to client preferences and advertising costs relating to transactions.

(ii) Negotiation costs: Costs involved in adjusting the transaction conditions with other parties to the transaction. These include the cost of transporta- tion arising when traveling to the site of the transaction, negotiation time converted as opportunity cost, and transaction mediation fees in the event that an intermediary is present in the process of matching up with other parties to the transaction. They also include renegotiation costs arising in the event of performing a renegotiation after the conclusion of the transaction contract.

(iii) Execution costs: Cost to compel the execution of a transaction by specifying details such as the conditions, rights, obligations, and actions involved in the transaction in sufficient detail and making them binding. This includes not only the cost of monitoring compliance with the agreement but also the costs of litigation in the event of any lawsuit arising from breach of the agreement, and the financial and time costs involved in having the court understand the contract clause correctly, rigorously substantiating the situation or situations that actually occurred, and legally compelling the parties to execute the proposed arbitration.

The costs listed above are sometimes classified into ex-ante costs and ex-post costs in view of whether they arise before or after the completion of the transaction. The cost of searching out, collecting, and transmitting information about situations (or events) that may potentially occur in the context of the transaction and the negotiation costs for the detailed configuration of conditions prior to the transaction are ex-ante costs, whereas the costs of monitoring the execution of the

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[9] When large costs derive not from the price of product elements (i.e., intermediate products such as raw materials and parts, and intermediate capital goods such as industrial machinery, capital, and labor power) but rather from the market transaction itself, instead of procuring these in the market (by outsourcing), it is sometimes possible for companies to economize by switching to in-house production (to internalize transaction costs). Coase (1937) argued that in this way, companies exist as resource allocation mechanisms that complement market transactions. It should be noted that Coase was a jurist.

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matters to be observed and of trial costs for renegotiation or litigation after the transaction is completed are considered to be ex-post costs. When the ex-ante costs are very high, arrangements for the transaction conditions and details such as rights, obligations, and actions will end up being left incomplete. If this yields ineffcient results, then the parties might undertake an after-the-fact renegotia- tion of the transaction conditions and other details in an attempt to improve the situation, but this renegotiation also comes at a cost. On the other hand, if it proves to be not possible to substantiate the resulting state of affairs in a court of law, then it is easily anticipated that the ex-post costs will be very large, such that it will be extremely difficult to come to detailed agreements on transaction conditions and the like. [10]

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[10] Although Coase organized the concepts of costs associated with market transactions and discussed corporate governance from the viewpoint of saving them, Williamson pointed out that the costs associated with various forms of transactions are a source of incompleteness of contracts and considered the governance of transactions from the viewpoint of the problems arising from the opportunistic behavior of traders (as seen in Section 2.2) that were made under the incompleteness. Williamson (1985) served as a bridge to the theory of incomplete contracts developed in the 1990s.

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