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KOREAN AUTOMOBILE ASSEMBLERS' CHOICE OF OUT-SOURCING CHANNEL: TRANSACTION COST APPROACH *

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Using the framework of transaction cost economics, this paper delves into Korean automobile assemblers' choice of out-sourcing channel. There are two types of out-sourcing channels in the Korean automobile industry, namely KEYOL and HADOGUB respectively.

We set the hypothesis that KEYOL is more effective than HADOGUB in reducing transaction costs arising from parts supply contracts. The result of empirical test confirms our hypothesis. The result may stem from the fact that KEYOL is an affiliated firm of assembler and the management boards of KEYOL have more intimate personal relationship with the boards of assembler than those of HADOGUB.

I. INTRODUCTION

An automobile consists of many parts. The number of required parts is estimated to be in the order of twenty thousands. Producing automobile parts requires various materials and processes. Due to this, it is not economical and feasible for an assembler to produce all the parts needed to complete a car. Although automobile assemblers are manufacturing some parts within their factories, they procure more parts from outside suppliers. When the parts are produced by assemblers, we say that the parts are *vertically integrated*, whereas when the parts are procured from outside suppliers, we say that the parts are *outsourced*.

There are many previous studies that concentrate on the determinants of vertical integration in the context of transaction cost economics.[1] Here, our interest

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[1] See Williamson(1985) and Shelanski and Klein(1995) for overviews of this literature.

lies not in the determinants of vertical integration but in Korean assemblers' choices of out-sourcing channels. The analysis is motivated by the fact that there are two types of out-sourcing channels in the Korean automobile industry, namely "HADOGUB" and "KEYOL".[2] They are usually regarded as the same sourcing channel in most of the existing literature. The novelty of this paper is that it distinguishes KEYOL from HADOGUB in terms of minimizing transaction costs. The paper will show that Korean assemblers choose KEYOL instead of HADOGUB when transaction-specific investments must be made under uncertainty.

The paper is organized as follows. In section Ⅱ, we distinguish KEYOL from HADOGUB by applying transaction cost economics and set out testable hypotheses. In section Ⅲ, we provide an empirical model and estimation results. Finally, in section Ⅳ, we conclude the paper and present implications of findings.

Ⅱ. TRANSACTION COST AND KEYOL

Transaction occurs when a good or service is transferred across a technologically separable interface. Transaction costs are the cost of drafting, and safeguarding a transaction.

Transaction Cost Economics(TCE) presupposes that economic agents have bounded rationality and the tendency of opportunism.[3] Bounded rationality refers to the limited human capacity to solve or anticipate complex problems. Opportunism means seeking self-interest with guile, which even includes lying, stealing, and cheating. Since contingent performance is costly to stipulate and is difficult for courts to enforce under presupposition of TCE, contracts tend to be incomplete.

Incomplete contracts inhibit the ability of transactors to make efficient adjustments to changing circumstances and the prospect of opportunistic behavior makes contracting with another firm hazardous. These problems are more likely to be serious when transactions are uncertain and when buyer and seller must invest in specific assets(Williamson, 1975, 1979).

When transaction costs are likely to be high, TCE suggests that vertical integration may offer advantages over market(Williamson, 1975, 1979). In a single firm, if one division can behave opportunistically toward another division, the overall supervisor tries to ensure that such behavior does not occur. Also, conflicts are often easier to resolve when they develop within a firm than when they develop between firms. Legal and other remedies may be inadequate and expensive

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[2] HADOGUB means subcontracting and reads HA-DO-GUB. KEYOL corresponds to Keiretsu in Japan.

[3] Transaction cost economics is introduced by Coase(1937) and developed by Williamson(1975, 1985).

compared to manager's orders.

However, the benefits of integration are limited by the loss of high-powered incentives and the increasing costs of managerial oversight as firms incorporate more activities(Williamson, 1985). Therefore, it is not economical to integrate all activities within one firm.

Due to these costs of vertical integration, Korean automobile assemblers are out-sourcing many parts from outside suppliers. The ratio of out-sourced parts usually exceeds 60% in terms of cost.

There are two types of out-sourcing channels in the Korean automobile industry, namely KEYOL and HADOGUB. They differ in capital involvement by the assembler and in the intimacy of personal relationship with the management boards of assembler, which have important ramifications for reducing transaction costs.

A KEYOL supplier is an affiliated firm to an assembler and its members of management board have intimate personal relationships with those of the assembler. Though HADOGUB suppliers may maintain long-term relationship with the assembler, it has nothing to do with capital involvement and their members of management boards do not have intimate personal relationships with those of the assembler.

These distinctions make KEYOL have advantages over non-equity, pure contractual forms of HADOGUB in reducing transaction costs when the transactions in question involve specific assets and uncertainty. The rationale may be summarized as follows.

First, capital involvement between the assembler and KEYOL creates an administrative hierarchy for settling disputes and an area for resolving conflicts, exchanging information, and adjusting collaborative activities(Pisano and Teece, 1989).[4] This hierarchial structure dispenses with the need for transactors to attempt the task of specifying a complete set of contractual provisions. Instead, they only need a broad set of governing rules that provide adjustments procedures to treat disputes when contingencies arise. This internal organization-like structure formed between the assembler and KEYOL considerably reduces transaction costs.

Second, intimate personal relationships are effective in mitigating opportunistic behavior of the suppliers. It is critical to know who the transaction partners are when economic agents have opportunistic tendency. If one can trust partners, it is quite possible to dispense with the need to attempt the impossible task of specifying a complete set of contractual provisions.

In reality, it is common that the boards of KEYOL contain one or more of family members or ex-employees of assemblers in the Korean automobile indus-

[4] See Williamson(1988)'s treatment of debt and equity not mainly as alternative financial instruments but rather as alternative governance structures.

try. The loyalty arising from them reduces transaction costs when opportunistic behavior is expected.

But KEYOL also entails certain costs. Generally, it takes more time and costs to organize KEYOL than HADOGUB. The assembler must spend time and money to select and organize KEYOL suppliers. Futhermore, after organizing KEYOL suppliers, the assembler should administer them from time to time since the KEYOL suppliers are affiliated firms to the assembler.

Ⅲ. EMPIRICAL ANALYSIS

In the previous section, we distinguished KEYOL from HADOGUB in terms of equity involvement by the assembler and personal relationship with the assembler. In this section, we test the hypothesis that KEYOL is more effective than HADOGUB in reducing transaction cost by showing that Korean automobile assemblers choose KEYOL instead of HADOGUB when the assembler and suppliers must make transaction-specific investments under uncertainty.

3.1 Model Specification

Let G_i be the governance mode chosen by the automobile assembler to manage the production of part i. And let G_{ki} represent KEYOL that produces part i and G_{hi} represent HADOGUB that produces that part, respectively. Then the outcome of the assembler's governance choice decision can be summarized as

$$G_i = G_{ki}, \text{ if } L_{ki}(\omega_i, \lambda_i) < L_{hi}(\omega_i, \lambda_i)$$
$$\text{and} \tag{1}$$
$$G_i = G_{hi}, \text{ if } L_{ki}(\omega_i, \lambda_i) > L_{hi}(\omega_i, \lambda_i),$$

where L_{ki} is the cost of maintaining production of part i in KEYOL and L_{hi} is the cost of maintaining production of part i in HADOGUB. They are assumed to be a function of asset specificity(λ) and uncertainty(ω) of part i.

For estimation purposes, the following model specification is employed:

$$L_{ki} = A + b\omega_i + c\lambda_i + u_i,$$
$$\text{and} \tag{2}$$
$$L_{hi} = d\omega_i + e\lambda_i + v_i,$$

where u_i and v_i are random errors assumed to have independent normal distributions, b, c, d, and e are coefficients to be estimated. "A" represents the administrative burden of transacting with KEYOL. As mentioned in section Ⅱ, it takes longer time and more resources to organize KEYOL than HADOGUB.

Since L_k and L_h are not actually observed, the estimation is based on the disposition of the dichotomous choice between KEYOL and HADOGUB. The probability that part j will be produced inside KEYOL is

$$\begin{aligned} P(L_{kj} < L_{hj}) &= P(u_j - v_j < (d-b)\omega_j + (e-c)\lambda_j - A) \\ &= F[(d-b)\omega_j + (e-c)\lambda_j - A], \end{aligned} \tag{3}$$

where $F(\cdot)$ is the distribution function with normal density.

The likelihood function of the model is as follows:

$$\begin{aligned} \Lambda = \prod_{j=1}^{n} & F[(d-b)\omega_j + (e-c)\lambda_j - A]^{y_j} [1 - F[(d-b)\omega_j \\ & + (e-c)\lambda_j - A]^{(1-y_j)}, \end{aligned} \tag{4}$$

where $y_j = 1$ if part j is produced inside KEYOL and 0 if produced by HADOGUB. And the number of observations is n.

To set out the hypotheses, three measures of asset-specificities and one measure of uncertainty are developed following Williamson(1983) and Masten(1984): (1) human-asset specificity, (2) physical-asset specificity, (3) site specificity, and (4) technical complexity.

Human specificity is transaction-specific know-how embedded in human capital. The existence of transaction-specific know-how and the difficulties of transfer mean that it will be costly to switch to alternative suppliers. Under the prepositons of TCE, switching cost may invoke recurrent opportunistic hagglings between the assembler and suppliers. The higher the specificity of human capital, the greater is the likelihood of assemblers' choice of KEYOL.

Physical specificity measures the extent to which parts are produced with physical assets, such as tools, jig, and dies, specific to the transaction with the assembler. Physical-asset specificity seems to increase the probability of choosing KEYOL for the same reason of human asset specificity. But in practice the physical-asset specificity will not have any effect on selecting KEYOL. The reason results from the effects of quasi-vertical integration.

"Quasi-vertical integration" refers to the ownership by an assembler of the specialized tools, dies, jigs, and patterns used in the production of parts(Monteverde and Teece, 1982b). With quasi-vertical integration, the assembler still contracts with parts-suppliers for the actual manufacture of the parts but the ownership of physically specific asset belongs to the assembler. Because the assemblers will exercise their ownership whenever necessary, quasi-vertical integration is sufficient to eliminate opportunism problem arising from physical asset specificity.

Site specificity measures the importance of locating upstream production close to subsequent stages of the manufacturing process. Various economies may arise

[Table 1] Summary of Hypotheses

	$(L_{hi} - L_{ki})$	*Assembler's Choice*
Human-asset specificity	+	G_{ki}
Physical-asset specificity		Neutral
Site specificity	+	G_{ki}
Technical complexity	+	G_{ki}

from positioning successive operations side by side. But if associated assets are costly to reposition, their alternative value may be low. Once the assets have been positioned, they are committed to a particular use.

We use technological complexity as a proxy for the degree of uncertainty following Masten(1984). The more complex an automobile part is, the more details are to be accounted for and the more dimensions could go wrong. All of these require recontracting that may increases transaction costs.

In sum, we expect specificities and complexity will have positive effects on the assemblers' choice of KEYOL. But the physical specificity will not influence the assemblers' choice of KEYOL due to the effect of quasi-vertical integration. The hypotheses are summanzed in [Table 1].

3.2 Data

The managers of parts-procurement inside two representative Korean automobile assemblers were asked to complete questionnaires designed to elicit information about the characteristics of the parts for each assembler's passenger car.[5] We follow the category of parts made by Monteverde and Teece(1982a).

The data contain 234 observations. Each of the supplied part is identified as either KEYOL or HADOGUB. The disposition of the entire KEYOL-or-HADOGUB program is summarized in [Table 2].

In order to determine the relative degrees of specificities and complexity of the parts, a 5-digit rating system is adopted. The actual explanatory variables used in the estimation are as follows.[6]

$HUMAN_h$ = 1, if the rating for human specificity is above 3,
= 0, otherwise;
$PHYSICAL_m$ = 1, if the rating for physical specificity is 3,
= 0, otherwise;

[5] To the original data set compiled by Ha(1989), this study adds human specificity for the same models of car.

[6] Subscript "m" and "h" denote "middle" and "high", respectively.

[Table 2] KEYOL-or-HADOGUB Program

CATEGORY	QUANTITY	KEYOL	HADOGUB
Body	70	8	62
Engine	31	2	29
Emission	8	1	7
Chassis	38	11	27
Steering	13	6	7
Fuel	3	0	3
Ventilation	26	10	16
Electrical	32	3	29
Other	13	0	13
Total	234	41	193

$PHYSICAL_h$ = 1, if the rating for physical specificity is above 4,
= 0, otherwise;
$SITE_h$ = 1, if the rating for site specificity is above 3,
= 0, otherwise;
$COMPLEX_m$ = 1, if the rating for technological complexity is 3,
= 0, otherwise;
$COMPLEX_h$ = 1, if the rating for technological complexity is above 4,
= 0, otherwise.

3.3 Estimation Results

Since the dependent variable is dichotomous and the random variables are assumed to have normal distributions, we adopt probit model for the estimation of the model.[7] The result of maximum likelihood estimation is presented in [Table 3].

As expected, $HUMAN_h$ and $SITE_h$ have positive and significant influence on the assemblers' choice of KEYOL. KEYOL is more likely to supply the parts that require specific human skills and geographical considerations.

$PHYSICAL_m$ and $PHYSICAL_h$ have negative coefficients but are not statistically significant. This result confirms the effect of quasi-vertical integration over physical asset specificity. Quasi-vertical integration enables Korean automobile makers to avoid the problem of opportunism arising from physical specificity as noted earlier.[8]

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[7] For more on pobit model, see Maddala(1983).

[8] For the case of U. S. automobile industry, Masten, Meehan and Snyder(1989) shows the same results.

[Table 3] Estimation Results

VARIABLE	OLS	PROBIT
Constant	−0.05(0.82)[***1)2)]	−2.86(6.24)[***]
$HUMAN_h$	0.10(1.96)[**]	0.57(2.32)[**]
$PHYSICAL_m$	−0.03(0.62)	−0.23(0.84)
$PHYSICAL_h$	−0.01(0.72)	−0.02(0.73)
$SITE_h$	0.17(2.77)[***]	0.74(2.49)[***]
$COMPLEX_m$	0.15(2.68)[***]	0.89(2.94)[***]
$COMPLEX_h$	0.22(5.89)[***]	0.02(5.12)[***]
FIRM A	0.22(4.52)[***]	1.56(4.31)[***]
R^2	0.29	0.38[3)]
Specification Test	14.41[***]	61.93[***]
Heteroskedasticity		6.80

Note: 1. ** and *** denote estimates are significant at the 5% and 1% significance level, respectively.
2. Figures in parenthesis are t-ratios for each estimate.
3. The McFadden's R^2 applies to PROBIT model.

Also as expected, $COMPLEX_m$ and $COMPLEX_h$, a proxy for uncertainty, has positive and significant influence on the probability of assembler's choice of KEYOL. As the degrees of complexity increase from middle to high, Korean automobile assemblers intensify the probability of choosing KEYOL.

Note also that the constant term has negative effect on the probability of selecting KEYOL. This coefficient measures the administrative burden of transacting with KEYOL. The negative and significant coefficient reflects the predisposition of assemblers toward HADOGUB procurement.

Finally, it should be noted that the data include characteristics of parts from two firms. To ensure that heteroskedasticity did not influence our results, we tested heteroskedasticity for the probit model and get the result of no heteroskedasticity.

Ⅳ. CONCLUSION

The analysis of this paper illustrates that Korean automobile assemblers choose KEYOL instead of HADOGUB when transaction-specific investments are needed under uncertainty. KEYOL supplies more specific and complex parts to the Korean automobile assembler than HADOGUB does. Only the physical asset specificity does not influence the choice of KEYOL due to the effect of quasi-vertical integration.

Our findings have an interesting implication for the selection of out-sourcing

channel of mechatronics-parts, such as ABS or air bags. In recent days, the rate of installation of these parts to the automobile is increasing very fast and expected to increase faster in the future. According to our findings, it is expected that the assemblers will select KEYOL instead of HADOGUB as mechatronics-parts supplier. The rationale for this prediction stems from the fact that manufacturing process of mechatronics-parts demands high human specificity and complex technology. For this reason, the entry of HADOGUB supplier into mechatronics-parts market is expected to be very difficult.

Finally, it is necessary to note that our findings and implications should be viewed as tentative since the analysis leaves much of the variance in the choice of KEYOL unexplained as indicated by the modest goodness-of-fit statistics.

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