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A Transaction Cost Approach to Make-or-Buy Decisions

Gordon Walker and
David Weber

This study focuses on make-or-buy decisions as a paradigmatic problem for analyzing transaction costs. Hypotheses developed from Williamson's efficient boundaries framework were tested in a multiple-indicator structural equation model. The influence of transaction costs on decisions to make or buy components was assessed indirectly through the effects of supplier market competition and two types of uncertainty, volume and technological. In addition to transaction costs, the decisions were hypothesized to be predicted by both buyer production experience and the comparative production costs between buyer and supplier. The hypotheses were tested on a sample of make-or-buy decisions made in a division of a U.S. automobile company. The results show that comparative production costs are the strongest predictor of make-or-buy decisions and that both volume uncertainty and supplier market competition have small but significant effects. The findings are explained in terms of the complexity of the components and the potential pattern of communication and influence among managers responsible for making the decisions. •

The transaction cost approach to the study of organizations covers issues ranging from varieties of organizational structure (Armour and Teece, 1978) to franchise contracting (Williamson, 1976). A transaction is the transfer of goods or a service between technologically separate units (Williamson, 1981), and the analysis of transactions focuses on achieving efficiency in their administration. The analytical framework has two sides: first, the administrative mechanisms whose efficiency is at issue and second, the dimensions of transactions that determine how efficiently a particular administrative mechanism performs. Matching these sides of the problem is the critical task.

If a transaction is sufficiently continuous or frequent to generate concern for the efficient use of resources involved, two dimensions determine the most efficient mode of governing the transaction: (1) the uncertainty associated with executing the transaction and (2) the uniqueness or specificity of the assets associated with the goods or service transacted. Assets are specific to a transaction when they are highly specialized and thus have little or no general purpose use outside of the buyer-supplier relationship. Williamson's (1975) argument is that in an imperfect world, where individuals have limited information-processing capacity and are subject to opportunistic bargaining, high uncertainty makes it more difficult for the buyer of the goods or service to evaluate the supplier's actions, and high asset specificity makes opportunistic supplier decisions particularly risky for the buyer. Transactions with high uncertainty, to which nonfungible assets have been dedicated, will be more efficient if governed completely by the buyer than if governed by the buyer and supplier in the product market. The problems of evaluating supplier performance under high uncertainty and of suffering potential supplier opportunism under high asset specificity are both reduced when the buyer has unilateral control over the transaction by producing the component in-house.

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Make-or-Buy Decisions

In the present study the transaction cost framework is applied to make-or-buy decisions for relatively simple components in a manufacturing division of a large U.S. automobile company. Make-or-buy decisions determine the firm's level of vertical integration, since each decision specifies which operations the firm will engage in and which it will contract out to a supplier. Although a number of ways of managing the buyer-supplier relationship have been identified, based on behavioral (Ouchi, 1980), strategic (Harrigan, 1983), or industrial economic (Blois, 1972) assumptions, here we focus on the prototypical choice between making a component within the firm or buying the component in a market partly regulated by competitive forces.

Both Anderson (1982) and Monteverde and Teece (1982a) found empirical support for the transaction cost approach to the study of vertical integration. In her study of forward integration into sales by firms in the electronics industry, Anderson (1982) showed that high asset specificity, uncertainty, and their interaction were associated with the decision to sell through an internal sales force rather than through independent marketing representatives. Anderson measured asset specificity as the extent of specialization in knowledge or working relationships between the salesperson and the company or the customer and assessed two types of uncertainty: the difficulty of evaluating performance and environmental unpredictability. Monteverde and Teece (1982a) found a strong effect, in the predicted direction, of asset specificity on backward integration into component production by General Motors and Ford. Monteverde and Teece measured asset specificity as an expert's subjective assessment of the amount of engineering effort invested by the buyer firm in developing a component. These studies provide important background for the present research in the way they applied transaction cost analysis to the study of vertical integration.

The present research relies most heavily, however, on Williamson's (1981) model of efficient boundaries, which implies, in addition to vertical integration, the possibility of shifting the performance of an activity from the firm to a supplier in the market, that is, of vertical deintegration. When the administrative structure and technological base of the firm or the supplier market change, deintegration may be advisable. Williamson's model, shown in Figure 1, indicates that when asset specificity is low, suppliers enjoy a production cost advantage over buyers, since they are able to pool possibly uncorrelated or negatively correlated demand and thereby achieve smoother production schedules and greater economies of scale. The production cost differential decreases as roughly an inverse function of the increase in asset specificity and approaches zero, never favoring the buyer.

A comparison of transaction costs between making and buying indicates that the firm should bring the operation in-house at a relatively early point (A) on the asset-specificity continuum. However, because production costs favor the supplier at this point, buyers should continue to purchase the component until the sum of the production and transaction cost differentials at A' points to their making the component.

In the model, the influence of uncertainty on transaction costs is held constant at a moderate level. Williamson (1975: ch. 2)

defined uncertainty in terms of the inability of decision makers to specify a complete decision tree. Thus uncertainty in the decision maker's environment is closely related to environmental complexity, and both are relevant to the efficient boundaries model to the extent that they introduce problems of bounded rationality in contracting between buyer and supplier (Williamson, 1975: 21–23). Williamson (1979) argued that uncertainty raises the costs of executing market transactions only when opportunism is present. In a competitive market, where asset specificity is low, buyers can recontract with other suppliers if changes in contract specifications need to be made. On the other hand, if either little or no uncertainty is associated with a transaction, the buyer can specify all (or almost all) the contingencies that might impinge on contract execution and thus defend against supplier opportunism. Thus, according to Williamson's model, uncertainty and supplier asset specificity are joint conditions for a decision to make a component.

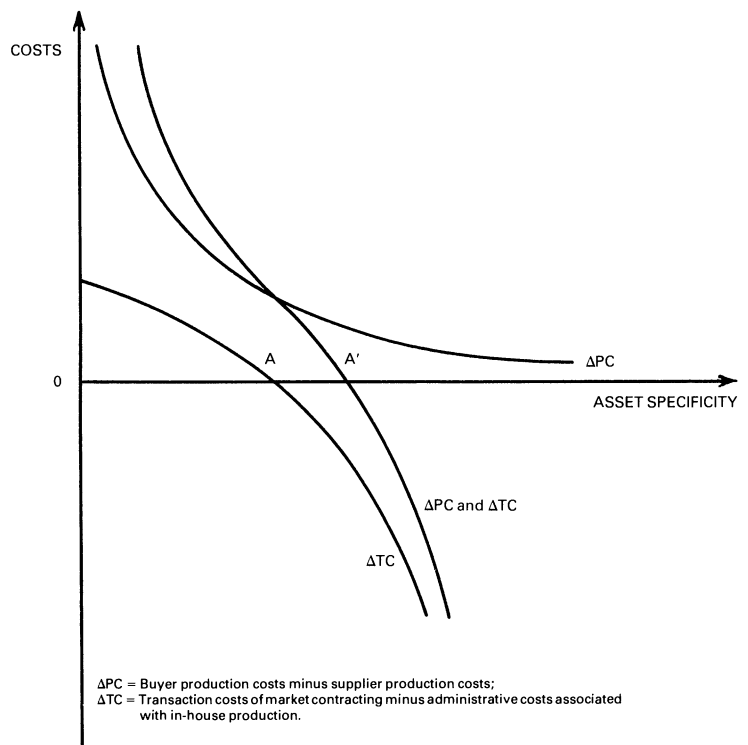


Figure 1. Relationship between asset specificity and transaction and production costs. (Adapted from Williamson, 1981: 560.)

In the present research, however, asset specificity and uncertainty are allowed to influence make-or-buy decisions independently. First, we assumed that sufficient uncertainty was inherent in all transactions included in the study to make it very difficult for the buyer to neutralize potential supplier opportunism effectively through contingent claims contracts (Williamson, 1975: 22); therefore any increase in asset specificity would tend to increase transaction costs. Second, because of the way that types of uncertainty we studied influenced transaction costs, we assumed they did so independent of the level of asset specificity.

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Two types of uncertainty — volume and technological — are identified here. Volume uncertainty depends on the assessment of fluctuations in the demand for a component and the confidence placed in estimates of the demand. When volume uncertainty is high, suppliers experience unexpected production costs or excess capacity and buyers experience stock-outs or excess inventory. These events increase transaction costs because of midcontract renegotiation. Since the firm should be able to coordinate variations in its own production stream more efficiently than variations with suppliers, the hypothesis follows:

Hypothesis 1 (H₁): Volume uncertainty leads to making rather than buying a component.

We also defined uncertainty in terms of change in component specifications. Technological change in component design requires retooling, which in the present case is paid for by the buyer, and recontracting with the supplier, if the component is currently purchased. Recontracting because of design changes may be efficient if the market is competitive and the buyer can avoid transactional complications due to opportunism (Williamson, 1979). However, as the frequency of technological change increases, the administrative costs of managing the interfaces between in-house engineering, purchasing, and outside suppliers may become higher than the administrative costs incurred in coordinating an internal engineering and production effort (Scherer, 1980: 90). Consequently, we argue that:

Hypothesis 2 (H₂): Technological uncertainty increases the likelihood of a make rather than a buy decision.

Although the efficient boundaries framework applies to every explicit (and implicit) make-or-buy decision, production cost differences between the market and in-house operations cannot always be assessed directly. In neither Anderson's (1982) study of forward integration into sales nor Monteverde and Teece's (1982a) examination of backward integration of relatively complex assemblies of components were differences in production cost included. These omissions may indicate how difficult it is to estimate the cost of producing a complex product or rendering a service such as sales. For simpler components, however, production costs should be relatively easy to measure. Consequently, in the present research, the comparative costs of production were included as a determinant of make-or-buy decisions. The hypothesis is:

Hypothesis 3 (H₃): The higher the supplier production cost advantage, the more likely the firm is to buy rather than make a component.

In contrast to Anderson (1982) and Monteverde and Teece (1982a), but consistent with Williamson's (1981) model, we used the level of market competition to indicate asset specificity. The less specialized the buyer-supplier relationship as indicated by the number of potential suppliers and their competitiveness, the more should suppliers be able to achieve operational and scale economies across customers. Therefore, we state the following hypothesis:

Hypothesis 4 (H₄): The competitiveness of the supplier market increases the production cost advantage of suppliers over buyers.

Moreover, high supplier competition decreases the potential for opportunistic bargaining (see Williamson, 1975: 16–19). As

a result, the transaction cost advantage of buying over making a component should increase. Consequently, the hypothesis can be stated:

Hypothesis 5 (H₅): Greater supplier market competition should lead to buying the component.

Williamson's (1981) model does not include buyer experience in producing a component as a factor influencing production costs. Thus he assumes that contracting in the market is the only initial condition of component supply. For the present study, however, such an assumption may not be valid, since the buyer is likely to have prior production experience.

In-house production knowledge should decrease the production cost advantage of suppliers over the buyer, thereby leading indirectly to a make decision. Although the economies of scale achieved by suppliers in a competitive market are greater than those achieved by buyers, this advantage will be less in transactions for components that buyers have gained experience in producing due to on-the-job learning (Abell and Hammond, 1979: ch. 3). However, buyers with a history of producing a component have better information about manufacturing it, and suppliers are thus less able to engage in opportunistic bargaining. Therefore, buyer experience lowers the costs of governing market contracting and so should lead to the decision to buy. Consequently, buyer experience affects the make-or-buy decision in opposite ways through its influence on production and transaction costs. The hypotheses are:

Hypothesis 6 (H₆): The experience a buyer has in producing a component reduces the production cost advantage of the supplier over the buyer.

Hypothesis 7 (H₇): Buyer experience in producing a component increases the likelihood of a buy decision.

In addition, the level of technological uncertainty may be determined by the buyer's production experience. Thompson (1967) has proposed that organizations partition their activities in a core and periphery pattern and protect the core from disturbances, so that economic efficiency criteria can be applied to decision making. In the present research, core activities were those that the firm had performed extensively and, therefore, for which it had developed substantial expertise, as indicated by the degree of production experience. The following hypothesis can thus be made:

Hypothesis 8 (H₈): Buyer experience in component production reduces technological uncertainty associated with the component.

The hypotheses stated above elaborate the efficient boundaries model shown in Figure 1 and will be tested in this study. An important question about this theory is its relationship to the actual process of decision-making, that is, whether the theory is paramorphic or isomorphic (Hoffman, 1960) to organizational decision making for make-or-buy choices. This question is difficult to answer, in part, because the mapping of variables in the transaction cost framework onto organizational process has generally been only loosely specified. For example, Williamson (1976: 102) recommended studying "related transactional phenomena [at] what might be called the semimicroanalytic level of detail." However, he was not clear about which variables these might be and how relationships among these variables represent processes of organizational decision mak-

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ing. Production and transaction costs may either be part of the basic decision-making protocol or located at a more general level of detail as broad indicators of protocol-level variables.

However, because of differences in the accuracy of the measurement of production and transaction costs and differences in their association with the subgoals of functional managers (e.g., purchasing, sales) involved in make-or-buy choices, the two types of cost may differ in the way they are mapped onto the decision-making process. Production costs are directly measured in part by calculating and aggregating input expenses, including direct and indirect labor, materials, and allocatable utilities; transaction costs, however, are typically assessed indirectly by measuring the degree of asset specificity and uncertainty associated with the buyer-supplier contract for production of the component or service delivery (see, e.g., Anderson, 1982, and Monteverde and Teece, 1982a). Because evaluations of comparative production costs are relatively clear and relate directly to the economic value of a make-or-buy decision, it is likely that they would consistently be part of the rules guiding the decision-making process. In contrast, because of the vagueness with which administrative costs associated with a transaction may be measured, transaction costs are not likely to be considered explicitly in every choice to make or buy, although in many cases decision makers may take into account the implications that a relatively high level of uncertainty and asset specificity have for current and future contracting with suppliers.

Furthermore, functional managers are also likely to differ in the importance that they assign to reducing transaction costs in contracts with suppliers, as compared to reducing production costs. All functional managers are likely to apprehend the consequences for unit performance of the production cost estimates of making and buying. In contrast, contracting hazards are typically considered greater by purchasing managers than by managers in sales and engineering. Consequently, the effect transaction costs have on a make-or-buy choice can partly reflect the influence exerted by the purchasing manager. This influence may entail nothing more than laying out the contracting problems associated with high uncertainty and low supplier market competition. However, information on in-house manufacturing experience and volume and technological uncertainty may have to be communicated to the purchasing manager if a reasonable assessment of potential transaction costs is to be made.

Thus, production costs are likely to be part of a formal process for make-or-buy decisions, whereas transaction costs may be included in informal protocols that reflect the differentiation among goals and information associated with each of the functions involved in the decision (March and Simon, 1958: 157). Although the formal protocol may be relatively easy to obtain, acquiring a reliable description of the informal decision-making process over a number of decisions is a formidable task.

A more feasible method is to move to a more general level by constructing latent variables for the constructs in the theory from variables that (1) might have been observed in the formal and informal protocols, (2) have strong face validity with the

managers engaged in the make-or-buy decision-making process, and (3) are consistent with the theory. An important advantage of testing the theory in this way is that the hypothesized effects of variables on the make-or-buy decision can be assessed simultaneously with their influences on one another. Using a structural equation approach, hypotheses linking (1) competition to production costs and (2) buyer experience to technological uncertainty and to production costs can be tested in addition to the hypotheses predicting make-or-buy decisions. The explanatory range of the theory is thus expanded.

Also, the predictive power of models of decision making construed at a general level has been found to be roughly equal to that of protocol descriptions when the decisions are made by individuals (Einhorn, Kleinmuntz, and Kleinmuntz, 1979). Since group protocols are likely to be less consistent than those for individuals because of the multiple and dynamic interaction effects among group members, the predictive success of models at a general level may be even greater than that of detailed descriptions. Consequently, by building and testing the present model at a more general level than the fine-grained description of the decision-making process, the explanatory power of the model may be increased without decreasing its ability to predict.

The major disadvantage of testing the theory at a more general level is that the effects of variables on make-or-buy outcomes may not be disentangled from mandated policies that are mechanically followed by the managers. The variable to which this ambiguity applies most strongly is obviously production costs, since these are likely to be part of the formal decision-making guidelines. Knowing the amount of discretion managers exercise in their treatment of variables would therefore substantially illuminate how transaction and production costs are considered in the make-or-buy decision-making process.

METHODOLOGY

The model we constructed is a structural equation system with observed and unobserved variables (Bagozzi and Phillips, 1982). The observed variables are indicators of the unobserved variables that represent the theoretical constructs. All constructs, except the make-or-buy decision itself, are indicated by more than one observed variable. These constructs were measured using the following indicators:

Volume Uncertainty

Expected volume fluctuations: The extent to which significant fluctuations are expected in the daily or monthly volume requirement for the component.

Uncertain volume estimates: The extent to which volume estimates for the component are expected to be uncertain.

Technological Uncertainty

Changes in specifications: The frequency of expected changes in specifications for the component.

Technological improvements: The probability of future technological improvements of the component.

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Supplier Production Advantage

Difference in manufacturing process: The extent to which substantial differences in manufacturing processes for the component between outside suppliers and the buyer favor the outside suppliers.

Difference in scale of operations: The extent to which substantial differences in the scale of operations for the component between outside suppliers and the buyer favor the outside suppliers.

Annual savings to make a component: The natural logarithm of the division's estimate of the annual savings to make as opposed to buy a component.

Competition among Suppliers

Competitive quotes: The extent to which it is difficult to judge the competitiveness of outside quotes on a component.

Number of suppliers: The extent to which there are enough potential suppliers to ensure adequate competition for the supply of the component.

Supplier proprietary technology: The extent to which leading outside suppliers of the component have proprietary technology that gives them an advantage over other producers.

Buyer Experience

Buyer tools and equipment: The degree of similarity between the tools and equipment required to manufacture the component and those the buyer already uses.

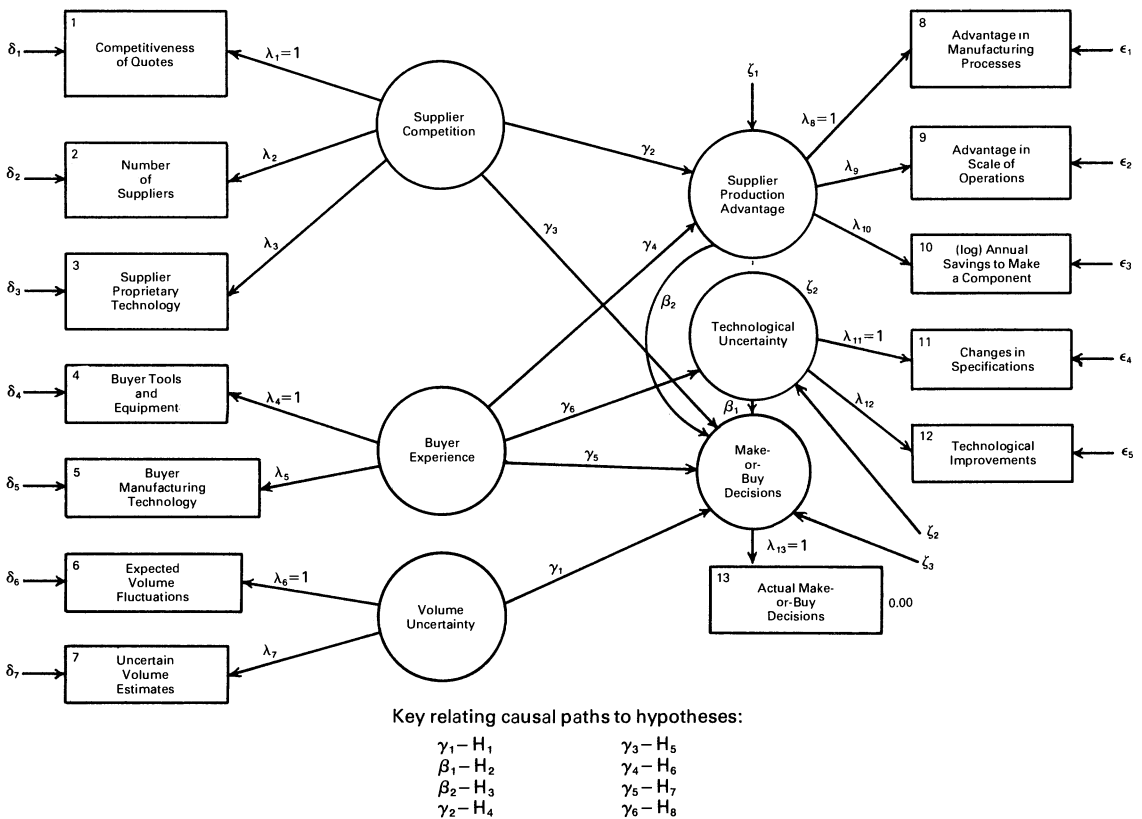


Figure 2. Structural equation model of predictors of make-or-buy decisions. (For simplicity, correlations among exogenous latent variables and among the error terms for the endogenous variables are omitted.)

Buyer manufacturing technology: The extent to which the buyer has strong expertise in the technology required to manufacture the component.

The structural equation model composed of these constructs and their indicators is shown in Figure 2. We follow the convention of using Greek symbols to represent the causal relationships among the constructs, the measurement relationships between the constructs and their indicators, and the error terms associated with both types of relationships. The correspondence between the hypotheses and the Greek symbols is presented in the figure.

Data and Methods

Williamson (1981) developed the model of efficient boundaries for every potential aspect of a firm's technology, from raw material extraction to distribution of the final product. However, the present study focuses, as did Anderson (1982) and Monteverde and Teece (1982a), on a particular stage, the production of components for assembly. In contrast to the sample used by Monteverde and Teece (1982a) in which the components ranged across various stages of final product assembly, the sample in this study consisted of relatively simple parts associated with the initial assembly stage.

The data consisted of 60 decisions made in a component division of a large U.S. automobile manufacturer over a period of three years. The sample of 60 emerged by exception from the roughly 20,000 parts the division used for assembly. The information for these 60 components was considered inadequate by the managers in the division for a competent decision to be made, and the make-or-buy decisions for these components were therefore referred to a committee for further evaluation. The committee then generated a substantially greater amount of information about the production of each component than had previously been available.

The effectiveness of the committee decision-making process can be seen in the number of components whose governance mode the process altered. The production of 20 components, out of 49 previously made, was shifted to the market, and four out of nine components previously bought were brought inside the firm. Two components in the sample were new.

The new decision-making process was a team effort, including component purchasing, sales, product engineering, and manufacturing engineering. To minimize key informant bias (Phillips, 1981) we asked each team member to provide information on that aspect of the decision that was relevant to his or her function. For each of the 60 parts, component purchasing answered questions about the level of market competition and the perceived relative advantage in production processes of the leading supplier over the division. Manufacturing engineering gave information about the division's experience in producing each component; product engineering indicated the level of technological uncertainty associated with the components; and sales provided data on the degree of volume uncertainty. Responses were made on a Likert-type scale of 1 to 5. Decisions were coded 0 for make, 1 for buy.

Although the estimates of the variables were subjective, each manager had extensive experience to draw on for his judg-

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ments and, in some cases, access to archival data on which subjective estimates could be based. The component purchasing manager had direct experience with the number of suppliers for each component and the extent of proprietary technology in production. His judgment of degree of competitiveness in supplier quotes was a subjective assessment based on general experience of supplier markets. Also, the purchasing manager had visited supplier plants and thus had recently judged the extent of supplier advantages in operations and manufacturing. In making judgments about fluctuations in future volume, the sales manager had access to capacity planning data, and he judged the extent of uncertainty in volume estimates on his general experience of their reliability. The manager of manufacturing engineering had access to a detailed breakdown of the manufacturing cost estimate for each component, including component-specific tools and equipment that could be compared to other production processes in the division, but his judgment of the degree of expertise in the division for producing the component was subjective. Finally, the product engineering manager made educated guesses about changes in design and technological improvements that might be made within five years, based on his responsibility for component design and specifications.

The data were analyzed using the unweighted least squares (ULS) procedure of Jöreskog and Sörbom (1982). This technique produces consistent estimates of the measurement and structural equation parameters of the theory without assuming an underlying distribution for the variables. For a number of reasons the procedure was appropriate for the present study. First, the sample size in this research is below Lawley and Maxwell's (1971) suggested minimum for analysis of covariance using maximum likelihood estimation, the most common alternative technique for the type of problem posed here. They recommended a sample size of 50 cases greater than half the number of measured variables times one plus the number of variables. Since thirteen variables were measured, about 140 cases would have been required. Second, the theory tested here included a dichotomous dependent variable, to which it is difficult to assign an underlying probability distribution. Monteverde and Teece (1982a) assumed that their measure of vertical integration was normally distributed and used probit analysis to test their theory. However, they constructed their measure by dichotomizing a continuous variable consisting of the percentage of components produced in-house. No such dimension from which make-or-buy choices could be constructed was appropriate for the present study. Also, it is not clear that the marginal probabilities of make-or-buy choices are either stable or unskewed in the sample of components studied here (cf. Bagozzi, 1981: 616). McNemar (1969: 221) pointed out that when an underlying normal distribution cannot be assigned to a dichotomous variable, the product-moment correlation is the appropriate coefficient of association, and it was therefore used in the present study. Had normality been assumed for the make-or-buy variable and biserial correlations computed, the correlations between make-or-buy and the other variables would be higher.

Standard errors for ULS estimates, unlike those for maximum likelihood, cannot be computed. Although the directions and

relative magnitudes of the estimated coefficients are informative, a measure of confidence in their difference from zero is desirable. Consequently, jackknife coefficients (Mosteller and Tukey, 1977: ch. 8) and their standard errors were computed for the (standardized) ULS estimates. Finally, LISREL V (Jöreskog and Sörbom, 1982), the program used to perform the un-weighted least squares analysis, produces an index of how well the structural equation model as a whole fits the data. Although the distributional properties of this measure are unknown, its magnitude indicates whether substantial changes in the model are needed to improve its descriptive power.

RESULTS

The correlation matrix, means, and standard deviations of the indicators are shown in Table 1. The measures of buyer experience are apparently skewed upward, indicating that their distributions are not normal and justifying further the use of ULS. Also, the two measures for technological uncertainty are highly correlated (.93), suggesting that these indicators carry almost the same information about the latent variable; consequently, the second measure was dropped from further analysis. When the model was tested with both indicators of technological uncertainty, a Heyward case (negative variance of the error term) for the first measure was produced. The program was unable to converge to a positive optimum, probably because of the high correlation between the two variables. The ULS estimates for the model that were significantly different from zero using the first indicator were also different from zero using both indicators. However, the correlations of the second indicator with the measures of buyer experience

Product-moment Correlations, Means, and Standard Deviations for Indicators of Make-or-Buy Decisions

Indicator	Mean	S.D.	Product-moment Correlations													
			1	2	3	4	5	6	7	8	9	10	11	12	13	
1. Competitiveness of quotes	2.78	.83	1.0													
2. Number of suppliers	2.95	.91	-.82	1.0												
3. Supplier proprietary technology	2.87	.96	.56	-.61	1.0											
4. Buyer tools and equipment	3.88	.74	.06	-.19	.13	1.0										
5. Buyer manufacturing technology	4.45	.77	-.02	-.17	.17	.69	1.0									
6. Expected volume fluctuations	2.87	.62	-.09	-.10	.06	.15	.23	1.0								
7. Uncertain volume estimates	2.92	.56	-.01	-.11	.01	.26	.25	.59	1.0							
8. Advantage in manufacturing processes	2.47	.89	-.25	.29	-.18	-.19	-.09	-.13	-.05	1.0						
9. Advantage in scale of operations	2.63	.88	-.25	.28	-.24	-.23	-.18	-.12	-.03	.81	1.0					
10. (log) Annual savings to make a component	6.92	5.11	.24	-.25	.03	.09	.03	.23	.21	-.61	-.58	1.0				
11. Changes in specifications	2.56	1.00	-.06	-.03	-.04	-.16	-.37	-.07	-.22	.15	.19	-.06	1.0			
12. Technological improvements	2.54	1.10	-.03	-.08	.05	-.09	-.26	.00	-.17	.10	.15	-.06	.93	1.0		
13. Actual make-or-buy decisions	.45	.50	-.08	-.09	-.10	-.09	-.11	-.29	-.16	.69	.72	-.51	.18	.14	1.0	

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were lower than those of the first, and the nomological validity of technological uncertainty was thus not completely established.

The results of the ULS and jackknife analyses are shown in Table 2. Note that the structural equation model, as specified,

Table 2

LISREL Estimation, Using Unweighted Least Squares and Jackknife Coefficients of the Structural Equation Model Shown in Figure 1

	ULS Estimates		Jackknife estimates	Jackknife standard errors	Critical value
	Unstandardized	Standardized			
Causal paths					
γ_1	-.369	-.284	-.284*	.139	2.03
γ_2	-.314	-.319	-.315*	.134	2.36
γ_3	.24	.203	.205*	.074	2.76
γ_4	-.256	-.236	-.198	.168	1.18
γ_5	.277	.213	.155	.189	.82
γ_6	-.444	-.341	-.316*	.074	4.24
β_1	.055	.055	.034	.143	.24
β_2	1.064	.886	.862*	.055	15.73
Parameters for measurement model					
λ_1	1.0	.845	.858*	.111	7.71
λ_2	-1.153	-.975	-.996*	.079	12.45
λ_3	.783	.662	.642*	.079	8.16
λ_4	1.0	.768	.818*	.169	4.83
λ_5	1.112	.854	.912*	.106	8.59
λ_6	1.0	.77	.799*	.223	3.58
λ_7	1.006	.775	.704*	.268	2.63
λ_8	1.0	.833	.838*	.067	12.4
λ_9	1.113	.927	.926*	.059	15.53
λ_{10}	-.84	-.7	-.708*	.077	9.17
λ_{11}^\dagger	1.0	1.0	1.0	-	-
λ_{13}	1.0	1.0	1.0	-	-
var(δ_1)	.285	.285	-.‡	-	-
var(δ_2)	.05	.05	-	-	-
var(δ_3)	.562	.562	-	-	-
var(δ_4)	.41	.41	-	-	-
var(δ_5)	.27	.27	-	-	-
var(δ_6)	.406	.406	-	-	-
var(δ_7)	.399	.399	-	-	-
var(ϵ_1)	.307	.307	-	-	-
var(ϵ_2)	.14	.14	-	-	-
var(ϵ_3)	.51	.51	-	-	-
var(ϵ_4)	0.0	0.0	-	-	-
Error term variances and covariances for endogenous latent variables					
ψ_{11}	.572	.825	.878*	.146	5.99
ψ_{22}	.884	.884	.912*	.052	17.41
ψ_{33}	.248	.248	.297*	.10	2.96
ψ_{12}	.068	.082	.1	.176	.56
Correlations among endogenous latent variables					
ϕ_{11}	.715	1.0	-	-	-
ϕ_{22}	.59	1.0	-	-	-
ϕ_{33}	.594	1.0	-	-	-
ϕ_{12}	.076	.117	.104	.183	.57
ϕ_{13}	.049	.075	.112	.193	.58
ϕ_{23}	.235	.397	.362*	.135	2.69
goodness of fit index			=	.984	
adjusted goodness of fit index			=	.972	

*Absolute value of critical ratio greater than 2.

†Note that indicator 12 is omitted because of its high correlation with indicator 11.

‡Because the variances of the observed variable error terms are one minus the squares of their respective λ 's, minor variation in the λ 's across the subsamples used to construct the jackknife led to substantially greater variability in the error term variances and consequently to skewed jackknife coefficients and standard errors.

does not include paths between market competition and technological uncertainty, nor between volume uncertainty and technological uncertainty or supplier production advantage. These relationships were, in fact, not significantly different from zero, controlling for the other parameters in the model. The critical ratios were .33, $-.715$, and $-.62$, respectively. The jackknife coefficients were, for the most part, close to the ULS estimates. The goodness of fit index, .984, was relatively high. This result suggests that a major proportion of the variance in the data was explained by the model as a whole. It should be noted that LISREL can show that theories are false but does not confirm them. Consequently, other models may explain the pattern of correlations equally well; in the present case, however, there was no alternative theory.

The theoretical constructs had generally high discriminant validity and strong convergent validity, as shown by the relative closeness of all unstandardized λ 's to 1.0 and the high value of each λ in the standardized solution. The jackknife coefficients for all λ 's were similar to the standardized estimates and had critical ratios substantially greater than 2. The amount of variance explained in the indicators by their relationship to the latent variables lay between .438 and .95. The reliabilities were .70 for supplier competition, .66 for buyer experience, .59 for volume uncertainty, and .68 for supplier production advantage.

Although supplier production advantage had strong convergent validity and reasonably high reliability, its discriminant validity was questionable because of the high correlations of its indicators with the make-or-buy decision. A test was therefore performed to determine if the make-or-buy variable was perfectly correlated with supplier advantage (Bagozzi, 1980: ch. 5). ULS was used to determine the goodness of fit of a model in which the correlation between supplier advantage and make-or-buy decisions was fixed at one and of a model in which the correlation was allowed to vary. A jackknife was then used to derive standard errors for the two goodness of fit indices, and a *t*-test performed to assess their difference. Although both indices were quite high — .961 (fixed correlation) and .99 (variable correlation) — the results show that they were significantly different ($p < .001$).

The hypothesis about the effect of the production advantage of the supplier on make-or-buy decisions was strongly supported (Figure 3). The ULS estimate was more than twice as large as the other path coefficients, and the critical ratio for the jackknife coefficient was quite high. The effect of supplier competition (here reverse scaled) on production advantage was moderate and had an acceptable critical ratio. Because the component purchasing manager answered questions about both supplier market competition and supplier production advantage, it was possible that the relationship of these variables was due to methods bias. To test this alternative hypothesis an analysis was run, using maximum-likelihood estimation, including the respondent as a latent variable indicated by measures of both market competition and supplier advantage. The chi-square value for the model was 2.09 without the methods bias, with 8 degrees of freedom, and was .54 with 2 degrees of freedom with methods bias. Their difference is 1.75 with 6 degrees of freedom, which was clearly not a significant improvement in fit to the data ($p = .94$).

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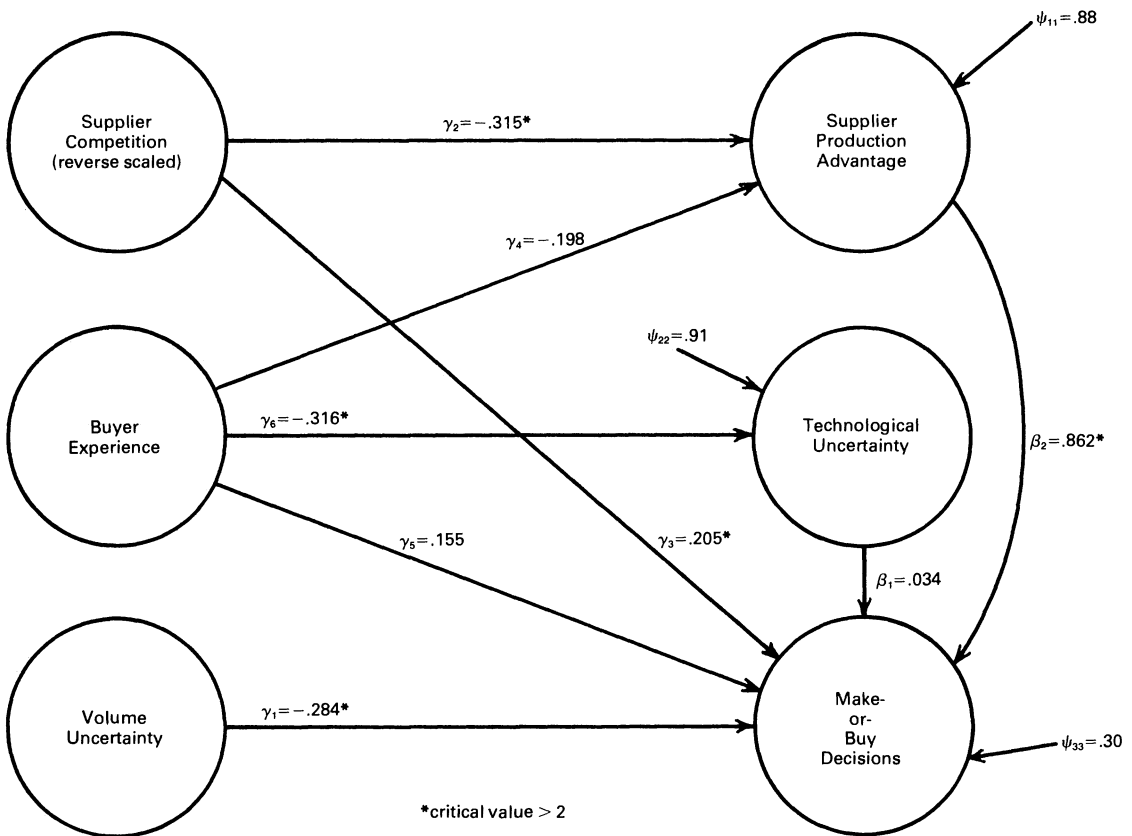


Figure 3. Jackknife estimates of structural equation model parameters. (Correlations among exogenous variables and error terms for endogenous variables are excluded.)

The influence of buyer experience on production advantage is roughly two-thirds that of competition, and the critical ratio of the jackknife coefficient is not acceptable. The direction of the effect of buyer experience on comparative production costs is negative, as hypothesized. Furthermore, the amount of variance explained in comparative production advantage is low ($1 - \psi_{11} = .12$).

The direct effects of competition and buyer experience on make-or-buy decisions were proxies for the influence of transaction costs due to variations in asset specificity. The results show that the effects of both variables were relatively small and that only market competition had an acceptable critical ratio for the jackknife coefficient. Both effects indicated a buy decision as hypothesized.

The influence of uncertainty on make-or-buy decisions also serves as a proxy for transaction costs. Of the two types of uncertainty studied here, only volume uncertainty had a significant effect in the predicted direction; technological uncertainty had a low standardized estimate and critical ratio. The estimate for technological uncertainty was positive, opposite to the direction hypothesized. Technological uncertainty was causally related to buyer experience; however, the amount of variance in uncertainty explained by the relationship was only roughly 9 percent ($1 - \psi_{22} = .088$). The total variance explained in make-or-buy decisions was substantial ($1 - \psi_{33} = .703$).

DISCUSSION

The results show mixed support for Williamson's theory. In any case, the small sample size and the fact that the data were drawn from a single corporate division limit the generalizability of the findings. Furthermore, the relative simplicity of the components studied may explain to some extent the failure of part of the model.

Although the functional managers were assigned variables in their area of expertise and the variables had good measurement properties, it would have been desirable to have had more information on the cognitive processes the managers used in making their judgments under the three conditions that existed: (1) when data were available as a base for their judgments, as in the case of the sales manager's assessment of fluctuations in volume; (2) when the data had to be related to more general experience, e.g., the manufacturing engineer's evaluation of the similarity of tools and equipment across production processes, and (3) when the manager's judgment was not based on specific data but on extensive general experience, as in the product engineer's estimate of technological uncertainty. Understanding these cognitive processes would help to ground the transaction cost concept in processes of managerial perception and judgment, which bear on the decision of how to govern a particular contracting situation.

In general, the effect of transaction costs on make-or-buy decisions was substantially overshadowed by comparative production costs. Production costs were likely to be salient in the decision-making process, first because the simplicity of the components studied here allowed detailed measurements of production costs to be made, and second, because production costs might have been associated more with division outcomes than with functional outcomes within the division. Consequently, communication of these costs should not be affected by differences in influence among functional managers in the informal decision-making process.

The extent to which market competition affects make-or-buy decisions may reflect the ability of the component purchasing manager to indicate how low competition leads to contracting difficulties. The purchasing manager may not have considered, however, the causal relationship connecting market competition and production costs. Thus, the level of market competition affected make-or-buy decisions indirectly through its influence on comparative manufacturing costs and at the same time may indicate, through its direct effect on make-or-buy outcomes, how the power to influence the decisions was informally distributed among the functional managers.

An implicit assumption in this study was that the costs of administering interfunctional coordination within the firm were virtually independent of the transaction costs associated with contracting in the market. If this assumption was not valid, then whatever administrative expenses were hidden in the comparative production cost measures would have been correlated with the indicators of asset specificity and uncertainty. The influence of production costs on the make-or-buy decision then might have been due in part to transaction costs within the firm, and the effect of market competition on production costs might have been the result of methods bias. This possibility was

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made less likely by the association of the annual savings to make a component with the other measures of comparative production costs. The annual-savings-to-make variable was the result of comparing buyer costs for a component to the supplier's price per unit, since accurate data on the cost schedules of suppliers were not generally available to the buyer. Buyer costs per unit, moreover, included variable costs and either allocatable fixed costs (such as utilities or supervision) that were dedicated to the manufacture of a specific component or fixed costs whose generalizability across components was regularly reevaluated to assess the appropriateness of the allocation. No buyer inventories or administrative costs incurred by the buyer as a result of inconsistent supplier performance were factors in the annual-savings-to-make measure. Consequently, although the supplier unit price undoubtedly contained administrative costs associated with component production, the buyer's assessment of its own production costs excluded them. The transaction costs of market contracting by the buyer were thus separate for the most part from the costs of buyer in-house production as measured in the present study. This separation is significant, since market contracting costs are seen as incurred by the buyer rather than the supplier. As a result, we can be reasonably confident that the supplier production advantage construct is relatively uncontaminated by transaction costs associated with the buyer-supplier relationship.

That volume and not technological uncertainty determined make-or-buy decisions suggests that midcontract changes in demand were judged more perilous than changes in tooling resulting from the redesign of components. Transaction costs associated with changes in volume may have been more significant to managers than changes in technology, for two reasons. Either shifts in demand for a component were more frequent than technological changes and were therefore communicated more often, or product engineering and sales differed in their reports on fluctuations. The difference between the effects of volume and technological uncertainty may also have been determined by the simplicity of the parts studied here, since alterations in the design of less complex components may have entailed lower transactions costs and thus required less attention. Another explanation of why volume uncertainty affected make-or-buy decisions but technological uncertainty did not concerns the way costs were borne for retooling. Because retooling was paid for by the buyer, recontracting due to technological change did not require substantial negotiation; the administrative costs of changes in volume, on the other hand, may have been borne by both parties and therefore may have resulted in more intensive negotiation. Finally, the importance of volume uncertainty indicates that scale efficiencies may have been crucial for suppliers. This finding is consistent with the strong effect of comparative production costs, which were measured in part by differences in the scale of operations between buyer and supplier.

The insignificant effect of buyer experience on production costs also may have been due to the relative simplicity of the components studied here. The market may have been larger and scale economies greater for simple components than for more complex ones. Therefore, the manufacturing history of the buyer may not have been as relevant for comparative

production costs as the supplier's ability to fill capacity and smooth production schedules. This result may not be due to a failure in cross-functional communication, since the relationship between buyer experience and production costs was based on the effect of the learning curve in manufacturing components, which was not directly relevant to the make-or-buy decision.

In contrast, translating buyer knowledge of production techniques into contracting expertise did require cross-functional communication. The absence of an effect of either buyer experience or technological uncertainty on make-or-buy decisions may indicate poor communication within the division of important information for contracting with suppliers. Even if in-house manufacturing experience was used in dealing with suppliers, its contribution to reducing transaction costs might have been negligible because of the relative simplicity of the components studied. Whether increasing the complexity of components studied would increase the importance of buyer knowledge for make-or-buy decisions remains to be seen.

That neither buyer experience nor technological uncertainty had an effect on decisions may be understood in an additional way. In an ongoing stream of make-or-buy decisions, a cyclical pattern for complex components may be found in which components are brought into the firm so it can gain production experience and reduce uncertainty and then are shifted back to the market when contracting hazards can be managed. For simple components this cycle may be compressed because of the reduction in the range of influence of buyer manufacturing information and technological uncertainty on production and transaction costs.

Thus the smoothing of disturbances affecting operations, which Thompson (1967) saw as the necessary condition for applying economic efficiency criteria in decision making, can be redefined as the management of uncertainty and opportunism in transactions within or across organizational boundaries to gain efficiency. The relationships between the efficient boundaries model and the behavioral consequences of Thompson's (1967) concept of an organization's technological structure require greater elaboration, particularly with regard to component complexity, interfunctional communication and coordination, and the conflict between the commitment to in-house production and the tendency to buy in a market where the threat of opportunism is reduced by prior production experience.

In the present research, the issue of market power, or the ability to maintain noncompetitive contracting practices, has been addressed exclusively as a property of suppliers. Since the buyer here is a large automobile company, it may be able to force its suppliers into noncompetitive practices (Pfeffer and Salancik, 1978: 54). For example, the buyer might shift uncertainty to suppliers, as suggested by Cyert and March's (1963) behavioral theory of the firm, rather than bring operations into the organization to reduce transaction costs. The power to shift uncertainty to the market should exist, however, only when a supplier is weak, that is, when other firms are available to take the buyer's business if the supplier is not compliant. If the supplier is strong, the administrative costs of allocating uncer-

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tainty to the supplier may be high, and producing the component internally may be the less costly alternative. Contrary to the market power argument, the results of the present study show that, when the competitiveness of the supplier market is controlled for, the organization does not shift volume uncertainty to suppliers but rather assumes production of the component. The level of technological uncertainty, furthermore, has no effect on make-or-buy decisions. To test the market power argument further, buyer control of uncertainty should be examined in markets stratified according to their level of competition. If administrative efficiency rather than power is the guiding principle in buyer-supplier relationships, then uncertainty should not be associated with the decision to buy, even in high competition markets.

According to the efficient boundaries model, organizations that do not shift their operations to the market or bring production of components in-house at the appropriate point on the asset-specificity continuum should perform less efficiently than those that do. Williamson (1983) discussed the normative implications of the transaction cost approach by referring to the penalties suffered in the product market by firms making incorrect vertical integration decisions. These penalties could be assessed by examining the performance of a number of organizations over time. This approach was clearly beyond the scope of the present study, however, since the sample of decisions was within a single firm and time period.

How the costs of the type of decision we studied are linked to overall organizational performance is an issue that should be examined in terms of both the efficient boundaries framework and the internal organization of the firm. Dollar measures of the efficiency associated with a decision should include savings in the administration of component manufacturing activities incurred through market or in-house production. Such savings are very difficult to estimate. To complicate matters, a comparative measure of buyer production costs that might be used to assess the efficiency of make-or-buy decisions was included in our model as an independent rather than dependent variable. Research is needed on the conceptual and methodological issues that arise in the study of transaction costs before normative statements can be made about the economic consequences of applying the efficient boundaries model.

The present research has been restricted to the make-or-buy alternatives. The decisions made by the automobile division here excluded other forms of buyer-supplier relationships, such as tapered integration, joint venture, and the type of coordination and dedicated supply called "kanban" by the Japanese. These types of relationships might be predicted by a transaction cost approach that dimensionalizes the mode of governance as well as the transaction. Further research, therefore, should not only vary component complexity and position in the stream of assembly, but the alternative mechanisms available to the buyer and supplier for the administration of their relationship.

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