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Transaction Cost Approach to Component  
Make-or-Buy Decisions

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and  
David Weber

Working Paper #1452-83

July 1983

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The transaction cost approach to the study of organizations covers a wide spectrum of issues, ranging from varieties of organizational structure (Armour and Teece, 1978), to franchise contracting (Williamson, 1976). A transaction is the transfer of a good or service between technologically separable units (Williamson, 1982), 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 which determine how efficiently a particular administrative mechanism performs. Matching these sides of the problem is the critical task.

Given sufficient continuity or frequency of a transaction to generate concern for the efficient use of resources repeatedly allocated to it, two general dimensions determine which mode of governing the transaction is most efficient: 1) the uncertainty associated with transaction execution and 2) the uniqueness or specificity of the assets assigned by the buyer or supplier to the good or service transacted. Williamson's argument (1975) 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 good or service to determine the correctness of the supplier's actions and high asset specificity makes self-serving supplier decisions particularly risky for the buyer. Transactions which are fraught with uncertainty and to which non-marketable assets have been dedicated will be more efficiently governed when performed completely by the buyer than when performed between a buyer and supplier in the product market. Both the evaluation and the vulnerability problems are

reduced when the buyer has direct control over the operation by performing it in-house.

In the present study we apply the transaction cost framework to make-or-buy decisions for components in a manufacturing division of a large US automobile company. Make-or-buy decisions are a special form of vertical integration which is the paradigmatic problem for transaction cost analysis (Williamson and Ouchi, 1981). 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 simple but prototypical choice between making a component within the firm and buying the product in a market which is regulated to a degree by competitive forces.

Both Anderson (1982) and Monteverde and Teece (1982) have found empirical support for the transaction cost approach to vertical integration. In her study of forward integration into sales by firms in the electronics industry, Anderson 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. Monteverde and Teece found a strong effect in the predicted direction of asset specificity on backward integration into component production by General Motors and Ford. These studies provide important background for the present research in the way they apply transaction cost analysis to the vertical integration problem.

The present research relies most heavily, however, on Williamson's (1982) model of efficient boundaries. The efficient boundaries concept 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 de-integration. When changes occur in the administrative

structure and technological base of the firm as well as in the supplier market, de-integrating an activity may be advisable. Although Williamson mentioned this alternative in his 1975 book (p. 21), his recent (1982) model describes in greater detail how transaction cost analysis might explain the outcomes of formal make-or-buy planning.

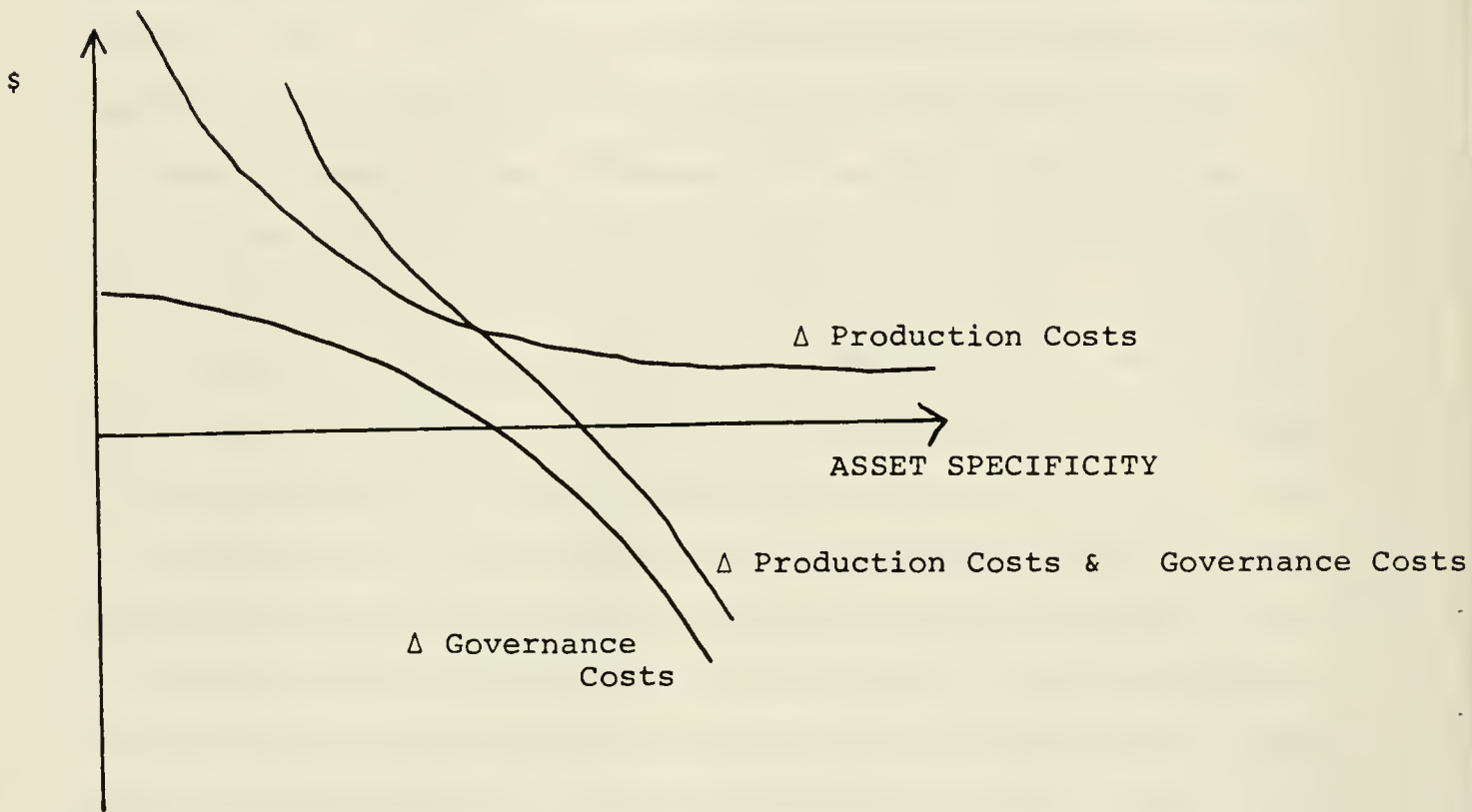
Williamson's model is shown in Figure 1. Holding uncertainty constant at a moderate level, production and transaction cost differences between making and buying are both related, in dissimilar ways, to the level of asset specificity. When asset specificity is low, suppliers enjoy a production cost advantage over buyers since they are able to pool possibly uncorrelated demand, thereby achieving smoother production volume and greater economies of scale. The cost differential decreases as roughly an inverse function of increases in asset specialization, and approaches zero, never favoring the buyer. A comparison of the transaction costs between make and buy, indicates bringing the operation in-house at a relatively early point on the asset specificity continuum because production costs favor the supplier at this point; however, buyers should continue to purchase the component until the sum of the production and transaction cost differentials indicate internalizing the activity.

Williamson develops 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, we focus, as did Anderson and Monteverde and Teece, on a particular stage; our concern is with the production of components for assembly. In contrast to Monteverde and Teece whose sample of components ranged across various stages of final product assembly, our sample consists of relatively simple parts which are input to the initial assembly stage.

Figure 1

Tradeoff Between Governance Costs and Production Costs

(Adapted from Williamson, 1982, p. 560)



$\Delta$  = cost of market contracting over cost of in-house production

Although the efficient boundaries framework applies to every explicit (and implicit) make-or-buy decision, cost differences between market and in-house production should clearly be easier to assess for goods rather than services and for relatively simple goods as opposed to those that are complex. Perhaps for this reason neither Anderson's study of forward integration into sales, nor Monteverde and Teece's examination of backward integration into component production, include production cost comparisons. In the present research, however, the comparative costs of production are proposed as a primary determinant of component make-or-buy decisions.

We use the level of component market competition to indicate asset specificity with regard to both production and transaction costs. 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 and thereby enjoy a production cost advantage over them. Greater competition in the market, moreover, should increase the transaction cost advantage of buying over making. Component market competition decreases the potential for opportunistic bargaining since buyers subjected to it can change suppliers with little difficulty (see Williamson, 1975, p. 16-19).

But buyers with a history of producing a component have better information about component manufacturing, and suppliers are thus less able to engage in opportunistic bargaining. Therefore buyer experience lowers the governance costs of market contracting. In addition, however, because the components in our sample are not complex and because we allow for prior buyer production in an ongoing stream of make-or-buy decisions, prior production experience of the buyer may reduce the production cost differential between the buyer and suppliers afforded by supplier competition. Consequently, in-house production knowledge should affect in opposite directions the

transaction and production cost differentials between the make and buy alternatives.

Williamson's (1982) model and the study by Monteverde and Teece focus on the issue of asset specialization and fix uncertainty as a dimension of transactions. Anderson, however, allows uncertainty to vary, and we follow her approach here. Our definition of uncertainty differs substantially from hers, however, since we study a different type of transaction. In her study of integration into sales, Anderson defined uncertainty in terms of the difficulty of evaluating the performance of sales people and the predictability of the firm's environment. We assume that for simple components, which are goods rather than services, uncertainty surrounding performance evaluation is a not a central aspect of buyer-supplier relations.<sup>1</sup>

We focus rather on the uncertain aspects of the market which may render the initial conditions of a buyer-supplier contract obsolete. Two types of uncertainty --volume and technological-- are identified here as potential causes of contract obsolescence. Similar to Anderson's measure of uncertainty as the perception of sales forecast accuracy, volume uncertainty involves the assessment of fluctuations in the demand for a component and the confidence placed in estimates of component demand. Contracts which are subject to moderate or large shifts in volume strain buyer-supplier relationships as unexpected production costs or excess capacity are incurred by the suppliers and stock-outs or excess inventory experienced by the buyer. These potential outcomes increase transaction costs through mid-contract renegotiation. Since the firm can coordinate variations in its own production stream more efficiently than with suppliers, high volume uncertainty should lead to making rather than buying a component.

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<sup>1</sup>Complex components may require the relaxation of this assumption.



We also define 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, if the component is currently bought, recontracting with the supplier as a result. Recontracting due to design changes may be efficiently accomplished with suppliers if the component market is competitive and thus relieves the buyer of transactional complications due to opportunism (Williamson, 1979).<sup>2</sup> But, as the frequency of technological change increases, the costs of managing the interface between engineering, purchasing and outside suppliers may become higher than those incurred by coordinating an in-house engineering and production effort. The comparison is even less favorable to outside supply when the market ceases to be competitive and a dominant supplier which has achieved a first mover advantage can bargain opportunistically over the period of technological change. Although asset specificity increases the transaction costs of market contracting under uncertainty, here we argue that, in the case of high technological uncertainty, because of cross-functional coordination requirements, in-house production will be administratively more efficient.

Although volume uncertainty can be considered exogenous to component production, technological uncertainty may be determined by buyer production experience. Thompson (1967) has proposed that organizations partition their activities in a core and periphery pattern and protect the core from disturbances in order to enable applying economic efficiency criteria to decision-making. In the present research, core activities are equated with those which the firm has performed extensively and therefore for which it has developed substantial expertise. Low technological uncertainty should be related to components produced in the core as indicated by the degree of buyer experience with their production.

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<sup>2</sup>Williamson (1982, p. 558, n. 19) makes a similar point regarding portable assets installed by the buyer in the supplier's facility.

The production costs associated with the market or the firm as the mode of governing component supply can be measured or at least estimated directly. Transaction costs, however, have eluded direct assessment. The typical research strategy for evaluating the effect of transaction costs on an organizational decision is to examine the influence on the decision of their determinants. Thus the effect of transaction costs on vertical integration is assessed by estimating the effects of asset specificity and uncertainty. We follow this approach in the present study. We propose that make-or-buy decisions are influenced directly by production cost considerations, which in turn market competition and buyer experience determine, and by transaction cost issues as indicated by the direct effects of market competition, buyer experience, volume uncertainty and technological uncertainty.

The model we construct is a structural equation system with multiple indicators for all theoretical constructs except the make-or-buy decision itself. The indicators are shown in Figure 2, and the structural equation model composed of both the latent variables and their indicators is presented in Figure 3. Note that the production cost differential is measured as buyer perceptions of supplier advantages over the buyer in size of operation and manufacturing processes, and as the (natural logarithm of the) dollar amount the buyer estimates it will save in a year if it makes rather than purchases the component from a supplier. Also, buyer experience with component production involves both expertise developed in specific techniques as well as the similarity of specific production equipment to other manufacturing equipment the buyer employs. In this way the informational and capital asset aspects of core technology are captured. The indicators of the other latent variables are relatively straightforward statements of their content as implied by the theory.

Figure 2

Indicators of Latent Variables in the Structural Equation Model

Competition Among Suppliers

1. The extent to which it is difficult to judge the competitiveness of outside quotes on a component.
2. The extent to which there are enough potential suppliers to ensure adequate competition for the sourcing of the component.
3. The extent to which leading outside suppliers of the component possess proprietary technology that gives them an advantage over other producers.

Buyer Experience

4. The degree of similarity between the tools and equipment required to manufacture the component and those already employed by the buyer.
5. The extent to which the buyer possesses strong experience/expertise in the technology required to manufacture the component.

Volume Uncertainty

6. The extent to which significant fluctuations in the daily/monthly volume requirement for the component are expected.
7. The extent to which volume estimates for the component are considered to be uncertain.

Supplier Production Advantage

8. The extent to which substantial differences in manufacturing processes for the component between outside suppliers and the buyer favor the outside suppliers.
9. The extent to which substantial differences in the scale of the operations for the component between outside suppliers and the buyer favor the outside suppliers.
10. Natural logarithm of the division's estimate of the annual savings to make as opposed to buy a component.

Technological Uncertainty

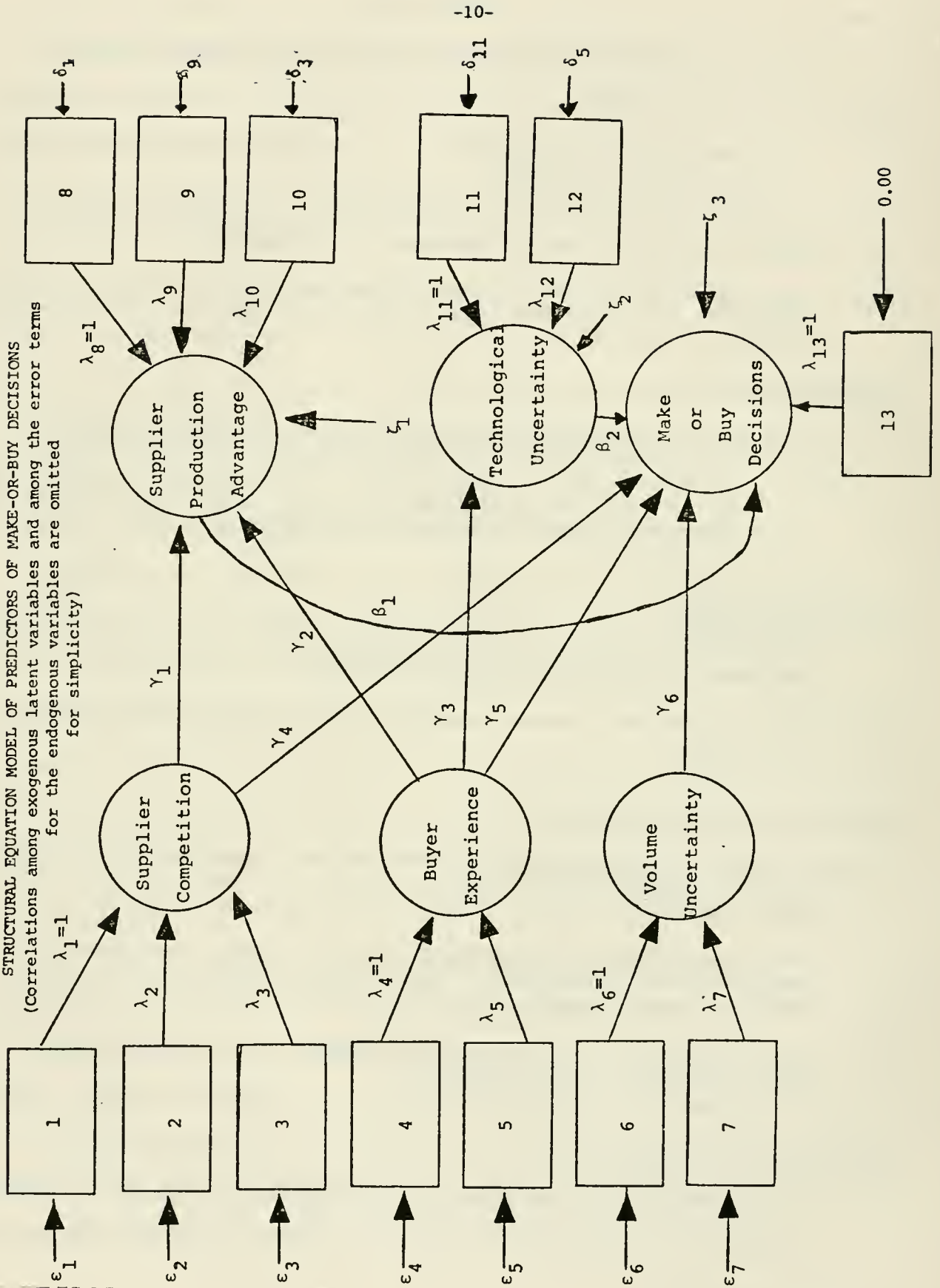
11. The frequency of expected changes in specifications for the component.
12. The probability of future technological improvements of the component.

Make-or-Buy Decisions

13. Actual decision made by the division.

Figure 3

STRUCTURAL EQUATION MODEL OF PREDICTORS OF MAKE-OR-BUY DECISIONS  
 (Correlations among exogenous latent variables and among the error terms for the endogenous variables are omitted for simplicity)



## Data and Methods

The data consist of 60 decisions made by a component division of a large US automobile manufacturer over a three year span. These decisions were formulated in a newly instituted formal make-or-buy decision making process that generated and collated a substantially greater amount of information about the production of each component than had previously been available. The sample of 60 emerged by exception from the roughly twenty thousand part numbers the division used for assembly. The information for these 60 components was considered inadequate for a competent decision to be made, and they therefore were referred to the committee for further evaluation.<sup>3</sup> A singular advantage of analysing the make or buy decisions for these components is that the committee developed relatively precise estimates of the savings the division would incur by making the component over the span of a year. These estimates were used in the present study along with managerial perceptions of supplier production advantage to indicate the production cost differential between the division and suppliers.

The formal process was a team effort involving several functions among which were component purchasing, sales and product and manufacturing engineering. To minimize key informant bias (see Phillips, 1982) we exploited this functional differentiation. A team member provided information on that aspect of the decision which was relevant to his or her function. For each of the 60 parts, component purchasing answered questions concerning the level of market competition and the perceived relative advantage in production processes of the leading supplier over the division. Likewise, manufacturing

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<sup>3</sup>The effectiveness of the formal process can be seen in the number of components whose governance mode the process altered. The production of twenty components, out of forty-nine 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.

engineering gave information about the division's experience in producing each component; product engineering indicated the level of technological uncertainty with regard to the components; and sales provided data on the degree of volume uncertainty. All responses were made on a Likert type scale of 1 to 5. Make or buy decisions were coded 0 if make, 1 if buy.

The data were analyzed using the unweighted least squares (ULS) procedure of Joreskog and Sorbom (1982). This technique produces consistent estimates of the measurement and structural equation parameters of the theory without assuming an underlying distribution for the variables. This property of the procedure makes it appropriate for the present study, since the theory tested here includes a dichotomous dependent variable.<sup>4</sup> Standard errors for ULS estimates, however,

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<sup>4</sup>One alternative strategy for testing a multiple indicator model with a 0-1 dependent variable is found in Anderson's study. She constructed the independent variables of her theory using a factor analysis of each item set separately and tested their effect on the vertical integration decision with discriminant analysis. The disadvantage of this approach is that the variables are estimated with measurement error, so that the coefficients of the discriminant function may be over or under estimated (Bagozzi, 1980). A second alternative is to assume that the probability distribution of the vertical integration decision is normally distributed. Both Bagozzi (1981) and Monteverde and Teece (1982) make this assumption. Bagozzi used biserial correlations to estimate associations between continuous latent independent variables measured by more than one item and a dichotomous dependent variable; he then estimated the parameters in his theoretical model using maximum likelihood. This method would have been appropriate for the present study but for two difficulties. First, the sample size in the present research is below Lawley and Maxwell's (1972) suggested minimum for analysis of covariance using maximum likelihood. They recommend a sample size of 50 cases greater than half the number of measured variables times one plus that number. Since thirteen variables were measured in the present study, in order to satisfy their criterion we would have needed roughly 140 cases to place strong confidence in the maximum likelihood estimates. Second, biserial correlations are typically significantly higher than product moment correlations. In the present study this tendency led to a problem of inverting the correlation matrix with biserial correlations included. Monteverde and Teece also assumed a normal distribution for their dependent variable and used probit analysis to test their theory. Like Anderson, however, they could not correct for measurement error in their parameter estimates. The unweighted least squares procedure is more robust due to its lack of distributional assumptions and its estimation of measurement error.

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, Chapter 8) and their standard errors were computed for the (standardized) ULS estimates. Finally, LISREL V (Joreskog and Sorbom, 1982), the program used to perform the unweighted 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 in a rough way 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 thus providing additional justification for the use of ULS. Also, the two measures for technological uncertainty are correlated .93, suggesting that these indicators carry highly similar information about the latent variable; as a result the second measure was dropped from further analysis.

The results of the ULS and jackknife analyses are found in Table 2. The jackknife coefficients are for the most part close to the ULS estimates. Substantial deviation occurs for six parameters,  $\gamma_2$ ,  $\beta_2$ ,  $\psi_{13}$ ,  $\psi_{12}$ ,  $\psi_{33}$  and  $\phi_{12}$ . The first four of these have low (absolute) critical ratios, and the ULS estimate lies within one standard error of the jackknife coefficient. For the last two parameters, however, the jackknife coefficient has a relatively high critical ratio. The parameter  $\psi_{33}$  is the variance of the error term for the make-or-buy decision; the ULS estimate, .291, indicates that the predictors explain roughly 71% of the variance for

Table 1

Product-Moment Correlations and Descriptive Statistics for  
Indicators Shown in Figure 2 and Make-or-Buy Decisions

<u>Indicator</u>	<u>Mean</u>	<u>S.D.</u>	<u>Product-Moment Correlations</u>												
1	2.78	.83	1.0												
2	2.95	.91	-.82	1.0											
3	2.87	.96	.56	-.61	1.0										
4	3.88	.74	.06	-.19	.13	1.0									
5	4.45	.77	-.02	-.17	.17	.69	1.0								
6	2.87	.62	-.09	-.10	.06	.15	.23	1.0							
7	2.92	.56	-.01	-.11	.01	.26	.25	.59	1.0						
8	2.47	.89	-.25	.29	-.18	-.19	-.09	-.13	-.05	1.0					
9	2.63	.88	-.25	.28	-.24	-.23	-.18	-.12	-.03	.81	1.0				
10	6.92	5.11	.24	-.25	.03	.09	.03	.23	.21	-.61	-.58	1.0			
11	2.56	1.00	-.06	-.03	-.04	-.16	-.37	-.07	-.22	.15	.19	-.06	1.0		
12	2.54	1.10	-.03	-.08	.05	-.09	-.26	.00	-.17	.10	.15	-.06	.93	1.0	
13	.45	.50	-.08	.09	-.10	-.09	-.11	-.29	-.16	.69	.72	-.51	.18	.14	1.0



TABLE 2  
LISREL Estimates, Using Unweighted Least Squares, and Jackknife Coefficients  
of the Structural Equation Model Shown in Figure 21

Parameters	Unstandardized Estimates	Standardized Estimates	Jackknife Coefficients	Jackknife Standard Errors	Critical Ratio	Parameters	Unstandardized Estimates	Standardized Estimates	Jackknife Coefficients	Jackknife Standard Errors	Critical Ratio
$\gamma_1$	-.329	-.306	-.366*	.131	2.64	$\text{Var}(\epsilon_1)$	.320	.320	---	---	---
$\gamma_2$	-.216	-.187	-.053	.164	.32	$\text{Var}(\epsilon_2)$	.023	.023	---	---	---
$\gamma_3$	-.441	-.339	-.310*	.073	4.25	$\text{Var}(\epsilon_3)$	.583	.583	---	---	---
$\gamma_4$	.196	.162	.198*	.097	2.04	$\text{Var}(\epsilon_4)$	.409	.409	---	---	---
$\gamma_5$	.214	.165	.236	.239	.91	$\text{Var}(\epsilon_5)$	.320	.320	---	---	---
$\gamma_6$	-.379	-.286	-.303*	.136	2.22	$\text{Var}(\epsilon_6)$	.432	.432	---	---	---
$\beta_1$	.904	.802	.694*	.121	5.73	$\text{Var}(\epsilon_7)$	.388	.388	---	---	---
$\beta_2$	.033	.033	.373	.415	.89	$\text{Var}(\delta_1)$	.213	.213	---	---	---
$\phi_{11}^2$	.680	1.0	1.0	0.0	ad	$\text{Var}(\delta_2)$	.156	.156	---	---	---
$\phi_{22}^2$	.591	1.0	1.0	0.0	ad	$\text{Var}(\delta_3)$	.572	.572	---	---	---
$\phi_{33}^2$	.568	1.0	1.0	0.0	ad	$\text{Var}(\epsilon_4)$	0.0	0.0	---	---	---
$\phi_{12}^2$	.101	.159	.537*	.182	2.95	nd = not defined					
$\phi_{13}^2$	.050	.080	.157	.193	.81	Goodness of fit index = .931 (adjusted for degrees of freedom = .365)					
$\phi_{23}^2$	.229	.396	.356*	.136	2.61	Note that indicator 12 is omitted because of its high correlation with indicator 11.					
$\phi_{11}^3$	.672	.853	.921*	.125	7.36	2's are correlations among exogenous latent variables.					
$\phi_{22}^3$	.685	.885	.910*	.052	17.50	3's are covariances among the error terms of endogenous variables.					
$\phi_{33}^3$	.291	.291	.534*	.107	4.99	4 Because the variances of the observed variable error terms are one minus the squares of their respective $\lambda$ 's, minor variation in the $\lambda$ 's across the sub samples used to construct the jackknife led to substantially greater variability in the error term variances and consequently skewed jackknife coefficients and standard errors. For this reason, the jackknife statistics of the error terms are substantively uninteresting.					
$\phi_{12}^3$	.079	.009	.196	.178	1.04	absolute value of critical ratio greater than 2.					
$\phi_{23}^3$	.039	.038	.021	.035	.60						
$\phi_{13}^3$	.033	.030	.017	.065	.26						
$\lambda_1$	1.0	.824	.502*	.113	4.97						
$\lambda_2$	-1.199	-.908	-1.096*	.081	13.53						
$\lambda_3$	.783	.646	.612*	.078	7.84						
$\lambda_4$	1.0	.769	.733*	.160	4.58						
$\lambda_5$	1.121	.861	1.091*	.094	11.61						
$\lambda_6$	1.0	.794	.717*	.207	3.46						
$\lambda_7$	1.038	.782	.719*	.241	2.98						
$\lambda_8$	1.0	.687	.936*	.041	22.83						
$\lambda_9$	1.036	.919	.941*	.059	15.94						
$\lambda_{10}$	-.738	-.654	-.649*	.094	6.90						
$\lambda_{11}$	1.0	1.0	1.0	0.0	ad						
$\lambda_{13}$	1.0	1.0	1.0	0.0	ad						

this variable. The jackknife coefficient reduces the variance explained to about 47%. The parameter  $\phi_{12}$  specifies the correlation between the exogenous variables, supplier competition and buyer experience. In this case, the jackknife procedure raises the magnitude of the parameter value substantially, suggesting that the distribution of the estimate is highly skewed (downward) across the sample. Except for this result, the application of the jackknife shows a generally stable pattern of coefficients for the sample. Caution should be used, however, in interpreting fine differences of magnitude in the results.

The goodness of fit index is relatively high. This result suggests that a major proportion of the variance in the data is explained by the model as a whole. It should be noted that LISREL falsifies theories but does not confirm them. Consequently, other models may do equally as well in explaining the pattern of correlations. In the present case, however, no alternative theory was evident.

The theoretical constructs have strong convergent validity as shown by the relative closeness of all unstandardized  $\lambda$ 's to 1.0 and the high value of each  $\lambda$  in the standardized solution. The reliabilities of supplier competition, buyer experience, volume uncertainty, and supplier production advantage are .69, .65, .6 and .69 respectively. The jackknife coefficients are similar to the standardized estimates and have critical ratios substantially greater than 2. Also, the variances of the error terms of the observed variables range from .023 (ignoring the zero variances for the variables with single measures) to .583. The amount of variance explained in the indicators by their relationship to the latent variables therefore lies between .417 and .977.

The hypothesis concerning the effect of supplier production advantage on make-or-buy decisions is strongly supported. The ULS estimate is more than

twice as large as the other path coefficients, and the critical ratio for the jackknife coefficient is relatively high. The strength of this result should not be surprising, given the relative simplicity of the components in our sample. The effect of supplier competition on production advantage is moderate and has an acceptable critical ratio. (Note that supplier competition is reverse scaled.) The influence of buyer experience on production advantage, however, is roughly two-thirds that of competition and the critical ratio of the jackknife coefficient is not acceptable. The direction of the buyer experience effect on comparative production costs is negative, as proposed.

The direct effects of competition and buyer experience on make-or-buy decisions are proxies for the influence of transaction costs due to variations in asset specificity. The results show that the effects of both variables are relatively small and that only market competition has a acceptable critical ratio for the jackknife coefficient. Both effects indicate a buy decision, moreover, consistent with the theory.

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 has a significant effect in the predicted direction. Technological uncertainty has a low standardized estimate and a relatively high jackknife coefficient that has a low critical ratio. The estimate for technological uncertainty is positive, the direction opposite to that proposed. Technological uncertainty, however, is causally related to buyer experience, confirming Thompson's argument concerning the association of core technology and low uncertainty, although the amount of variance in uncertainty explained by the relationship is only roughly 12 percent

$$(1 - \psi_{22} = .115).$$

In summary, component-relevant production experience by the buyer, has neither a direct effect on make-or-buy decisions, nor an indirect effect through comparative production advantage or technological uncertainty. Buyer experience does predict the level of technological uncertainty associated with a component, however. Supplier competition on the other hand, influences make-or-buy decisions both directly, and indirectly through supplier production advantage. Volume uncertainty, finally, has a direct effect on decisions.

### Discussion

Our propositions were drawn mainly from Williamson's model of transaction costs, especially his (1982) efficient boundaries framework. Rather than fixing uncertainty surrounding transactions, however, we allowed it to vary as fluctuations in volume and in component specifications. The results show that make-or-buy decisions were strongly predicted by comparative production costs and transaction cost determinants and that comparative production costs were influenced by the degree of supplier competition. Also, following Thompson (1967), we proposed a negative relationship between uncertainty and the extent to which the buyer had experience producing a component. This hypothesis was confirmed, and in general our theory based on Williamson's model was supported.

Three hypotheses were falsified, however. These propositions involved the effects of buyer experience on supplier production advantage and on make-or-buy decisions, and the influence on these decisions of technological uncertainty. These results may be due in large part to the type of component and stage of assembly for which make or buy decisions were made in the present

research. The market may be larger and scale economies greater for simple components than for more complex products. Therefore, the manufacturing history of the buyer may not be as relevant for comparative production costs as is the supplier's ability to fill capacity and smooth demand.

It is interesting that experience in the manufacture of first-stage components also does not significantly reduce the buyer's vulnerability to opportunistic supplier bargaining. In the present study we defined asset specificity both in terms of the level of competition in the component market and the degree of buyer knowledge of production techniques. In this way a distinction can be made between the potential for opportunistic bargaining on the part of the supplier due to dedicated assets and the vulnerability to opportunism on the buyer's part due to poor information. The results show that simply knowing the nature of correct supplier behavior with regard to a component production contract is not sufficient to lead to market supply, whereas being able to switch suppliers in a competitive market does induce a buy rather than a make decision. Whether increasing the complexity of components tends to augment the importance of buyer knowledge for make or buy decisions remains to be seen (see, for example, Monteverde and Teece, 1982).

That volume and not technological uncertainty influences make-or-buy decisions suggests that mid-contract changes in demand are more perilous than changes in tooling caused by component redesign. This result may hinge on the simplicity of the parts studied here and on the consequent ease with which changes in specifications may be implemented. The alteration of more complex components would entail greater coordination costs and more extensive changes in manufacturing equipment. Another explanation of this result is that because retooling is straightforwardly paid for by the buyer, recontracting due to technological change does not involve substantial negotiation; the costs of changes in volume, on the other hand, may be born by both parties and

therefore induce more prolonged contracting. Also, the importance of volume uncertainty indicates that scale efficiencies may be crucial for suppliers. This finding is thus consistent with the strong effect of comparative production costs which are measured in part by differences in the scale of operations between buyer and supplier and which should be easier to assess for simple components.

That neither buyer experience nor technological uncertainty had an effect on decisions may be due to two factors. First, as emphasized above, the importance of buyer manufacturing knowledge and of technological uncertainty in transactions with suppliers may depend on component complexity. Second, however, the reduction in vulnerability to opportunism, and thus transaction cost benefits afforded by high buyer experience and low uncertainty may be offset by the tendency to make rather than buy, in deference to sunk costs and the desire to maintain control over components with relatively stable specifications. In an ongoing stream of make-or-buy decisions, therefore, a cyclical pattern for complex components should be found in which parts are brought into the firm to gain production experience and reduce uncertainty and then shifted back to the market when contracting hazards are manageable. For simple components, this cycle may be compressed due to the reduction in the range of influence buyer manufacturing information and technological uncertainty have on production and transaction costs compared across the firm and market.

Thus the smoothing of disturbances affecting operations, which Thompson saw as the necessary condition for applying economic efficiency criteria to decision making, can be redefined as the management of uncertainty and opportunism in transactions within or across organizational boundaries for efficiency purposes. Williamson's (1982) characterization of Thompson's core technology concept as a series of site specific activities is consequently

incomplete since it captures only the kind of technological interdependence which entails transportation costs. The relationships between the efficient boundaries model and the behavioral consequences of Thompson's concept of organizational technological structure require greater elaboration, particularly with regard to component complexity and the conflict between the commitment to in-house production and the reduction of vulnerability to specialized suppliers which in-house production provides.

The efficient boundaries model is prescriptive in the sense that organizations which do not shift their operations to the market or bring component production in-house at the appropriate point on the asset specificity continuum should perform less well than those that follow the theory. However, the model is also descriptive as it portrays the implicit vertical integration policies of successful firms (see Williamson, 1981). Our approach has been to test a theory, based on the efficient boundaries framework, in which make-or-buy decisions are simply predicted. Comparing decisions in terms of their cost efficiency is problematic for both conceptual reasons and for reasons of data availability. In our model, for example, comparative production costs were included as an independent rather than dependent variable. Furthermore, dollar measures of the cost efficiency associated with the decisions should include savings in the administration of component manufacturing activities incurred through market or in-house production; these savings are very difficult to estimate. Williamson (1983) discusses the normative implications of the transaction cost approach by referring to the penalties suffered in the market by firms that made wrong vertical integration decisions. He focuses therefore on variation across organizations in the efficiency of their boundaries. This method was clearly beyond the scope of our study since we examined a sample of decisions within a single firm and time frame. How the costs of the type of decision we have studied

are linked to overall organizational performance is an issue of aggregation that should be examined by relating the efficient boundaries framework to the internal organization of the firm. Much research needs to be performed therefore on the conceptual and methodological issues which arise in the study of transaction costs before strong normative statements can be made about the economic consequences of applying the efficient boundaries model.

Finally, we have restricted ourselves in the present research to the make or buy alternatives only. The decisions made by the automobile division here excluded other forms of buyer-supplier relationship 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 which 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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