

Profit Centers,  
Single-Source  
Suppliers, and  
Transaction Costs

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This paper addresses criticisms of transaction-cost theory that it overstates the effect of asset specialization on vertical integration and understates the costs of managing interunit relationships within an organization, particularly for nonstandard organizations and markets. We apply the theory simultaneously to decentralized supply relationships in a manufacturing corporation and to the corporation's relationships with single-source suppliers. Our results support the core proposition of the theory—that specialized assets have lower transaction costs within the organization. However, the hybrid characteristics of these supply relationships challenge both the theory's basic assumptions and its predictive power. Corporate decentralization and relational contracting in the market diminish the role of asset specificity as a necessary condition for low transaction costs in-house and as a sufficient condition for high transaction costs in the market. Therefore, how the theory should be used as a predictor of shifts in the current boundaries of the corporation is unclear. •

## BACKGROUND

Do organizations and markets govern transactions differently? This question has motivated a large body of research that has reached divergent conclusions. Proponents of transaction-cost theory (Williamson, 1985) have found that organizations and markets differ in their governance capabilities. Other authors (Stinchcombe, 1983; Granovetter, 1985; Eccles and White, 1988), however, suggest that the transaction-cost argument is stated too strongly. They argue that organizations and markets are not discrete institutions to which the theory can be straightforwardly applied.

A central hypothesis of transaction-cost theory is that interunit relationships in which supplier assets are specialized have lower transaction costs inside an organization than when the relationship occurs between organizations (Klein, Crawford, and Alchian, 1978; Riordan and Williamson, 1985; Demsetz, 1988). Asset specialization increases the buyer's loss if the supply relationship is terminated. The potential for a higher loss provides the supplier with an opportunity to bargain for a greater share of the value of the relationship. Thus, as the supplier's assets become specialized, it should be more reluctant to bear the costs of adapting to changes in the buyer's needs. Such a difficulty in bargaining between units is managed more effectively, according to transaction-cost theory, by organizational authority than by contracting in the market. Organizational authority is more effective because the organization controls resource allocation to the units and has better information about their costs (Williamson, 1975: 154).

A substantial amount of research (Monteverde and Teece, 1982; Anderson and Schmittlein, 1984; Masten, 1984; Walker and Weber, 1984) has produced results that are consistent with this logic. The standard test of the theory, when examining how transactions are governed, is to predict whether an activity is performed inside or outside an organization by the extent to which the activities' assets are specialized. These tests have shown for several types of functions (e.g., sales force, manufacturing component fabri-

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cation, research and development) that assets in the firm tend to be more specialized than the assets of independent suppliers.

There are two potentially troubling characteristics of these studies. First, they have not compared transaction costs inside the organization to transaction costs between the organization and its outside suppliers under comparable degrees of asset specialization. This comparison is required to demonstrate that an organization has superior governance capabilities relative to the market. Second, the causes of asset specificity in interunit relationships have not been specified. This omission is significant, since assets inside an organization may become specialized after they are vertically integrated. The inference that an organization lowers transaction costs by vertically integrating operations with high asset specificity may therefore be incorrect. These omissions make it difficult to respond to critics who have argued that the theory overstates the effect of supplier asset specificity on vertical integration (Dore, 1983; Coase, 1988; Demsetz, 1988) and understates the bureaucratic and interunit bargaining costs that vertical integration entails (Perrow, 1986; Eccles and White, 1988).

These criticisms are particularly relevant to research on organizations and markets that do not conform to ideal types. In many organizations, in-house units may be governed like market suppliers. Multidivisional corporations decentralize control over interdivisional supply relationships. Decentralization induces a market-like incentive system favoring coordination within the divisions, organized as profit centers, at the expense of coordination between them (Chandler, 1962; Galbraith, 1973; Williamson, 1975). Evans and Grossman (1983) argued that such a market-like incentive system is both more costly and less effective than the market itself. Williamson (1985: 140) also expressed reservations about the effectiveness of "high powered incentives" within a corporation. Finally, Eccles and White (1988) described cases in which profit centers in multidivisional corporations prefer relationships with independent suppliers to in-house relationships because the latter are more difficult to manage.

Conversely, market suppliers may be governed like organizational units (Stinchcombe, 1983; Bradach and Eccles, 1989). The existence of "quasi-firms" (Eccles, 1981) and long-term contracts (Joskow, 1985) as substitutes for vertical integration (Kleindorfer and Knieps, 1982) have long been observed. MacNeil (1978), furthermore, described markets in which the supplier's expectation of an enduring business generates effective norms of conflict resolution. MacNeil called this type of supply relationship "relational contracting." A critical test of the theory would compare the effect of asset specialization on transaction costs within decentralized corporations to its effect in hybrid market supply relationships, like relational contracting. This is precisely our purpose in this paper.

## HYPOTHESES

**Asset specificity.** Decentralized multidivisional firms are composed of profit centers that may supply each other with goods and services. Corporate management must weigh the

effect on corporate performance of poor interdivisional adaptation to ongoing changes in a supply relationship against the effect of higher profitability in the supplying division. Increasing asset specificity in the supplying profit center may raise the costs of poor interdivisional adaptation beyond divisional gains. Therefore, when divisions with specialized assets do not facilitate adaptation with their internal customers, corporate management may intervene to reduce the potential loss or signal that intervention will occur if coordination does not improve (Eccles and White, 1988). This threat of intervention reinforces the effectiveness of other coordination mechanisms developed to resolve interunit conflict involving specialized assets (Thompson, 1967: chap. 5; Galbraith, 1973).

For relational contracting with outside suppliers, we argue the reverse: As asset specificity increases, governance becomes weaker rather than stronger. Although relational contracting lowers conflict resulting from asset specialization (Williamson, 1979), its effectiveness is based on suppliers' expectations rather than on the force of organizational authority. Since, in transaction-cost theory, expectations do not bind as strongly as authority (Dow, 1987), increasing asset specificity exposes the latent incompatibility between the corporation's interests and those of outside suppliers. Relational contracting practices are therefore strained. Therefore our hypothesis is as follows:

**Hypothesis 1 (H1):** The effect of supplier asset specificity on transaction costs will be lower within a multidivisional corporation than in relational contracting with market suppliers.

**Preselection investment in technology.** Potential suppliers may invest in new technology to increase the probability that they will be selected to supply the input. However, once the supplier is chosen, this investment may influence subsequent conflict with the buyer. To signal commitment to the buyer and influence the selection decision, part of the supplier's investment should not be redeployable (Klein and Leffler, 1981; Williamson, 1983).<sup>1</sup> Since, by H1, the adaptation costs associated with these specific assets (Williamson, 1985: 179) should be better managed within the organization than in the market, we hypothesize:

**Hypothesis 2 (H2):** The effect of supplier preselection investment in technology on transaction costs should be lower for relationships between profit centers than in relational contracting with outside suppliers.

**Supplier market competition.** Supplier asset specificity and supplier market competition have often been confounded (Walker and Weber, 1984). In fact, almost by definition, as supplier assets become more specialized, the competitiveness of the supplier market should decrease. However, the argument for the effect of market competition on transaction costs is somewhat different from that of asset specificity. Since the availability of competitors makes it easier for the buyer to switch suppliers, it raises the credibility of a buyer's threats to terminate the relationship. The more credible the threat of termination, the less the supplier should haggle with the buyer over adaptation costs. However, this proposition should not be equally true for relationships between profit centers and relational contracting with outside suppliers.

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The theory here concerns contracting problems faced by the buyer after the supplier has invested in new technology to get the buyer's business. We do not examine the motivations that led the supplier to make the investment. Presumably, one of these would be the large size of the order the supplier would receive from the buyer.

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Williamson (1985: 151) argued that organizations have a bias toward maintaining authority over internal transactions, whatever the level of asset specialization. Corporate encouragement to buy inside may also reflect the need to maintain volume in some inputs, e.g., labor and capital, or functions, e.g., advertising and basic research, that have large economies of scale. Thus, an internal procurement bias would lower the threat of termination for profit centers. Conversely, in market supply, both the authority relation and economies of scale in inputs and functions are absent. The ancillary costs of termination are thus reduced and the credibility of termination threats increased. We thus hypothesize:

**Hypothesis 3 (H3):** The influence of supplier market competition on transaction costs should be lower for relationships between profit centers than in relational contracting with outside suppliers.

## The Comparability of Interprofit Center Relationships and Relational Contracting

Our hypotheses assume that differences between internal and external suppliers are not due to variation in the technology of the inputs supplied. Technological differences may be related to the product life cycle (Harrigan, 1983) or to management's choice of technology to increase demand for the end product (Riordan and Williamson, 1985). Such differences are important, since they may influence the supplier's value to the corporation.

In markets in which new technology determines product success, performance is higher the earlier in a technology's life cycle effective interunit adaptation occurs. The corporation is therefore likely to coordinate relationships with specialized suppliers more extensively when their technologies are new. If asset specialization for inside and outside suppliers occurs at different stages in the life cycle, the corporation will value the relationships with these suppliers differently. The results for H1 will therefore be biased.

The dynamics of supplier market competition are also likely to differ across the stages of the technology life cycle (Stigler, 1951; Harrigan, 1983). Technology diffusion and entry of new firms into the market are important for competition in the early stage of an industry; but in the mature stage, competition is shaped by increasing consolidation. If the dynamics of competition differ between profit centers and outside suppliers, it is possible the results for H3 will be biased.

Furthermore, managers may choose among different technologies to enhance demand for the end product (Riordan and Williamson, 1985). If the choice of a technology determines the degree of asset specificity and is made simultaneously with the decision whether to make or buy (Williamson, 1985: 89), then inputs supplied within the corporation may differ technologically from those produced by outside suppliers. Since economic losses due to interunit conflict will be higher for technologies that enhance demand, technological differences between inside and outside suppliers may confound H1 and H3. To control for the effect of technology, we predict both asset specificity and market competition by an input's technological age. Age of technology relates both to the product life cycle and to demand-enhancing features of the input. We compare these predictions across profit centers



and market suppliers to identify technological differences between them.

## METHOD

### Research Setting

**The assembly division.** We studied the supply relationships of one large assembly division (over two billion dollars in revenues) in a very large U.S. manufacturing corporation. The division produces a number of consumer products for sale to the corporation's customers. The consumer products vary in design but are sufficiently similar to be built from a generic set of about 250 inputs. In addition to having design differences, inputs may be manufactured with varying grades of material that affect the quality of the consumer product.

The design, production, and marketing of consumer products are organized through product programs within the assembly division. These programs form an important subdimension of the division's structure, which is organized first around functions, e.g., engineering, marketing, and operations. Purchasing personnel within the operations department establish and manage relationships with suppliers, both inside and outside the corporation. The purchasing function is organized first by product program and then by type of input, e.g., electronics, plastic moldings.

**Supply relationships with component manufacturing divisions.** Over 50 percent of the inputs to the assembly division come from component-manufacturing divisions, operated as profit centers, within the corporation. The component divisions sell their output to the assembly division, to other corporate units, and to customers in the market outside the corporation. Supply relationships between the assembly division and component divisions were virtually mandated until several years before the present study was initiated (see Eccles, 1985, for a description of inter-profit-center contracting modes). At that time, corporate management perceived that the production costs of the assembly division's product-market competitors were lower than the assembly division's costs for products of equal quality. Lower costs meant that these competitors were earning a greater financial return than the assembly division. They were also a threat to the assembly division's market share. Market share in turn was a critical determinant of the division's costs because of the large economies of scale required for efficient operations. Furthermore, it was apparent that competitors were less vertically integrated than the corporation investigated here. Since a major source of the assembly division's costs were inputs from the component divisions, it was necessary to assess the production-cost competitiveness of these divisions. The corporation therefore released the assembly division from its mandated relationships with the component divisions and allowed it to force them to compete with potential outside suppliers. This new policy of exchange autonomy (Eccles, 1985) created a more adversarial atmosphere between the assembly division and the component divisions than had existed under the policy of mandated relationships.

**Relationships with outside suppliers.** At the time of our study the assembly division's relationships with its outside

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suppliers strongly resembled MacNeil's (1978) concept of relational contracting. This resemblance was due to a policy the assembly division had implemented, three years before our data were collected, to reduce its supplier base and change its practices for managing suppliers. Under the new policy, the assembly division moved from competitive bidding to a system based on the assembly division's target price for the input. In addition, before the new policies were implemented, suppliers were contractually obligated to absorb changes in material costs. The new policies replaced this obligation with negotiated adjustments based on an evaluation of supplier costs. Suppliers, moreover, were expected to improve their productivity and quality continuously. These changes increased the level of information exchange with suppliers, especially regarding costs. The relationship with the supplier, under these terms, was expected to last for the duration of the consumer-product program, which could exceed five years. Since the supplier was likely to be the only source of the input to the program, supplier expectations of a long-term, exclusive relationship were created. These expectations were likely to lead suppliers to attenuate short-term conflict over cost allocation, consistent with relational contracting behavior.

The new policy was not risk-free. Since an outside supplier was likely to be the single source of an input, it was highly likely that the assets of the supplier would become at least partly specialized over time to the assembly division's operating practices. More specialized assets would raise the division's cost of switching to a new supplier if the current supplier performed poorly. This potential attenuation of the supplier markets for the division's inputs may have also made it more difficult to assess the competitiveness of outside suppliers' performance.

To reduce the potential supplier-management problems associated with high switching costs and low supplier market competition, the division chose suppliers that consistently performed better than their competitors. The likelihood that future assembly-division requirements would be met effectively was thereby increased, for two reasons: (1) the capabilities of the suppliers were higher; and (2) the consistent high performance of the suppliers represented an investment in reputation that would be damaged if they began to take advantage of their new close relationship with the assembly division. Finally, because an outside supplier chosen in the supplier-reduction program was likely to deliver more than one input to the division and was expected to meet all of the division's demand for each input, the division constituted a larger percentage of the supplier's total volume. The division's bargaining position in conflicts with the supplier was thereby increased.

**Background field research.** To ground our theory in the experience of assembly division managers, we interviewed personnel in purchasing, engineering, and logistics over a period of three years. The supplier-reduction program and exchange-autonomy policy with component divisions were implemented during this period. Five group meetings were held with purchasing and engineering managers. In these

meetings the managers presented cases illustrating the determinants of both in-house and outside supplier performance. These cases provided important data on the type of information purchasing managers had about suppliers and on their perceptions of effective supplier relationships. During the last two years of this field research we visited a component division to investigate differences between selling inside and outside the corporation. We also observed the extent to which the component division made its investment decisions in response to assembly-division requirements. Finally, over an eight-month period during the third year, we observed weekly meetings between assembly-division personnel and market suppliers that were part of the assembly division's cost-reduction program. The interview, case, and observation data gathered during this phase of the study suggested that the theory proposed above was closely applicable to the supplier-management problems of the assembly division. These data also suggested how to operationalize our variables.

### **Variables**

*Transaction costs.* We defined transaction costs as the difficulty experienced by the assembly division in reaching agreement with its suppliers on the allocation of adjustment costs. Difficulty in reaching interunit agreement on cost allocation specifically measures the intensity of bargaining over adjustment costs. Although the structure and intensity of the bargaining situation may be affected by institutional factors, as we hypothesize, they do not determine its definition or measurement. Thus we believe that our narrow operationalization of transaction costs excludes any obvious confounding by institutional factors and thus addresses the critiques of both Demsetz (1988) and Dow (1987) regarding transaction-cost measurement. Demsetz (1988) asserted that the costs an organization incurs in managing its resources are not comparable to transaction costs. He defined management costs quite broadly, more as general administrative costs than as expenses related to coordinating specific activities. Transaction costs, however, are defined narrowly as the "costs of negotiating" in relationships with suppliers (Demsetz: 151, note 5). Similarly, Dow (1987) argued that in both organizations and markets the assessment of interunit agreement must be separated from the institutional resources required to achieve it. This implies that the efficiency of transactions should be compared across institutions, independent of the institutional factors that shape transaction characteristics (Dow, 1987: 19). If this criterion is not met, Demsetz's critique of transaction-cost theory in terms of the incomparability of management and transaction costs must be reckoned with.

Dow also argued that interunit adaptation and agreement on how it should be achieved are important elements in evaluating the efficiency of interunit relationships. Our definition of transaction costs combines these elements. Adjustment costs in supply relationships represent the costs of adaptation directly and are a focal point of supplier-management practice because of price competition in the assembly division's product market. Agreement over cost allocation is an important goal of negotiations with suppliers, since it is a condition for effective adaptation.

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We measured allocation difficulties for two causes of adjustment cost: engineering changes and changes in the costs of raw material inputs to component fabrication. Engineering changes and changes in material costs have different origins, but both may lead to higher transaction costs. Engineering changes originate in the assembly division but are not under the control of division purchasing. Purchasing does experience, however, the ensuing conflict with the supplier over the adjustment costs associated with the changes. In contrast, material cost changes originate in the markets supplying the division's suppliers. A division supplier must decide whether to absorb the costs and lower its profits or attempt to pass them on to the assembly division by requesting a price increase. Our measures of transaction costs are (1) the difficulty of agreement with the supplier on the allocation of costs due to engineering changes for the part (measured on a 7-point Likert-type scale) and (2) the difficulty of agreement with the supplier on the allocation of costs due to changes in material costs for the part (measured on a 7-point Likert-type scale).

*Asset specificity.* Asset specificity has been operationalized in many ways (Williamson, 1985: chap. 4). We measured the construct in terms of the uniqueness of the supplier's technical labor skills and manufacturing equipment for producing the product delivered to the assembly division. This operationalization is consistent with Klein, Crawford, and Alchian (1978: 300), who argued that unique assets enable suppliers to appropriate quasi-rents in the contracting process, and with Walker and Weber (1984), who used supplier proprietary technology as an (inverse) measure of supplier market competition. We measured asset specificity as (1) the extent to which the production of the part requires technical labor skills that are relatively unique to the supplier (measured on a 7-point Likert-type scale) and (2) the extent to which the production of the part requires manufacturing equipment that is relatively unique to the supplier (measured on a 7-point Likert-type scale).

*Preselection investment in technology.* We operationalized supplier preselection investment in new technology with one measure. Our hypothesis for supplier technology investment requires that the investment be made in order to increase the supplier's chances of selection. If the investment was made for other reasons, the proportion of nonredeployable assets is likely to be small. We measured whether the supplier invested in new technology to increase the likelihood of being selected as a supplier for this category of part (measured as yes or no).

*Supplier market competition.* Walker and Weber's (1984) supplier market competition construct was measured in part by variables that denoted the degree of competition directly. These variables were highly correlated (coefficient alpha = .7 for three variables) and had strong predictive validity. We chose to measure the variable that was most correlated with the construct ( $r = .975$ ) as our indicator of supplier market competition in the present study: the extent to which there are enough potential suppliers to ensure adequate competition at the commodity level for the provision of the input (on a 7-point Likert-type scale).

*Age of input technology.* We operationalized the age of input technology with two variables that focus on the input's design and manufacturing process: (1) the newness of the design technology of the input (measured on a 7-point Likert-type scale) and (2) the newness of the manufacturing process used to produce the input (measured on a 7-point Likert-type scale).

### Data Collection

**Sample selection.** We chose our sample of supplier relationships by drawing a random subset of 100 from the assembly division's 250 generic inputs. To collect data about the supplier relationships for this sample, we focused on supplier relationships for two consumer-product programs in the assembly division. Both of these programs were affected by the assembly division's new policies regarding the selection and management of suppliers both inside and outside the corporation.

**Questionnaire data.** We constructed a questionnaire for distribution to the purchasing managers of the assembly division who were responsible for selecting and managing suppliers for the two programs. During the period of background field work for the study, purchasing managers had demonstrated substantial knowledge about the division's internal suppliers and its external supplier markets. A subset of these managers reviewed the questionnaire to evaluate the accuracy and relevance of its concepts and language. The operationalizations of the variables listed above reflect the judgments of these managers. After review, the questionnaire was distributed to purchasing managers who were asked to provide information on relationships with suppliers for each input in the sample. We received usable questionnaires on 99 inputs. Forty-four inputs were procured from internal profit centers and 55 from outside suppliers. Thirty-two of these inputs were repeated for both consumer-product programs. Consequently, we received information on 67 of the 100 inputs in our random sample.<sup>2</sup> Eighty-nine percent of the market suppliers in our sample were single-source suppliers and all but one of the remaining 11 percent had contracts that guaranteed a fixed percentage of the division's volume.

**Key-informant bias.** We measured the variables by using managers' responses to questionnaire items. The use of this kind of subjective data has been common in research on transaction costs (Monteverde and Teece, 1982; Anderson and Schmittlein, 1984; Masten, 1984; Walker and Weber, 1984); and although none of these studies has measured transaction costs directly, their results have shown strong construct and predictive validity for transaction-cost determinants. However, there are several causes for concern about using subjective data.

Results from analyses of variables measured using subjective responses may have limited external validity because they may be confounded by perceptual bias. Our use of purchasing managers as key informants may bias our results toward the perspective of this function in the assembly division. However, Heide and John (1990) found in industrial components industries that buyers' and suppliers' perceptions of the degree to which supplier assets were specialized were strongly

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To see whether the subsample of 67 was representative, we compared the proportions of in-house and market suppliers in this sample to their proportions in the sample of 100. The proportions were not statistically different between the two samples.



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and significantly correlated. Their results indicate that the buyers have extensive and reliable knowledge of the supplier market, the kind of knowledge the assembly division's purchasing personnel displayed in our conversations with them. Heide and John's findings also suggest that the emphasis transaction-cost studies place on the judgment of the buying unit is not misplaced. Transaction-cost research on vertical integration has typically focused on the buyer, since the buyer's experiences and interpretations of the supplier's behavior determine subsequent integration or deintegration decisions. The significant correlation of the buyer's and supplier's judgments of supplier asset specialization provides evidence that the buyer can accurately perceive the causes of potential supplier opportunism.

Key-informant bias may also be present due to differences in the supplier selection and management practices of the two consumer-product programs to which our respondents belong. We tested for these differences, as described below. Finally, each manager may have his or her own bias in responding to our instrument. Unfortunately, because information on each product in our sample was provided by a single manager, we were unable to separate true information about the product from systematic respondent bias due to individual differences. Since our questions referred to objective phenomena in managers' experiences with suppliers and were clearly understood by our respondents, we feel confident that subjective bias in our data should be low. Nonetheless, we addressed this problem in a variety of ways, as discussed below.

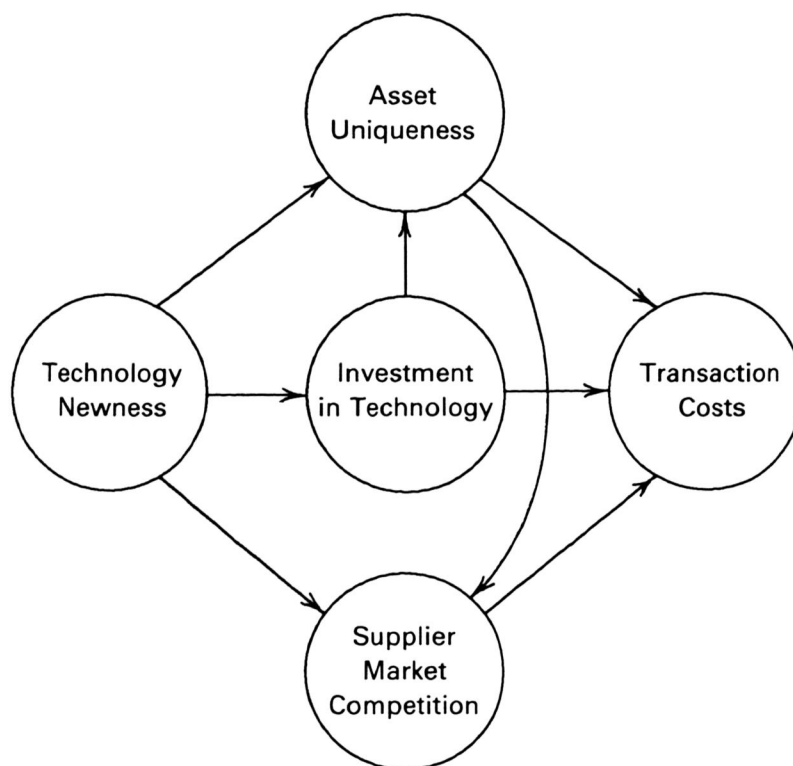
## Analysis

**Hypothesis testing.** We represented the hypotheses as a multiple-indicator structural equation model (Bagozzi and Phillips, 1982) estimated using the maximum-likelihood method of LISREL VI (Jöreskog and Sörbom, 1984). The model for the hypotheses, using our measures, is presented in Figure 1. In Figure 2 we present the model using Greek letters, by convention, to represent the parameters we estimated.

We tested the hypotheses by constraining the parameter representing a hypothesized relationship to be equal for both groups of suppliers, then allowing the parameter to be different between the groups. The difference in chi-square between these two estimates of a parameter indicates whether there is a difference between profit centers and market suppliers.

**Comparison of means for types of supplier.** By analyzing the moments matrices of profit centers and market suppliers we tested our hypotheses and compared the means of the two types of suppliers at the same time (see Jöreskog and Sörbom, 1984: chap. 5; Byrne, Shavelson, and Muthen, 1989). The means were compared on the five constructs in our model: difficulty in allocating adjustment costs, asset specificity, preselection investment in technology, supplier market competition, and age of input technology. This test replicates the conventional transaction-cost assessment of the organization-market dichotomy. To the extent that the

**Figure 1. Input technology and predictors of transaction costs.**



means of the two types of supplier do not differ on these constructs, the market-organization dichotomy is blurred.

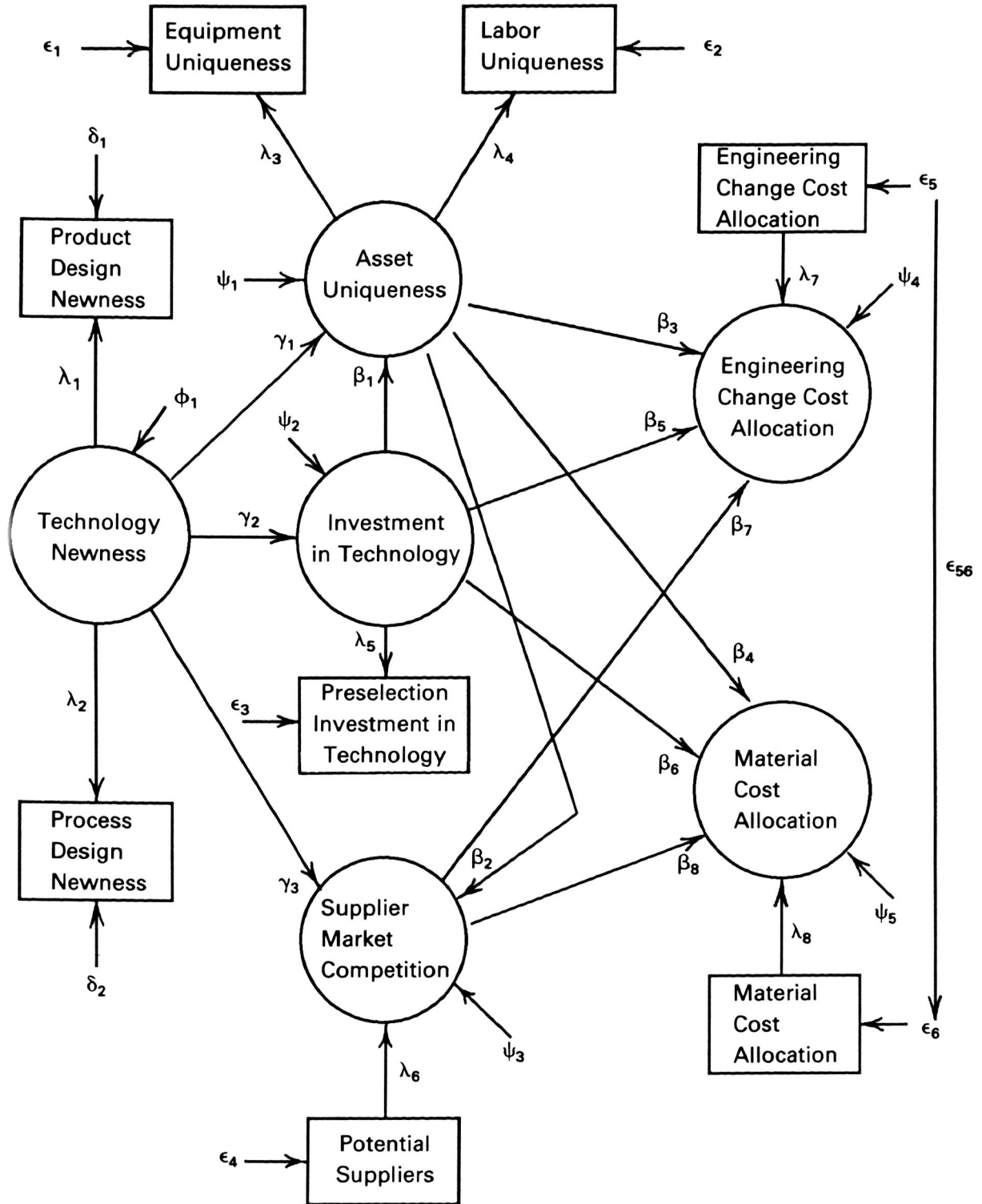
**Jackknife estimates of the parameters.** Maximum-likelihood estimation of structural equation models assumes that each variable has a normal distribution. However, Monte Carlo tests have shown that although the estimates are robust for strong violations of this assumption (Sharma, Durvasula, and Dillon, 1989), the standard errors of these estimates are not robust. Since our variables clearly violate the assumption of multivariate normality, we jackknifed (Mosteller and Tukey, 1977: chap. 7) the maximum-likelihood results to obtain new estimates and standard errors that are not based on distributional assumptions.

**Model specification.** To eliminate a Heywood case (an estimate of a negative variance) that appeared in our initial run (for  $\delta_2$  in Figure 2), we estimated the parameters in the model following Rindskopf's (1984) method. Following Rindskopf, we reconstructed the model so that error terms were estimated as exogenous variables; the parameters estimating the error terms were then squared to calculate the error variances, which could not be negative. However, for simplicity, the results are reported using the notation in the model shown in Figure 2.

**Assessment of key-informant bias.** We assessed potential key-informant bias in our results in three ways. First, it is possible that bias was introduced because respondents belonged to the two product programs that may have differed on unobservable characteristics. We assessed this potential confounding of our results by regressing the two programs on all the variables in a logistic regression. If these variables pre-

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Figure 2. Model predicting transaction costs, including both measurement and causal paths.



dict the programs, thereby indicating significant differences between them, the programs may confound the structural equation model results. Second, key-informant bias might be present in the effect of outliers on the maximum-likelihood estimates. The jackknife procedure assesses this effect. The closer the jackknife estimates are to the maximum-likelihood values, the less likely it is that problem outliers exist in the

data. Finally, key-informant bias might be manifested through correlated measurement error (Phillips, 1981). If the fit of our model to the data is good without specifying correlated measurement error, whatever bias might exist adds little to the explanatory power of the model. To assess the goodness of fit of the model to the data, we report the  $\chi^2$  goodness-of-fit test using the maximum-likelihood estimates. This test is a rough approximation of fit, since it is sensitive to sample size and assumes that the data are multivariate normal. Consequently, we also used the Type II parsimonious normed-fit index (Mulaik et al., 1989), which takes into account both sample size and the parsimony of the model.

## RESULTS

The correlation matrices, means, and standard deviations of the variables are shown in Table 1. The correlation matrices for profit centers and outside suppliers indicate that the two types of transaction costs, although significantly correlated, are not adequate indicators of a single construct. The correlations between the two variables are not high enough to suggest a strong coefficient of reliability. Furthermore, the correlations between the two indicators and the other vari-

Table 1

<b>Means, Standard Deviations and Correlations</b>									
Variable	Mean	S.D.	1	2	3	4	5	6	7
<b>Profit centers</b>									
1. Product design newness	3.33	1.38	–						
2. Process design newness	3.20	1.69	.79	–					
3. Labor uniqueness	3.81	1.71	.43	.50	–				
4. Equipment uniqueness	4.64	2.09	.46	.50	.84	–			
5. Investment in technology	1.61	.50	–.45	–.71	–.42	–.41	–		
6. Supplier market competition	3.93	1.60	–.08	–.02	–.52	–.62	.08	–	
7. Engineering cost allocation	3.34	1.77	–.15	–.10	.11	.23	–.04	–.55	–
8. Material cost allocation	2.89	1.56	–.29	–.26	–.36	–.42	.03	.01	.30
<b>Outside suppliers</b>									
1. Product design newness	2.80	1.78	–						
2. Process design newness	2.46	1.59	.73	–					
3. Labor uniqueness	3.19	1.91	.33	.46	–				
4. Equipment uniqueness	3.61	2.00	.53	.64	.60	–			
5. Investment technology	1.71	.46	–.16	–.40	–.31	–.32	–		
6. Supplier market competition	5.10	1.56	–.36	–.19	–.08	–.45	.17	–	
7. Engineering cost allocation	2.80	1.69	.02	.23	.31	.19	–.29	–.00	–
8. Material cost allocation	2.76	1.60	.06	.20	.28	.25	–.39	–.10	.58

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ables are clearly different in magnitude, suggesting low concurrent validity and strong potential for interpretational confounding (Burt, 1976). Consequently, we predicted each indicator separately. To control for potential bias due to common measurement properties of the two transaction-cost indicators, we estimated the covariance between their measurement errors ( $\epsilon_{56}$ ).

Table 2 presents the results for construct validation. The covariance between the indicators of transaction costs ( $\epsilon_{56}$ ) is statistically significant and does not differ across the two types of supplier ( $\chi^2 \text{dif}_1 = .78, p = .62$ ). This result suggests that both measures are related to an unobserved construct, but not strongly enough so that it constitutes a latent variable in the model. The implications of this finding for the measurement of transaction costs are elaborated below.

The results also show that our measures of asset uniqueness have significantly less error in profit centers than in outside suppliers ( $\chi^2 \text{dif}_3 = 11.3, p = .01$ ). However, the reliability of the construct (Bagozzi, 1980: 181) in each group is acceptable (.89 for the profit centers; .78 for the outside suppliers). The two types of suppliers do not differ in the measurement of technology newness ( $\chi^2 \text{dif}_3 = 7.09, p = .07$ ; reliability = .87).

Table 3 shows that the two types of suppliers differ in their mean values only for the construct of market competition. Profit centers have lower competition than market suppliers, consistent with Walker and Weber's (1984) results. These findings support our assertion that the two types of supply relationships are embedded in hybrid institutions.

Table 4 shows the findings for the three hypotheses and other causal paths. H1 is supported: asset uniqueness leads

Table 2

<b>Maximum-Likelihood Estimates for Construct Validation of Technology Newness, Asset Uniqueness, and Transaction Costs*</b>				
Parameter	Unstandardized M.L.E.	Standardized M.L.E.	Jackknife estimate of M.L.E.	$\chi^2$ Difference between profit centers and outside suppliers
Technology newness				7.09
$\lambda_1$	1.00	.76	–	
$\lambda_2$	1.36	1.00	1.78† (.14)	
$\delta_1$	1.07	.65	–	
$\delta_2$	0.00	0.00	–	
Asset uniqueness				11.3*
Profit centers				
$\lambda_3$	1.00	.75	–	
$\lambda_4$	1.45	.96	1.44† (.12)	
$\epsilon_1$	.87	.21	–	
$\epsilon_2$	.46	.04	–	
Outside suppliers				
$\lambda_3$	1.00	.75	–	
$\lambda_4$	1.49	.99	1.56† (.12)	
$\epsilon_1$	1.49	.62	–	
$\epsilon_2$	.45	.04	–	
Transaction costs				
$\epsilon_{56}$	.44	.44	.42† (.06)	.78

•  $p < .05$ .

\* Standard errors are in parentheses.

†  $|T| > 2$ .



Table 3

**Differences in Construct Means between Profit Centers and Outside Suppliers**

Variable	Unstandardized M.L.E.	Standardized M.L.E.	Jackknife of M.L.E.	Jackknife S.E.
Technology newness	.55	.44	.36	.27
Asset uniqueness	.34	.24	.39	.26
Investment in technology	.02	.04	.03	.06
Supplier market competition	-.81	-.47	-.82*	.26
Engineering cost allocation	-.16	-.09	-.16	.60
Material cost allocation	.12	.07	.07	.33

\*  $|T| > 2$ .

to lower interunit conflict for profit centers than for outside suppliers (for engineering cost allocation,  $\chi^2_{dof_1} = 3.95$ ,  $p = .047$ ; for material cost allocation,  $\chi^2_{dof_1} = 8.51$ ,  $p = .004$ ). Interestingly, higher levels of asset uniqueness lead to lower levels of conflict for profit centers but have no effect on conflict for outside suppliers (compare estimates of  $\beta_3$  and  $\beta_4$  between the two types of suppliers).

In contrast, both H2 and H3 are disconfirmed. Preselection investment in technology leads to greater difficulty in reaching interunit agreement regarding cost allocation ( $\beta_5$  and  $\beta_6$ ) for both profit centers and outside suppliers. The coefficients are not significantly different between the two types of suppliers (engineering cost allocation,  $\chi^2_{dof_1} = .60$ ,  $p = .44$ ; material cost allocation,  $\chi^2_{dof_1} = .00$ ,  $p = 1.0$ ). Furthermore, contrary to expectations, supplier market competition predicts lower interunit conflict for profit centers than for outside suppliers (engineering cost allocation,  $\chi^2_{dof_1} = 13.9$ ,  $p = .001$ ; material cost allocation,  $\chi^2_{dof_1} = 5.78$ ,  $p = .017$ ). Like asset specificity, higher market competition leads to less conflict ( $\beta_7$  and  $\beta_8$ ) for the component divisions but has no effect for outside suppliers.

The effects of technological age on asset specialization and supplier market competition do not vary between profit centers and outside suppliers ( $\chi^2_{dof_1} = .74$ ,  $p = .39$ ; and  $\chi^2_{dof_1} = .31$ ,  $p = .58$ , respectively). Thus, we can be reasonably certain that technology differences between the two types of suppliers do not bias our results. Interestingly, for both types of suppliers, newer technology relates to both greater asset uniqueness and greater supplier market competition ( $\gamma_1$  and  $\gamma_3$ , respectively).

Asset uniqueness and supplier market competition are negatively related ( $\beta_2$ ), as expected. But, contrary to expectation, preselection investment in technology does not affect asset uniqueness ( $\beta_1$ ). These results are the same for both profit centers and outside suppliers ( $\chi^2_{dof_1} = .27$ ,  $p = .61$ ; and  $\chi^2_{dof_1} = 1.07$ ,  $p = .31$ , respectively).

Finally, key-informant bias does not appear to confound our findings. The logistic regression results presented in Table 5 show that none of the variables we studied are related to the two product programs. Thus the programs are not an important omitted variable in the model. Also, in general, the jackknife values are reasonably close to the maximum-likelihood

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Table 4

<b>Results for Hypotheses</b>				
Parameter	Unstandardized M.L.E.	Standardized M.L.E.	Jackknife estimate of M.L.E.	$\chi^2$ Difference between profit centers and outside suppliers
Hypothesis 1				
Profit centers				
$\beta_3$	-.40	-.32	-.45† (.17)*	3.9*
$\beta_4$	-.99	-.88	-1.03† (.23)	8.5*
Outside suppliers				
$\beta_3$	.27	.21	.23 (.28)	
$\beta_4$	.22	.19	.19 (.22)	
Hypothesis 2				
Profit centers				
$\beta_5$	-.67	-.18	-.76† (.20)	.60
$\beta_6$	-1.09	-.32	-1.07† (.31)	.00
Hypothesis 3				
Profit centers				
$\beta_7$	-.82	-.80	-.85† (.18)	13.9*
$\beta_8$	-.51	-.55	-.55† (.21)	5.8*
Outside suppliers				
$\beta_7$	.13	.13	.11 (.22)	
$\beta_8$	.03	.04	-.02 (.12)	
Estimates for other causal paths				
$\gamma_1$	.62	.54	.77† (.11)	.74
$\gamma_2$	-.22	-.57	-.29† (.03)	3.75
$\gamma_3$	.42	.30	.52† (.21)	.31
$\beta_1$	-.23	.08	-.26 (.39)	1.07
$\beta_2$	-.85	.69	-.83† (.15)	.27
Estimates for error terms				
$\phi_{11}$	1.19	.96	.83† (.09)	
$\psi_{11}$	1.07	.76	1.12† (.08)	
$\psi_{22}$	.39	.83	.39† (.02)	
$\psi_{33}$	1.25	.72	1.56† (.24)	
$\psi_{44}$	1.51	.86	1.57† (.17)	
$\psi_{55}$	1.35	.85	1.33† (.15)	

\*  $p < .05$ .

\* Standard errors are in parentheses.

†  $|T| > 2$ .

estimates, suggesting that outliers are not a major contributor to the results.

The chi-square goodness of fit for the model shows that we cannot reject it ( $\chi^2_{df,44} = 52.99, p = .17$ ). This statistic suggests that there is no unspecified systematic structure of the

Table 5

<b>Logistic Regression of Product Program on Product Technology and Predictors of Transaction Costs</b>				
Variable	Parameter	S.E.	$\chi^2$	$p$
Intercept	2.15	2.17	.97	.33
Supplier market competition	-.18	.20	.78	.38
Labor uniqueness	.17	.19	.86	.36
Equipment uniqueness	-.25	.21	1.54	.22
Investment in technology	-.04	.62	.00	.94
Engineering cost allocation	-.02	.16	.02	.89
Material cost allocation	-.04	.17	.04	.83
Product design newness	-.12	.23	.30	.58
Process design newness	-.19	.27	.54	.46
Likelihood ratio: $\chi^2$ (59 d.f.) = 91.03; $p = .005$ .				

error terms that might represent key-informant bias. Also, the Type II parsimonious normed goodness of fit index is .96. The model is thus a good fit to the data, controlling for the number of parameters estimated and our small sample size.

## DISCUSSION AND CONCLUSIONS

Do organizations and markets govern transactions differently? Our answer is a highly qualified yes. The basic proposition of transaction-cost economics is sound: supplier asset specificity within the corporation is associated with lower transaction costs than asset specificity in the market. However, our results stretch and reshape the theory in ways that partially support its critics. These changes are related to the hybrid characteristics of the organization and markets we studied.

Decentralization in the corporation and relational contracting with market suppliers affect supplier relations in ways that strike at traditional research on transaction costs. The means of the profit centers and outside suppliers differ only in their degree of market competition. Thus a conventional test of transaction-cost theory, which compares the level of asset specificity inside and outside an organization, would fail. This failure supports arguments (Stinchcombe, 1983; Eccles and White, 1988) that hybrid organizations and markets are more similar than transaction-cost theory proposes. Moreover, because in-house and market supply have the same level of interunit conflict, a process of institutional selection based on transaction costs would not favor one type of supplier over the other.

Although in-house and market supply relationships appear to be hybrid or nonstandard, H1 is supported. This result is confounded neither by age of technology nor by extent of competition. We infer that the coordination mechanisms the division uses to manage specialized inputs in-house are simply more effective than the mechanisms available in the market. This is the essence of the transaction-cost theory of vertical integration. However, because support of H1 may be related to better in-house management of new technologies rather than to specialized assets, we estimated the direct relationship between age of technology and both types of cost allocation. The estimates were not significant ( $\chi^2_{dif_1} = .53$ , for engineering change cost allocation difficulties;  $\chi^2_{dif_1} = .52$ , for material cost allocation difficulties).

How much in-house coordination mechanisms represent the old centralized control of profit-center relationships, as opposed to new practices, has important implications for interpreting the results for H1. Two examples, both focused on the relationship between new technology and asset specialization, highlight the difference between old and new mechanisms. One important, enduring old practice is that a large, relatively powerful centralized engineering staff coordinates the development of new technologies in the component divisions. Technologies that create unique assets are especially salient, since they give the corporation a potential edge over its competitors. The corporation gains, however, only if a component division adapts a technology successfully to an assembly division's needs. For this reason, and because suc-

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Successful adaptation of the technology leads to learning about its generalizability, staff engineers have an incentive to help resolve problems between the profit centers and the assembly division. We frequently observed staff engineers in consultative roles, both in the assembly division and in the component divisions. No such role for these engineers was observed in relationships with outside suppliers.

An example of a new coordination mechanism developed to improve the effectiveness of supplier operations, both inside and outside the corporation, is "early sourcing," which has long been a practice in Japanese manufacturing firms (see Rubinger, 1985) and is becoming widely adopted by U.S. manufacturing organizations (*Purchasing Magazine*, 1985). The major goals of early sourcing are to utilize the supplier's technological expertise and to create a product design compatible with the supplier's manufacturing facilities, leading to lower costs and higher quality. Suppliers participating in early sourcing are brought into the process of developing a product either as it is being designed by the buyer's engineers or as the technology itself is being developed. This practice contrasts with traditional supplier involvement, which typically occurs after the first product prototype is made, long after technology development and product design have been completed. Early sourcing gives the buyer more information about the supplier's capabilities and its cost structure. Furthermore, inputs that are early-sourced from component divisions tend to be produced with more unique assets than early-sourced inputs from outside suppliers.<sup>3</sup> Therefore, because of better information, negotiations over cost allocation for unique assets in the profit centers may be less difficult than negotiations for comparable assets in outside suppliers.

We cannot say whether H1 is supported because of the vestiges of centralization or the successful management of decentralization, or both. If only old centralized practices are effective and they decline as decentralization takes hold, we would expect to see transaction costs rise in the corporation. If effective new practices can replace the old, then transaction costs will remain lower for unique assets in the corporation.

These alternative scenarios for interunit coordination show that our results for H1 support the transaction-cost framework more as a theory of organization design than as a theory predicting changes in the boundary of the firm. The important difference between transaction-cost theory and other theories of organization design is that it compares relationships within an organization to market contracting. The theory is silent, however, on how to compare coordination mechanisms between organizations or within the same organization over time.<sup>4</sup> Such a comparison would be a necessary part of analyzing a single organization's move from central to decentralized control over supplier relations. Further development of the theory is therefore required to address the issues our supportive findings raise.

It seems clear, moreover, that although H1 is supported, the corporation is unlikely to vertically integrate specialized outside suppliers. By lowering the potential for opportunistic behavior, relational contracting reduces the transaction costs

### 3

Regressions show a significant relationship between early sourcing and asset uniqueness ( $p < .10$ ) for profit centers, controlling for technology newness, but no relationship for outside suppliers. Like technology newness, early sourcing has no direct effect on transaction costs.

### 4

Williamson's theory (1975: chap. 8; 1985: chap. 11) regarding the efficiency of the multidivisional form addresses the problem of reducing unnecessary coordination between divisions rather than improving necessary coordination.

associated with specialized market suppliers, even though they have new technology and low competition. Because specialized outside suppliers do not cause the corporation to incur high transaction costs, they are unlikely to be candidates for integration. This finding supports Coase (1988) in his assertion that asset specificity is not a sufficient condition for vertical integration (cf. Klein, 1988, and Williamson, 1988).

Relational contracting not only decreases the threat of vertical integration, but it also reduces the threat that outside suppliers will be terminated. Decentralization has the opposite effect on in-house units: it increases the threat of termination. The net outcome is that market competition leads to greater cooperation in-house, contrary to H3. Thus in-house suppliers are apparently not protected by an internal procurement bias. Since market incentives are viable within the corporation for standard inputs, the costs of managing them are likely to be low and may approach the costs of managing standard inputs with new technology in the market under relational contracting. This result challenges the assumption in transaction-cost theory that the market manages all standard assets more efficiently (e.g., Williamson, 1981; Masten, 1984; Riordan and Williamson, 1985).

Neither decentralization nor relational contracting have a salubrious effect on the behavior of suppliers that have made preselection investments in new technology. Unexpectedly, these investments do not involve specialized assets, suggesting that these suppliers are unlikely to participate in buyer programs such as early sourcing. Nor are the markets for these products highly competitive. Therefore, within the corporation, profit centers with new technology investments are influenced neither by the coordination mechanisms to manage specialized suppliers nor by the discipline of market competition. Outside the corporation, relational contracting may break down because of the need to cover the high fixed costs of new investment in an emerging market.

**External validity.** Our variables may have limited external validity because they do not measure dollar prices or costs. This limitation is characteristic of research on transaction-cost theory. The "microanalytic" focus that Williamson (1985: 403) advocated has led researchers to measure managerial experience in a number of institutional contexts. Generalizing the constructs underlying these measures and the logic connecting the constructs is a primary research task to which the present study contributes.

Our measurement of transaction costs illuminates some problems in developing a single, generalizable construct. The covariation of measurement error between the transaction-cost indicators ( $\epsilon_{56}$ ) may represent their shared content: the difficulty of agreeing on adjustment-cost allocation. In turn, the poor convergent validity of the measures may be due to unshared content: the different causes of adjustment costs—engineering changes and material cost changes—that they capture. This result suggests that estimating the process of achieving agreement with a supplier may be separated from the substantive issues about which agreement is reached.

Measuring more broadly defined transaction costs is therefore likely to be at least as complex as our problem here,



## Transaction Costs

since they include both interunit conflict and governance costs. To reduce this complexity, future researchers may choose to decompose broad concepts into their unique contents, e.g., product design changes, and predict each content with a separate theory. This theory should be tailored to the practices and policies that can be tied to the specific content predicted. Since our predictions for engineering and material cost changes were similar, we infer that their institutional contexts were comparable.

Several distinguishing characteristics of our sample and method deserve to be discussed. First, in contrast to previous transaction-cost studies, which typically have analyzed convenience samples, we analyzed a random sample from the complete product list of the division. Thus we can be reasonably confident that our results generalize to the population of assembly division inputs. Second, like Walker and Weber (1984), but unlike authors of other previous studies, we simultaneously tested our hypotheses and estimated a measurement model. We thereby identified that part of the covariance among the variables due to measurement alone. Third, our knowledge of how our theory applies to the institutional context in which it was tested not only increased the study's internal validity but indicates the type of organization and supplier relationships to which our model and results apply. Because supplier reduction and "outsourcing" programs have been adopted by many U.S. manufacturing firms, we believe our model may have reasonably wide applicability.

**Conclusion.** While defending the core of transaction-cost theory, our findings raise questions concerning how the theory should be applied to complex economic institutions facing strong competition in their product markets. Corporate decentralization and relational contracting diminish the role of asset specialization as a necessary condition for low transaction costs in-house and as a sufficient condition for high transaction costs in the market. Therefore, how the theory should be used as a predictor of shifts in the current boundaries of the corporation is unclear.

We suspect that the effect of in-house asset specialization on transaction costs reflects both enduring supplier governance practices and new policies designed to improve supplier performance. How and when, in the history of an organization, supplier asset specialization determines the organization's boundaries thus becomes a critical question. Careful research on the separate origins and consequences of in-house and market governance is therefore a necessary and central research agenda for transaction-cost theory.

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