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Institutional Choice and the Organization of Production: The Make-or-Buy Decision

by

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1. Introduction

Having selected an end-product line, a producer must decide which in the stream of intermediate products and processes successively combining to form his eventual output to administer himself and which to delegate to outside suppliers, along with the terms under which any external procurements would take place. The transaction-cost literature has provided a number of insights into the factors likely to affect the outcome of such decisions (e.g., see WILLIAMSON [1975, 1979]; and KLEIN, CRAWFORD and ALCHIAN [1978]). But because of the mainly verbal arguments adopted by these authors, some questions have remained regarding the generality and validity of their hypotheses.

This paper employs some simple but plausible assumptions about the incidence of bargaining and contracting costs to model this series of procurement decisions – sometimes referred to as a firm's make-or-buy program – as part of a producer's overall optimization problem. In addition to identifying conditions under which the transaction-cost arguments can be expected to hold, the model permits investigation of a number of interactions and relationships not readily amenable to verbal analysis. For example, the degree to which specialized investments are adopted to support production is often a matter of discretion to the parties involved: the hazards of exchange that arise in the presence of such investments may induce the parties to choose more standardized designs or to invest less than would otherwise be optimal. Whereas earlier arguments have taken the extent of asset specificity as given, this analysis determines the level of investment in transaction-specific assets under each organizational arrangement endogenously. The model also permits an investigation of the factors affecting the choice of contract length governing external

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procurements. It is shown that the motivation for risk neutral agents to write long term contracts arises because of the real costs incurred in bargaining at contract renewal time rather than from a desire to control the distribution of the gains from trade *per se*.

The following section introduces the model and section 3 characterizes the behavior of agents in a vertical supply relationship under internal and external organization. The effects of asset specificity and uncertainty on optimal contract length are examined, and a tendency to underinvest in transaction-specific assets under external procurement is demonstrated. Comparisons of the relative efficiencies of internal and external organization as a function of the degree of uncertainty associated with the transaction and of the profitability and durability of transaction-specific investments are taken up in section 4. Concluding comments appear in a final section.

2. *The Model*

Transaction-specific investments result when physical or human capital is specially designed or located for a particular use or user and, consequently, has a discretely lower value in its next best use. Thought of in spatial terms, the decision to invest in a transaction-specific asset is comparable to the selection of a more or less unique product, process or site along a continuum of characteristics, technologies or locations. Examples of such investments appearing in procurement manuals include "preproduction engineering, special tooling, special plant rearrangement, training programs and such nonrecurring costs as initial rework, initial spoilage and pilot runs."[1]

In general, the extent to which a producer is willing to undertake specialized investments will affect the value of his operation; special designs or locations may either reduce production costs or raise the value of final products. The hazard is that, because such investments usually have a significantly lower value in their next best alternative application, large expenditures leave greater amounts at stake if the transaction does not, for one reason or another, take place. As a result, agents may be reluctant to commit themselves to transaction-specific relationships.

The problem for the downstream producer (or buyer) is to decide whether to make the investment himself and thus internalize the transaction, or to procure his input needs externally. If he decides to vertically integrate production, he must choose a level of investment and supervise its operation. If,

[1] Defense Acquisition Regulations, paragraph 32,866. The model presented here is formally most similar to the efficient breach models of ROGERSON [1984] and SHAVELL [1980]. The decision to invest in a transaction-specific asset is equivalent to the reliance decision of those models.

alternatively, he buys from an outside supplier, the upstream firm (or seller) would then choose the level at which to invest, contingent on the returns he expects to receive from subsequent sales to the buyer. The make-or-buy decision involves the producer choosing that mode of procurement which maximizes his expected profits.

To model this, let λ be a measure of the extent to which undertaking specialized investments raises the value of the transaction, r be the level of transaction-specific investments actually undertaken, and define the following:

$(1+\lambda)v(r)$ = the value of the investment in its intended use (assumed to accrue to the downstream firm and gross of any payments to the upstream producer);

$v(r)$ = the value of the investment in its next best alternative application (assumed to accrue to the investing party); and

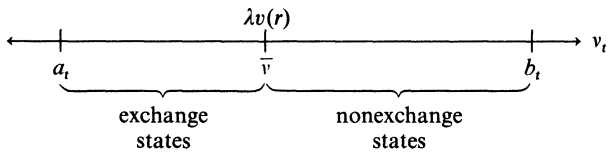
v_t = the net revenue of the downstream firm from engaging in some alternative profit opportunity, which is a random variable distributed continuously within (a_t, b_t) (see below).

Thus, if the investment were used in its intended use, the net value of the transaction would be $(1+\lambda)v(r)$; while if the transaction did not take place and all resources were used in their next best applications, the net gains would be $v(r)+v_t$. The difference between these values represents the quasi-rents at stake in a given period, or $Q_t=(1+\lambda)v(r)-(v(r)+v_t)=\lambda v(r)-v_t$.

Assuming that it would never be profitable to invest in a transaction-specific asset for its secondary or scrap value alone (i.e., that $v'<1$), it follows that for a positive level of investment to be efficient, it must be true that $\lambda>0$ and $v'>0$. (In addition, it is assumed that $v''<0$.) Again, λ in this context may be interpreted as a measure of the profitability of transaction-specific investments: the greater λ, the greater the value of the assets in their specialized application relative to the alternatives.

Note that even if an investment is made, it may not be efficient to use it in its intended use ex post for high values of v_t; specifically, employing a transaction-specific investment in its intended application is efficient if and only if its value in that use is greater than or equal to its opportunity costs; or formally, if $(1+\lambda)v(r)\geqq v(r)+v_t$. Define $\bar{v}$ such that $\bar{v}=(1+\lambda)v(r)-v(r)=\lambda v(r)$. $\bar{v}$ is then the value of v_t for which it just becomes efficient to employ a specialized investment in its intended use ex post. Graphically we see that this value depends on both the profitability and the actual level of investment in specialized assets.

Those values of v_t for which it is efficient to employ the investment in its intended use will be referred to as *exchange states*, and those for which it is employed in some alternative application as *nonexchange states*. The asset is assumed to have a useful life or durability of T years.



In addition to the value of the goods and services procured, the net value of a transaction to the parties involved also depends on the costs of conducting the transaction itself. The important costs associated with external procurement are those of bargaining and contracting, and with internal procurement, the bureaucratic inefficiencies of large scale organization. With regard to the latter, it is assumed only that the additional demands placed on a manager's time and attention by internalizing successive transactions results in a positive administrative burden, the level of which will be denoted $\bar{B}$.[2] The assumptions adopted regarding bargaining and contracting costs are laid out below.

1. Bargaining costs: Parties to an exchange may actively seek to effect a favorable distribution of the gains from trade through a wide variety of strategies ranging from simple haggling to protracted, full-scale negotiations. Examples of bargaining tactics include the strategic withholding of information (see, e.g., HARRIS and TOWNSEND [1981], and in a context similar to that of the present paper, CROCKER [1983]) and efforts to commit to favorable bargaining positions (CRAWFORD [1982]). In addition to the considerable outlays of time and energy which may accompany bargaining efforts and the direct costs of establishing credible commitments, such behavior typically results in allocations which are not on the full information contract curve. All of these represent losses due to strategic bargaining.

The precise nature of the strategies available to an agent will, of course, have important implications for the practical design of institutional remedies. For present purposes, however, we abstract away from the actual tactics employed and assume only that individuals can affect the distribution of rents by engaging in bargaining. Specifically, let $\gamma = \Gamma(\psi_B, \psi_S)$ be the share of quasi-rents accruing to a transaction that is appropriated through bargaining by the seller, where ψ_B and ψ_S represent the resources devoted to bargaining by the buyer and seller, respectively. Assuming that the "bargaining technology," Γ, is strictly convex, it is shown in the appendix that the total amount spent on bargaining, $\psi^* = \psi_B^* + \psi_S^*$, is increasing in the level of quasi-rents, i.e., $\partial\psi^*/\partial Q > 0$.

2. Contracting costs: To avoid the costs of strategic bargaining in settings of repeated exchange, the parties may attempt to formalize a division of gains through a contract. Compliance with the terms of a contract is regulated by recourse to a third party in the event of a dispute. However, because

[2] Factors affecting the magnitude of $\bar{B}$ are considered to a greater extent in MASTEN [1982]. Also see WILLIAMSON [1975], chapter 7.

contracts are inevitably incomplete (TOWNSEND, [1979]), the greater the dispersion of future states of the world, i.e., the more uncertainty associated with a transaction, the greater the likelihood of being contractually locked into an unprofitable undertaking or of needing to litigate a breach. Since more uncertainty is associated with performance at distant than at proximate dates, the implicit costs of contracting will tend to be increasing and cumulative over the length of a contract covering repeated transactions.

To illustrate this, assume that the state of the world in any future period is serially correlated with the state that occurred in the previous period. Then $v_t = v_{t-1} + \theta$, where v_t is the state in period t and $\theta \in (\alpha, \beta)$ is a random variable. If we define $\omega = \beta - \alpha$ as the range of the distribution of θ, and $w_t = b_t - a_t$ as the range of v_t as preceived from time 0, it can be shown that $w_t = w_{t-1} + \omega$, and by recursive substitution, that $w_t = t \cdot \omega$.[3] Further assuming that the potential losses due to incomplete contracting are proportional to the range of possible contingencies, the expected costs of a contract of length τ would be

$$c(\tau, \omega) = \sum_{t=1}^{\tau} t \cdot \omega = \omega \frac{\tau(\tau+1)}{2} .$$

As a measure of the range of the distribution of θ, ω is intended to be a proxy for the level of uncertainty associated with the transaction. The principle advantage of this over other characterizations of contracting costs (c.f. DYE [1980]) is that it captures the effects of the interaction between the amount of uncertainty associated with a transaction and the distance of the relevant horizon on the hazards of long term contractual agreements.

3. *The Investment Decision*

This section characterizes the investment levels chosen under internal and external procurement and, in the case of the latter, the choice of contract terms adopted by the buyer. It is assumed that the probability distribution of v_t, $f(v, t)$, is known to both the buyer and the seller and that both are risk neutral.

3.1 Internal Organization

Consider first the investment decision when production is internalized within a single firm. For a given λ, expected profits for the firm are

[3] This is most easily seen by considering the extreme values which v is capable of taking in any period and then considering how much higher or lower v could be in the next period given that it takes either of the most extreme values in the previous period. The width of the distribution will increase by exactly ω over that in the preceding period.

$$E(\pi^*) = \int_0^T \int_{a_t}^{\bar{v}} (1+\lambda)v(r)f(v,t)\,dv\,dt + \int_0^T \int_{\bar{v}}^{b_t} (v_t + v(r))f(v,t)\,dv\,dt - r - \bar{B} \ .$$

The first expression on the right-hand side of this equation is the expected revenue over the life of the investment from its employment in its intended use, and the second term the expected revenue in nonexchange periods, i.e., when the firm undertakes an alternative profit opportunity and uses the investment in its secondary use. Again, r is the direct cost of investment and $\bar{B}$ the administrative burden of organizing an additional transaction within the firm.

The first-order condition characterizing the firm's choice of r is

$$\int_0^T \int_{a_t}^{\bar{v}} ((1+\lambda)v')f(v,t)\,dv\,dt + \int_0^T \int_{\bar{v}}^{b_t} v' f(v,t)\,dv\,dt = 1 \ , \tag{1}$$

or

$$F(\bar{v})(1+\lambda)v' + (1-F(\bar{v}))v' = 1 \ , \tag{1'}$$

where

$$F(\bar{v}) = \int_0^T \int_{a_t}^{\bar{v}} f(v,t)\,dv\,dt \ .$$

Equation (1′) states that the level of r chosen by the integrated producer is that which equates the marginal cost of the investment with the marginal value of the investment in exchange states, $(1+\lambda)v'$, times the cumulative probability that it will be efficient to exchange, $F(\bar{v})$, plus the marginal value of the investment in nonexchange states, v', times the respective probability, $1-F(\bar{v})$. Equations (1) and (1′) also define the efficient level of investment in transaction-specific assets, which we will denote r^*. Hence, no loss of allocative efficiency is attributable to internal procurement. Internal organization does, however, entail the bureaucratic costs of large scale organization.

3.2 External Procurement

Suppose instead that specialized investments were undertaken by an independent supplier. In the absence of a contract between the buyer and seller, the payment received by the seller for subsequent deliveries would depend on the outcome of bargaining between the parties. Specifically, let y_t be the amount the buyer pays the seller for a delivery in period t. This amount is constrained by the respective alternatives faced by the parties. Thus, y_t must be greater than $v(r)$ or it would pay the seller to use his assets in their secondary application. Likewise, y_t could not exceed $(1+\lambda)v(r) - v_t$ for otherwise it would be in the interest of the buyer to undertake an alternative profit opportunity. Since y_t must be within these bounds we may write

$$y_t = \gamma_t((1+\lambda)v(r) - v_t) + (1-\gamma_t)v(r) \quad , \tag{2}$$

where $\gamma_t = \Gamma(\psi_B^t, \psi_S^t)$ is the outcome of the bargaining game described in section 2 and the appendix. Recalling that the surplus or quasi-rents at stake in a given period is $Q_t = (1+\lambda)v(r) - v_t - v(r) = \lambda v(r) - v_t$, (2) can easily be rewritten as

$$y_t = v(r) + \gamma_t Q_t \quad ; \tag{2'}$$

or in other words, the payment made by the buyer to the seller in the absence of a contract is the amount the seller could get for his services elsewhere plus whatever share of the quasi-rents the seller can extract from the buyer through bargaining.

To prevent repeated bargaining, the parties may specify a division of rents ex ante in a contract[4]. However, if the length of the contract is less than the life of asset, i.e., $\tau < T$, bargaining will take place over the quasi-rents accruing over the remaining life of the investment. The problem for the buyer and seller is to choose the level of investment, the price to apply over the length of the contract, and the number of periods over which the contract is to be written. We may treat the payments made by the buyer to the seller under the contract as an agreement on γ_c which determines the payment as a function of the level of quasi-rents; specifically, we let $y_c = v(r) + \gamma_c Q_t$, where y_c is the payment made by the buyer to the seller under the terms of the contract[5].

Under these assumptions, the expected profits of the buyer are

$$\begin{aligned} E(\pi_B) = &\int_0^{\tau}\int_{a_t}^{\bar{v}} ((1+\lambda)v(r) - y_c) f(v,t)\,dv\,dt \\ &+ \int_{\tau}^{T}\int_{a_t}^{\bar{v}} ((1+\lambda)v(r) - y_t - \psi_B^{*t}) f(v,t)\,dv\,dt \\ &+ \int_0^{T}\int_{\bar{v}}^{b_t} v_t f(v,t)\,dv\,dt - \omega\frac{\tau(\tau+1)}{2} \quad , \end{aligned} \tag{3}$$

where ψ_B^{*t} is the buyer's expenditure on bargaining activities in period t.

The first two expressions in (3) are the buyer's expected revenues in contract and post contract periods if the exchange takes place, the third term is his revenue in nonexchange periods, and the final term represents the costs of contracting.

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[4] To avoid unduly complicating the analysis, it is assumed here that bargaining is entirely precluded in periods covered by the contract and that the hazards inherent to contracting, such as those arising from maladaptation to changing circumstances or the need to litigate compliance, are adequately reflected by $c(\tau, \omega)$, the costs of contracting described in section 2.

[5] Since investments are undertaken ex ante and the parties are risk neutral, only the expected value of the contract matters, and therefore the terms under which y_c is paid, e.g. whether period-by-period or in a lump sum, do not affect the choice of r.

The seller's expected profits, in turn, are

$$(4) \qquad E(\pi_S) = \int_0^{\tau} \int_{a_t}^{\bar{v}} y_c f(v,t)\,dv,dt + \int_{\tau}^{T} \int_{a_t}^{\bar{v}} (y_t - \psi_S^{*t}) f(v,t)\,dvdt + \int_0^{T} \int_{\underline{v}}^{b_t} v(r) f(v,t)\,dvdt - r \ ,$$

where the first two terms in (4) are the seller's expected revenues in contract and postcontract exchange periods, respectively, while the third is his revenue if he does not exchange with the buyer but uses the investment in its secondary use. Under external procurement, the seller would incur the investment cost, r.

Since prior to investing, a large number of potential suppliers may exist, it is reasonable to assume that the seller's expected profits at the time the contract is written are constrained to a competitive level[6]. Hence, given ex ante competition for the contract to supply the buyer, the problem can be formulated as one in which the buyer chooses a contract (γ_c, τ), which maximizes his expected profits subject to the fact that the seller will invest competitively given that contract. In effect, the buyer by adjusting γ_c and τ is able to move along the seller's isoprofit locus and thereby implicitly select r[7].

Examining first the buyer's choice of γ_c, we find the first order condition

$$(5) \qquad F(\bar{v})(1+\lambda)v' + (1 - F(\bar{v}))v' - \int_{\tau}^{T} \int_{a_t}^{\bar{v}} \frac{\partial \psi^{*t}}{\partial Q_t} (\lambda v') f(v,t)\,dvdt = 1$$

Let $\tilde{r}$ satisfy this equation. The last term on the left-hand side of (5) is the change in the *total* amount spent on bargaining for a change in r, which is positive since both $\partial \psi^{*t}/\partial Q_t$ and $\lambda v'$ are positive. It is readily apparent by comparison of (5) with (1′) that for $\tau < T$, $\tilde{r}$ will be less than r^*. Hence, the model reveals a tendency to underinvest in transaction-specific assets under market procurement.

Notice that the value of $\tilde{r}$ depends on the sum of bargaining expenditures but not on the distribution of quasi-rents (γ_t). This occurs because the buyer is able, in effect, to compensate the seller for expected losses from bargaining by offering a high enough payment under the contract. This raises a point worth emphasizing: *even where quasi-rents exist and complete contracts are not feasible, an efficient level of investment in transaction-specific assets will occur unless strategic behavior incurs real costs in exchange, as opposed simply to redistributing the gains from trade.*

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[6] In actuality, it will often be the case that a certain number of suppliers are already advantageously situated to supply the buyer due to residues of previous investments. Nevertheless, there will generally be more competition prior to the commitment of new specialized assets than during their useful life.

[7] This problem can be solved either by maximizing the Lagrangian with respect to γ_c, τ and r or by substituting $dr/d\gamma_c|_{\pi_s=0} = 0$ and $dr/d\tau|_{\pi_s=0}$ into the first order conditions characterizing the buyer's choice of γ_c and τ.

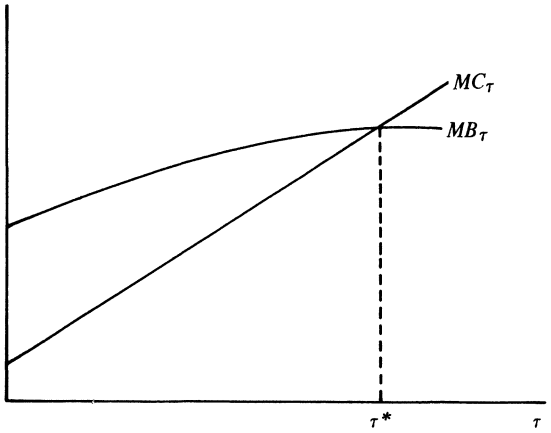

Figure 1

Turning now to the choice of τ, the corresponding first-order condition is

$$\int_{a_t}^{\bar{v}} \psi^{*\tau} f(v,\tau)\,dv = \omega \frac{(2\tau+1)}{2} \quad (6)$$

The left-hand side of (6) is the marginal benefit of contracting which is the decrease in expected bargaining costs from extending τ; and the right-hand side is the marginal cost of writing the contract for an additional period. These relationships are depicted in Figure 1[8].

Recalling that the level of bargaining expenditures is an implicit function of the level of quasi-rents, an increase in Q will lead to a higher level of bargaining and thus raise the marginal benefit curve. Hence, optimal contract length will increase with the profitability of transaction-specific investments. An increase in ω, representing greater uncertainty, on the other hand, increases the slope of the marginal cost curve and reduces optimal contract length[9]. Moreover, note that if bargaining were to take place over the remaining quasi-rents between τ and T rather than period-by-period as the model assumes[10],

[8] The shape of the marginal benefit curve reflects the fact that, given the convexity of Γ, ψ^* and hence MB_τ will be increasing at a decreasing rate in τ.

[9] This result will be mitigated to the extent that expected quasi-rents and, thus, expected bargaining expenditures were to rise due to changes in the distribution of $f(v,t)$ as ω increased.

[10] Implicit in the way bargaining expenditures have been included in equations (3) and (4) is the assumption that only a single contract is written over the life of the asset, even though it may in fact be profitable to write a second contract after the expiration of the first. If the second were written, the buyer and seller would bargain over the expected quasi-rents at stake during the length of the new document rather than period-by-period. The qualitative results of the model would be unchanged. Optimal contract length, however, would then depend on T.

then an increase in T would also raise Q and ψ and would therefore also imply a longer optimal contract length.

Note that the total costs associated with external procurement include both the inefficiency due to underinvestment in r and the total amounts spent on bargaining and contracting.

4. Comparative Statics

We are now prepared to begin the comparison of the relative efficiencies of internal and external organization of production. The principal exogenous factors of concern are λ, the profitability of transaction-specific investments; T, the durability of those investments; and ω, the level of uncertainty associated with the transaction.

Cursory inspection of equations (5) and (6) provides two immediate results. The first is that *if $\lambda = 0$, that is, if there is no difference in the value of investments in their first and secondary uses, or in other words, if all assets are of a standardized nature, a spot market (i.e., exchanges on a day-to-day basis without a contract) will be the efficient institution.* In this case, no bargaining can take place since either party can turn to alternative partners if one seeks to gain at the expense of the other[11]. Inasmuch as market exchange avoids the burden of internal administration ($\bar{B}$), and generates no costs of its own, external procurement would be the preferred governance mechanism.

A second result, as readily apparent as the first, is that *when $T = 0$, spot markets are efficient.* Thus, if investments were not durable or, in other words, if there existed no sunk costs, even highly personalized commodities would be efficiently provided by classical markets[12].

We now prove the following:

Theorem 1: *A producer is more likely to choose internal over external procurement the greater the profitability of transaction-specific investments.*

Proof. To show this, define

$$\Delta = E(\pi^*(r^*; \lambda)) - [E(\pi_B(\tilde{r}; \lambda)) + E(\pi_S(\tilde{r}; \lambda))] \ ,$$

which is the difference between expected profits under internal organization and the expected joint profits accruing to the transaction under external pro-

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[11] An alternative way to demonstrate this result is to observe that when $\lambda = 0$, $Q = 0$ and therefore $\tau = 0$. Hence, when assets are fungible, markets are perfectly contestable and, as argued in BAUMOL, PANZER and WILLIG [1982], also efficient.

[12] Many customized services would probably be of this type; made-to-order ice cream sundaes come to mind. Note that this result conforms to MAKOWSKI's [1979] finding that personalized commodities are efficiently produced in *static* competitive markets.

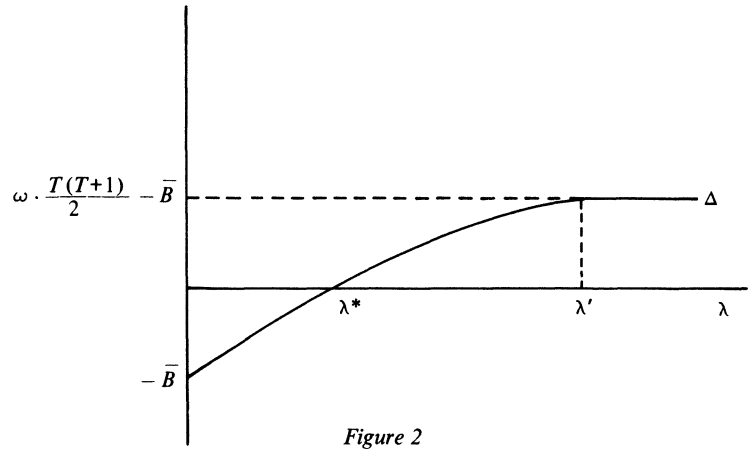

Figure 2

curement. Since r^* and $\tilde{r}$ vary optimally under the corresponding institutions the envelope theorem implies

$$(7)\quad \Delta_\lambda = [F(\bar{v}(r^*;\lambda))v(r^*) - F(\bar{v}(\tilde{r};\lambda))v(\tilde{r})] + \int_\tau^T \int_{a_t}^{\bar{v}(\tilde{r};\lambda)} \frac{\partial \psi^{*t}}{\partial Q_t} \cdot v(\tilde{r}) f(v,t)\,dv\,dt \ .$$

The final term is the increase in expected bargaining costs for an increase in the profitability of the investment. Since both $\partial\psi^{*t}/\partial Q_t$ and $v(\tilde{r})$ are positive, this term is also positive for $\tau < T$. The term in brackets is the difference between the expected marginal value of investing with respect to λ at r^* and $\tilde{r}$. Since $\tilde{r} \leqq r^*$, $v(\tilde{r}) \leqq v(r^*)$ and $F(\bar{v}(\tilde{r};\lambda)) \leqq F(\bar{v}(r^*;\lambda))$, and consequently (7) is strictly positive for $\tau < T$. Q.E.D.

The curve Δ is drawn in Figure 2 as a function of λ. As noted earlier, when $\lambda = 0$, there are no losses associated with market procurement, while internal procurement imposes the additional administrative burden, $\bar{B}$. Hence, at $\lambda = 0$, Δ, which depicts the advantage of internal over external procurement, is negative and equal to $-\bar{B}$. However, the losses due to external organization increase continuously with λ up to λ'. At this point, optimal contract length reaches T, the life of the asset, all bargaining is precluded and an efficient level of investment in transaction- specific assets occurs (see equation 5). Thus, at λ', $\Delta = \omega(T(T+1))/2 - \bar{B}$, the difference between the cost of a full-term contract of length T and the administrative burden of internal organization. In figure 1, external procurement is preferred for negative values of Δ, i.e., from 0 to λ^*, and internal procurement thereafter.

Theorem 2: *A producer is more likely to choose internal over external organization the greater the durability of transaction-specific assets.*

Proof. Again, it has already been shown that for $T = 0$, external procurement is the desired mode of organization. Therefore, it need only be shown that Δ_T is positive:

$$\Delta_T = \int_{a_T}^{\bar{v}(\tilde{r})} (1+\lambda)\big(v(r^*) - v(\tilde{r})\big) f(v, T)\, dv$$
$$+ \int_{\bar{v}(r^*)}^{b_T} \big(v(r^*) - v(\tilde{r})\big) f(v, T)\, dv$$
$$+ \int_{\bar{v}(\tilde{r})}^{\bar{v}(r^*)} [(1+\lambda)v(r^*) - (v_t + v(\tilde{r}))] f(v, T)\, dv$$
$$+ \int_{a_T}^{\bar{v}(\tilde{r})} \psi^{*T} f(v, T)\, dv \ .$$

The first, second and final integrals are easily signed and positive. To see that the third integral is also positive, recall from the definition of $\bar{v}$ that

$$(1+\lambda)v(r^*) \geqq v_t + v(r^*) \quad \text{for } v_t < \bar{v}(r^*) \ .$$

But

$$v_t + v(r^*) > v_t + v(\tilde{r}), \forall\, v_t$$

since $v(r^*) > v(\tilde{r})$.

Therefore

$$(1+\lambda)v(r^*) > v_t - v(\tilde{r})$$

between $\bar{v}(\tilde{r})$ and $\bar{v}(r^*)$. Hence, Δ_T is positive. Q.E.D.

Increases in the durability of transaction-specific investments increase the period over which rents accrue to those investments and thus, tend to raise the costs of market-mediated exchange. In terms of Figure 2, an increase in T pivots Δ upward around the vertical intercept and thereby decreases the range of λ over which external procurement is the preferred organizational arrangement.

Theorem 3: *A producer becomes more likely to choose internal over external procurement the greater the level of uncertainty associated with the transaction.*

Proof. When $\omega = 0$, the hazards of long term contracting due to uncertainty are eliminated. Increases in the dispersion of contingencies raise the opportunity costs of being locked into inflexible contracts, shortening the optimal contract length but increasing the opportunities for strategic behavior in follow-on purchases. On the margin, the effect of a change in the degree of uncertainty on Δ is

$$\Delta_\omega = \frac{\tau(\tau+1)}{2} > 0 \ .$$

Hence, uncertainty also raises the costs of market mediated exchange relative to internal organization. Q.E.D.

5. *Concluding Remarks*

Given that there are benefits to be derived from trade, every transaction contains a potential source of conflict: each party will wish to arrange the terms

of trade in such a way as to appropriate for himself as large a share of those benefits as possible. The problem of economic organization is how best to limit the wasteful byproduct of that conflict, namely, the strategic use of information and resources by agents as each seeks to establish a personally favorable distribution of the gains from trade. The mechanisms through which we effect a solution to that problem are our institutions. By moving a transaction from one institutional setting to another, certain strategies may be precluded and thus specific costs avoided. The problem therefore becomes one of evaluating the tradeoffs and identifying the circumstances under which one set of institutions will be preferred to the remainder.

Although the efficiency of various institutional arrangements is one of the central themes of microeconomics, relatively little attention has been devoted to the systematic analysis of the choice among alternative institutions. One reason for this may be that, except perhaps under the special conditions characterizing perfectly contestable markets, each institution will generate a second-best solution to the problem. Comparisons therefore depend on the relative costs of attempting to define and secure mutually beneficial terms of trade under each arrangement, the precise level of which in any particular application is strictly an empirical question. But even as an empirical matter, there are fundamental obstacles to making such comparisons. First of all, the losses which would have occurred due to strategic behavior are simply not observed for institutions not chosen. And even for those institutions which do emerge, such costs may be difficult to quantify[13].

Nevertheless, the possibility of developing meaningful propositions regarding institutional form remains open. The key is to recognize that the nature of a transaction often affects the efficiency of alternative institutions in a differential manner. Preferences, technology and other temporal and spatial relationships facing decision-makers may influence the incentives to engage in strategic behavior and the losses occasioned by that conduct differently in one institutional context than in another. If such differences can be identified, testable hypotheses regarding institutional form can be based on observable details of the environment in which the transaction takes place.

This paper has provided a simple model of the make-or-buy decision based on comparative static results which illustrates this approach to institutional choice problems. Taking the costs of internal administration as a burden to be overcome before production will be internalized, it is shown that the losses associated with market procurement of supplies – and thus the incentive to internalize – is likely to increase with the profitability and durability of transaction-specific investments and with the uncertainty associated with the transaction. These results offer support to a number of contentions advanced in the transaction-cost literature, notably by WILLIAMSON [1975, 1979] and KLEIN,

[13] For example, it may be difficult to measure the losses incurred due to the strategic withholding of information by a party to an exchange.

CRAWFORD and ALCHIAN [1978]. In addition, however, the model also permitted an investigation of the interaction between transaction costs and the levels of investment in transaction-specific assets under each institution. In that regard, a tendency under external procurement to underinvest in such assets or to choose more standardized designs than would otherwise be optimal was identified.

It was also shown that the motivation to write long term contracts arises because of the real costs incurred negotiating the terms of trade at contract renewal time, rather than from a desire to control the distribution of quasirents *per se*. Moreover, optimal contract length is a positive function of the profitability and durability of transaction-specific investments and a negative function of the uncertainty accompanying a transaction.

A growing body of empirical work has begun to examine these relationships. Corroborating evidence has been found by MONTEVERDE and TEECE [1982], MASTEN [1984] and ANDERSON and SCHMITTLEIN [1984] in several contexts employing various measures for the independent variables. In addition, the approach adopted here provides a basis to derive implicit measures of the relative costs associated with the use of alternative organizational arrangements. In effect, the latter reduces to asking the following question: Given the economic environment in which they appeared, what structure of organizational costs is most likely to have generated the observed combination of institutional forms? Posed in this way, that structure becomes amenable to maximum likelihood estimation (see MASTEN [1984]).

The model of this paper abstracts away from many interesting and relevant issues in bargaining and contracting theory for reasons of tractability and employs relatively ad hoc characterizations of the costs associated with those activities. Nevertheless, the propositions underlying those abstractions are generally consistent with the results of the theoretical literature (see, e.g., TOWNSEND [1979], and CROCKER [1983]) and are also supported by the empirical research cited above. Inasmuch as the precise nature of the strategies available to agents determines the design of organizational arrangements, however, more detailed analyses of the differential costs of alternative institutional structures is clearly warranted.

Summary

This paper provides a simple model which treats the firm's make-or-buy decision as part of a producer's overall optimization problem. Comparative static results offer support for several contentions advanced in the transaction-cost literature. More importantly, the model permits investigation of a number of interactions and relationships not readily amenable to verbal analysis. In particular, the effects of asset specificity and uncertainty on optimal contract

length are examined, and a tendency to underinvest in transaction-specific assets under external procurement is demonstrated.

Zusammenfassung

Institutionelle Wahl und die Organisation der Produktion
Die Entscheidung für Eigen- und Fremdherstellung

Dieser Artikel beinhaltet ein einfaches Modell, in dem die Entscheidung einer Unternehmung über Eigen- oder Fremdherstellung als Teil des Gesamtoptimierungsproblems eines Produzenten behandelt wird. Die Ergebnisse der komparativen Statik unterstützen verschiedene Vermutungen, die aus der Transaktionskostenliteratur hervorgehen. Mehr noch, das Modell erlaubt die Untersuchung einer Anzahl von Interaktionen und Beziehungen, die einer rein verbalen Analyse nicht zugänglich sind. Es werden die Auswirkungen von Vermögensspezifikationen und von Unsicherheit über die optimale Vertragslänge untersucht. Weiterhin wird gezeigt, daß bei Fremdherstellung eine Tendenz, zu wenig in transkationsspezifische Anlagen zu investieren, vorherrscht.

Appendix

Let Q represent the level of appropriable quasi-rents, and ψ_B and ψ_S the resources expended on bargaining by the buyer and seller. Also let γ represent the share of Q which the seller is able to appropriate, where

$$\gamma = \Gamma(\psi_B, \psi_S) \ ,$$

and

$$\Gamma_{\psi_B} < 0, \ \Gamma_{\psi_B\psi_B} > 0 \ .$$
$$\Gamma_{\psi_S} > 0, \ \Gamma_{\psi_S\psi_S} > 0 \ .$$

The function Γ summarizes the "bargaining technology" available to the agents and has the following interpretation: *Ceteris paribus*, expenditures on bargaining by the buyer, ψ_B, decrease γ and hence the effective price he pays for the product, whereas expenditures by the seller increase γ and the price. Furthermore, incremental expenditures on bargaining by either party have diminishing influence on γ.

The payoff functions of the buyer and seller are assumed to be of the following form:

$$P_B = \bar{\pi}_B - \gamma Q - \psi_B \ , \quad \text{and}$$
$$P_S = \bar{\pi}_S + \gamma Q - \psi_S \ ,$$

where $\bar{\pi}_B$ and $\bar{\pi}_S$ are arbitrary constants.

The game is assumed to be played noncooperatively. In each period, each player's strategy, given the other's choice of ψ, is defined by the first-order condition for his payoff function with respect to his strategy:

$$\frac{\partial P_B}{\partial \psi_B} = -\Gamma_{\psi_B} \cdot Q - 1 = 0 \;\rightarrow\; -\Gamma_{\psi_B} \cdot Q = 1 \;;$$

$$\frac{\partial P_S}{\partial \psi_S} = \Gamma_{\psi_S} \cdot Q - 1 = 0 \;\rightarrow\; \Gamma_{\psi_S} \cdot Q = 1 \;.$$

Totally differentiating the above first-order conditions yields the following matrix equation:

$$Q \begin{bmatrix} -\Gamma_{\psi_B\psi_B} & -\Gamma_{\psi_B\psi_S} \\ \Gamma_{\psi_B\psi_S} & \Gamma_{\psi_S\psi_S} \end{bmatrix} \cdot \begin{bmatrix} d\psi_B^*/dQ \\ d\psi_S^*/dQ \end{bmatrix} = \begin{bmatrix} \Gamma_{\psi_B} \\ -\Gamma_{\psi_S} \end{bmatrix}$$

Using Cramer's rule, we find

$$\frac{d\psi_B^*}{dQ} = \frac{(\Gamma_{\psi_B} \cdot \Gamma_{\psi_S}\Gamma_{\psi_S})Q - (\Gamma_{\psi_S} \cdot \Gamma_{\psi_B}\Gamma_{\psi_S})Q}{|J|} \;,$$

and

$$\frac{d\psi_S^*}{dQ} = \frac{(\Gamma_{\psi_S} \cdot \Gamma_{\psi_B}\Gamma_{\psi_B})Q - (\Gamma_{\psi_B} \cdot \Gamma_{\psi_B}\Gamma_{\psi_S})Q}{|J|} \;,$$

where

$$|J| = Q^2 \cdot (\Gamma^2_{\psi_S\psi_B} - (\Gamma_{\psi_B\psi_B}\Gamma_{\psi_S\psi_S})) \;.$$

Since the change in the total amount spent on bargaining is the sum of the individual amounts,

$$\frac{d\psi^*}{dQ} = \frac{d\psi_B^*}{dQ} + \frac{d\psi_S^*}{dQ} = \frac{Q \cdot (\Gamma_{\psi_B}\Gamma_{\psi_S\psi_S} + \Gamma_{\psi_S}\Gamma_{\psi_B\psi_B} - \Gamma_{\psi_B\psi_S}(\Gamma_{\psi_S} + \Gamma_{\psi_B}))}{|J|} \;.$$

Noting that the first order conditions imply $-\Gamma_{\psi_B} = \Gamma_{\psi_S}$ in equilibrium, the previous equation reduces to

$$\frac{d\psi^*}{dQ} = \frac{Q \cdot (\Gamma_{\psi_B}\Gamma_{\psi_S\psi_S} + \Gamma_{\psi_S}\Gamma_{\psi_B\psi_B})}{|J|} \;,$$

which, given the assumptions above, can be easily signed, implying

$$\frac{d\psi^*}{dQ} > 0 \;.$$

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