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On the Transaction Costs Determinants of Vertical Integration

By

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1. Introduction

The extensive development of the transaction cost approach to the organization of firms (and industries) has been, without question, among the most significant advances in industrial organization over the last twenty years. This development began with path-breaking work by Williamson [1975, 1979, 1985], Klein, Crawford, and Alchian [1978], and others that pushed forward the agenda of explaining firms' boundaries that was first laid out by Coase [1937] forty years earlier. Their work focused attention on the ways in which ex post quasi-rents could create hazards for long-term contractual relations when contracts are incomplete, and the effects that this could have on firms' choices of whether to integrate distinct stages in the vertical chain of production and distribution. By doing so, it identified a pervasive – and potentially measureable – feature of long-term contracting settings as a critical determinant of the degree to which firms would choose to integrate activities.

Just as one would hope, this conceptual breakthrough was soon followed by empirical work aimed at testing the theory. Very quickly it became clear that the theory had significant predictive power. Indeed, as early as 1987, Joskow [1988] could write that “This work generally provides strong empirical support for the importance of transactions cost considerations, especially the importance of asset specificity in explaining vertical relationships.” Developments since have not changed this conclusion.¹

At the same time that empirical work was providing this confirmation, a closely related and more formal theory of vertical integration emerged, beginning with Grossman and Hart's [1986] seminal paper. Like what I shall call the “Williamsonian” transaction costs theory, this “property rights theory” (see Hart [1995]) took the incompleteness of contracts and development of ex post quasi-rents as critical to understanding vertical integration. It differed from the Williamsonian theory in two essential respects. First, the property rights theory focused in a very explicit way on the manner in which integration could affect the level of non-contractible ex ante investments undertaken by contracting parties. Second, in contrast to the Williamsonian theory, which assumed that contracting hazards could be completely avoided by bringing the transaction within the firm (more on this later), the property rights theory assumed that opportunism was present in all organizational modes, so that the integration decision involved a comparison of the nature and efficiency costs of

¹Masten [1996] provides a nice compilation of some of the best work on transaction costs studies of vertical integration and vertical contracting more generally. Shelanski and Klein [1995] survey the area.

opportunistic behavior in differing organizational forms.

Because the two theories both focus on contractual incompleteness and ex post quasi-rents, it is often presumed that the empirical literature on transaction cost determinants of vertical integration provides support for both. I will argue here, however, that this is true in only a relatively weak sense. The two theories do share the prediction that integration decisions matter in the presence of incomplete contracts and ex post quasi-rents; and the empirical literature does show that the presence of quasi-rents matters for integration decisions. But this alone is not a very demanding test. In fact, the property rights and Williamsonian theories provide quite distinct predictions about the integration decisions of firms. While the Williamsonian theory predicts that any increase in quasi-rents will increase the likelihood of vertical integration (a finding that is so far consistent with nearly all of the existing empirical literature), the property rights theory offers much more refined predictions about the types of specificity that will matter for integration decisions, and the direction in which various types of specificity will move the likelihood of integration. As a result, I will argue, tests of the property rights theory (and, at the same time, more demanding tests of the Williamsonian theory) await further empirical work.

The rest of this paper is organized as follows. In Section 2, I lay out in detail how the property rights and Williamsonian theories differ. For this purpose, I focus on a simple linear-quadratic property rights model and examine the comparative statics predictions that emerge from it. (I also note there some difficulties with using existing property rights theory to explain integration patterns.) In Section 3, I discuss the findings of three of the most well-known empirical papers on the transaction costs determinants of vertical integration in light of these observations. My particular focus is on what these papers might tell us about the extent to which the property rights theory's predictions hold. The general lesson to be learned from this exercise is that these papers simply do not tell us enough about the economic environments under study to judge the property rights theory. As a result, it is relatively easy to construct a variety of reasonable property rights models of these settings that either do or don't accord with the observed relationships in the data. The implication of this fact is that the existing empirical literature provides little guidance regarding which of the two theories better explains patterns of integration. Section 4 offers concluding remarks.

2. The Williamsonian Theory and the Property Rights Theory

What I shall call the “Williamsonian” theory takes as its starting point two observations: First, that in many exchange relationships it is difficult to specify fully the contracting parties’ obligations and, second, that in many cases the parties become “locked in” to one another to some extent over the course of their relationship (i.e. the parties develop “relationship-specific assets”). Using Klein, Crawford, and Alchian [1978]’s terminology, there are then *ex post* quasi-rents, because the value of trade within the relationship comes to exceed the value of outside trading opportunities.² When contracts are incomplete and *ex post* quasi-rents are present, the contracting parties face the hazard of *ex post* opportunistic behavior: each party to the contract may engage in inefficient behavior in an attempt to “hold-up” the other party and obtain a larger share of the available quasi-rents.³ This reduction in the efficiency of the trading relationship, if large enough, may motivate one of the contracting parties to bring the transaction “in house” – that is, to vertically integrate – to avoid these hazards. A central prediction of the theory is then that when contracts are incomplete, greater levels of quasi-rents increase the likelihood of vertical integration.⁴

The property rights theory, developed in Grossman and Hart [1986], Hart and Moore [1990] and elsewhere (see Hart [1995] for an overview), starts from the same basic premises, but differs from the Williamsonian theory in its greater level of formalization, in its focus on the effect of integration on the efficiency of *ex ante* choices of non-contractible investments, and in its view that the same types of opportunistic behavior may create efficiency losses – sometimes severe ones – both within integrated firms and across firm boundaries. Although the “specificity” of investments is important in this theory, the types of specificity that are important, and the predicted direction of their effects, can differ substantially from the Williamsonian theory. To illustrate these points, in the next subsection I examine the

²Williamson cites four kinds of specificity as giving rise to such conditions: site specificity (the parties’ have committed immobile physical assets to a “cheek-by-jowl” relationship), physical asset specificity (the parties must make investments in specialized physical assets), human asset specificity (the parties develop specific human capital), and dedicated assets (one or both parties build productive capacity for which there is insufficient demand absent their trading relationship).

³As Masten [1984] puts it: “Idiosyncratic assets, because of their specialized and durable nature, imply that parties to a transaction face only imperfect exchange alternatives for an extended period. The more specialized those assets, the larger will be the quasi-rents at stake over that period, and hence the greater the incentive for agents to attempt to influence the terms of trade through bargaining or other rent-seeking activities once the investments are in place.”

⁴Joskow [1988] puts this prediction succinctly as follows: “Other things equal, we expect the parties to more frequently choose vertical integration or a long-term contract as the quasi-rents associated with specific investments become more important and the associated benefits of precommitment increase.”

determinants of integration in the context of a simple linear-quadratic property rights model.

2.1. A Simple Property Rights Model

Consider a simple bilateral trade setting. There are two agents who may wish to trade tomorrow, a buyer B and a supplier S . The seller S uses an asset for the production of his product. In what follows, I focus on the incentives for buyer integration; that is for B to own the upstream asset. I denote by $A_B = 1$ the case in which B owns the upstream asset (vertical integration), and by $A_B = 0$ the case in which S owns this asset (non-integration).

Since I have in mind a situation in which there are likely to be downstream assets as well, there is also in principle a possibility of seller integration in which S owns both the downstream and the upstream assets. Implicitly, in what follows I am assuming that any observed integration is buyer integration, in which B controls both the upstream and downstream assets. In large part, I do this because the empirical studies I discuss later in the paper focus on buyers' decisions of whether to procure internally (e.g. GM's decision of whether to own its own engine plant). In two of these three studies, this may be justified by the fact that the buyers are making these decisions over the procurement of many inputs so that supplier ownership of the buyer's assets is not generally a viable option.^{5,6}

At time 0, the two parties can decide who will own the upstream asset (e.g. B may purchase it from S if S initially owns it). Also at that time, they may agree about the levels of some contractible investments. For simplicity, we assume that for the relationship to be productive, there are certain given levels of these investments that must be made (so that this is not a choice variable for the parties, although the appropriate levels will need to be specified contractually *ex ante*). As in Hart [1995], no other agreements about trade are possible, because the good to be traded is not describable in advance.

At time 1, each of the parties may make some non-contractible investments. We denote by $i_B \in \mathbb{R}_+$ the buyer's non-contractible investment level and by $i_S \in \mathbb{R}_+$ the seller's non-

⁵Of course, this feature would ideally be part of a more complete model of the integration decision than what I present here. (For one such model, see Bolton and Whinston [1993].)

⁶In situations in which one does not know on *a priori* grounds the form that any observed integration takes, an immediate issue in applying the property rights model empirically is whether this difference in integrated structures is empirically distinguishable. If so, then one would want to allow for a choice between three possible ownership structures. If not, then the property rights model can be used instead to predict the probability that *some* integrated outcome is observed. (This also raises the theoretical question of the degree to which an integrated firm is able to design the allocation of control, or authority, within the firm; that is, whether "B ownership" and "S ownership" are really the only two possible forms of authority within the firm.)

contractible investment level. The associated costs are $c_B(i_B)$ and $c_S(i_S)$.

At time 2, the buyer and the seller bargain over trade. Denote by $\pi(i_B, i_S)$ the profits available from the efficient trade, and by $w_B(i_B, i_S|A_B)$ the payoff to the buyer in his next-best alternative to trading with S given that investment levels i_B and i_S have been taken, and that the ownership variable is A_B . When $A_B = 0$, this involves procurement from another supplier (or some form of self-production) or shutting down; when $A_B = 1$ this could involve either procurement from another supplier, hiring another manager to come in and produce the input using the upstream asset owned by B , or shutting down. Likewise, let $w_S(i_B, i_S|A_B)$ denote the payoff to the seller in his next-best alternative to trading with B given that investment levels i_B and i_S have been taken, and that the ownership variable is A_B . This will involve selling to another buyer when $A_B = 0$ or shutting down; when $A_B = 1$, this could involve either selling to another buyer using a technology that does not use the asset, running another firm, or shutting down. I assume that the parties engage in Nash bargaining and (for simplicity) that they have equal bargaining power; hence, they split any available surplus (the quasi-rents) evenly.

Note that in contrast to Hart and Moore [1990], I allow for an agent's investments to affect not only his own trading alternatives but also those of the other contracting party—that is, we consider “cross-investments” as well as “self-investments”. For example, a seller might invest in improving the quality of the product that can be produced using his asset. This would affect his trading alternatives if he owned the asset, but would affect the buyer's alternatives if instead the buyer owned the asset.⁷ Thus, I take the essence of the “property rights” model in what follows to be its focus on the effect of the allocation of ownership on ex ante non-contractible investment choices. I do this because this generalization seems indispensable if the property rights theory is to be a serious contender in explaining patterns of integration.

We make the following assumptions about these functions:

$$\begin{aligned}\pi(i_B, i_S) &= \alpha_0 + \alpha_B i_B + \alpha_S i_S \\ w_B(i_B, i_S|A_B) &= [\beta_0 + \beta_{B0} i_B + \beta_{S0} i_S](1 - A_B) + [\beta_1 + \beta_{B1} i_B + \beta_{S1} i_S] A_B \\ w_S(i_B, i_S|A_B) &= [\sigma_0 + \sigma_{S0} i_S + \sigma_{B0} i_B](1 - A_B) + [\sigma_1 + \sigma_{S1} i_S + \sigma_{B1} i_B] A_B \\ c_B(i_B) &= \frac{1}{2}(i_B)^2\end{aligned}$$

⁷As another example, S might invest in training B how to use its input more effectively.

$$c_S(i_S) = \frac{1}{2}(i_S)^2,$$

where $(\alpha_B, \alpha_S) \geq 0$ (so that positive levels of investment are efficient) and $\alpha_0 > \text{Max}\{\beta_0 + \sigma_0, \beta_1 + \sigma_1\}$, $\alpha_B \geq \text{Max}\{\beta_{B0} + \sigma_{B0}, \beta_{B1} + \sigma_{B1}\}$, and $\alpha_S \geq \{\sigma_{S0} + \beta_{S0}, \sigma_{S1} + \beta_{S1}\}$ (these three conditions imply that it is always efficient for the two parties to trade ex post; i.e., quasi-rents are always present). Let α , β , and σ denote the respective parameter vectors. This linear-quadratic formulation has the advantage that we can identify in a very simple way the marginal returns to investment. The assumptions adopted in Chapter 2 of Hart [1995] correspond to the case in which $\beta_{S0} = \beta_{S1} = \sigma_{B0} = \sigma_{B1} = 0$, $(\alpha_B, \alpha_S, \beta_{B0}, \beta_{B1}, \sigma_{S0}, \sigma_{S1}) \geq 0$, $\alpha_B > \beta_{B1} > \beta_{B0}$, and $\alpha_S > \sigma_{S0} > \sigma_{S1}$.

2.1.1. The first-best

Consider, first, the efficient levels of investments. These solve:

$$\max_{i_B, i_S} \pi(i_B, i_S) - c_B(i_B) - c_S(i_S) = \alpha_0 + \alpha_B i_B + \alpha_S i_S - \frac{1}{2}(i_B)^2 - \frac{1}{2}(i_S)^2. \quad (2.1)$$

The solution to this problem is $(i_B^{**}, i_S^{**}) = (\alpha_B, \alpha_S)$, and the resulting joint surplus is $W^{**} = \alpha_0 + \frac{1}{2}(\alpha_B)^2 + \frac{1}{2}(\alpha_S)^2$.

2.1.2. Equilibrium investment levels

Now consider the equilibrium levels of investment undertaken by the parties given the ownership variable A_B . The buyer chooses i_B to solve:

$$\max_{i_B} w_B(i_B, i_S | A_B) + \frac{1}{2}[\pi(i_B, i_S) - w_B(i_B, i_S | A_B) - w_S(i_B, i_S | A_B)] - c_B(i_B)$$

or

$$\max_{i_B} \frac{1}{2}[\pi(i_B, i_S) + w_B(i_B, i_S | A_B) - w_S(i_B, i_S | A_B)] - c_B(i_B).$$

This gives first-order condition

$$\frac{1}{2}\left[\frac{\partial \pi(i_B, i_S)}{\partial i_B} + \frac{\partial w_B(i_B, i_S | A_B)}{\partial i_B} - \frac{\partial w_S(i_B, i_S | A_B)}{\partial i_B}\right] = \frac{\partial c_B(i_B)}{\partial i_B}.$$

Substituting using our assumed functional forms and solving we get:

$$i_B^*(A_B; \alpha, \beta, \sigma) = \frac{1}{2}[\alpha_B + (\beta_{B0} - \sigma_{B0})(1 - A_B) + (\beta_{B1} - \sigma_{B1})A_B]. \quad (2.2)$$

In a parallel fashion we can get the seller's equilibrium investment level as:

$$i_S^*(A_B; \alpha, \beta, \sigma) = \frac{1}{2}[\alpha_S + (\sigma_{S0} - \beta_{S0})(1 - A_B) + (\sigma_{S1} - \beta_{S1})A_B]. \quad (2.3)$$

We can then denote by $W(A_B; \alpha, \beta, \sigma)$ the equilibrium level of welfare given ownership structure A_B and parameters (α, β, σ) [obtained by substituting (2.2) and (2.3) into (2.1)].

2.1.3. Comparative statics predictions of the theory

Now consider how changes in various parameters effect the likelihood of vertical integration. To apply the model to actual data, we want to allow for the presence of other, unobserved, factors affecting the integration decision. Here I do this by assuming that the actual joint surplus under ownership structure A_B is $W(A_B; \alpha, \beta, \sigma) + \varepsilon_{A_B}$, where ε_{A_B} is a random variable unobserved to the econometrician. With this assumption, buyer integration will be observed if $W(1; \alpha, \beta, \sigma) - W(0; \alpha, \beta, \sigma) \geq (\varepsilon_1 - \varepsilon_0)$. Thus, for comparative statics we are interested in how changes in the parameters affect the difference

$$\Delta(\alpha, \beta, \sigma) \equiv [W(1; \alpha, \beta, \sigma) - W(0; \alpha, \beta, \sigma)].$$

Note, first, that the value of $(\alpha_0 - \beta_0 - \sigma_0)$ is *irrelevant*: that is, changes in the level of quasi-rents that do not affect the marginal returns to investments have *no bearing* on the likelihood of vertical integration. As one implication, then, we see that in contrast to the predictions of the Williamsonian theory, greater levels of specificity of *contractible* investments have no bearing on the integration decision as long as they do not affect the marginal returns from any non-contractible investments.

We now study how changes in the marginal returns to non-contractible investments affect the likelihood of observing vertical integration. Consider first a change in the marginal productivity of B 's investment when B and S trade, α_B . For this change we have

$$\begin{aligned} \frac{\partial \Delta}{\partial \alpha_B} &= [i_B^*(1; \cdot) - i_B^*(0; \cdot)] + [\alpha_B - i_B^*(1; \cdot)] \frac{\partial i_B^*(1; \cdot)}{\partial \alpha_B} - [\alpha_B - i_B^*(0; \cdot)] \frac{\partial i_B^*(0; \cdot)}{\partial \alpha_B} \\ &= \frac{1}{2} [i_B^*(1; \cdot) - i_B^*(0; \cdot)] \\ &= \frac{1}{2} [(\beta_{B1} - \sigma_{B1}) - (\beta_{B0} - \sigma_{B0})]. \end{aligned}$$

Thus, if B invests more under integration, then an increase in α_B – which increases the joint return from B 's investment – increases the probability of integration. Likewise, if S invests more under nonintegration (i.e. when he owns the upstream asset) then an increase in α_S , the joint return from S 's investment, *reduces* the probability of integration:

$$\begin{aligned} \frac{\partial \Delta}{\partial \alpha_S} &= \frac{1}{2} [i_S^*(1; \cdot) - i_S^*(0; \cdot)] \\ &= \frac{1}{2} [(\beta_{S1} - \sigma_{S1}) - (\beta_{S0} - \sigma_{S0})]. \end{aligned}$$

Following similar derivations, we can determine the effects of changes in the marginal returns to investments on B and S 's disagreement payoffs:

$$\begin{aligned}\frac{\partial \Delta}{\partial \beta_{B0}} &= -\frac{\partial \Delta}{\partial \sigma_{B0}} = -\frac{1}{2}[\alpha_B - i_B^*(0; \cdot)] \\ \frac{\partial \Delta}{\partial \beta_{B1}} &= -\frac{\partial \Delta}{\partial \sigma_{B1}} = \frac{1}{2}[\alpha_B - i_B^*(1; \cdot)] \\ \frac{\partial \Delta}{\partial \sigma_{S0}} &= -\frac{\partial \Delta}{\partial \beta_{S0}} = -\frac{1}{2}[\alpha_S - i_S^*(0; \cdot)] \\ \frac{\partial \Delta}{\partial \sigma_{S1}} &= -\frac{\partial \Delta}{\partial \beta_{S1}} = \frac{1}{2}[\alpha_S - i_S^*(1; \cdot)].\end{aligned}$$

Table 1 summarizes these effects for the case in which there is under-investment under either vertical structure (so that $\alpha_j > i_j^*(A_B; \cdot)$ for $j = B, S$). In this case an increase in the marginal effect of i_j on j 's disagreement payoff under ownership structure A_B increases the likelihood of observing that ownership structure (denoted by a “+” in Figure 1), while an increase in i_j 's effect on $-j$'s disagreement payoff under ownership structure A_B reduces this likelihood (denoted by a “-” in Figure 1). The reason is straightforward: In a situation of under-investment, an increase in investment levels under a particular ownership structure raises the surplus generated under that structure. When the marginal effect of i_j on j 's disagreement payoff increases under an ownership structure, that increases j 's optimal investment level under that structure; when the effect of i_j on $-j$'s disagreement payoff increases, however, this causes j to decrease his investment, lowering the joint surplus associated with that ownership structure. The results are reversed when we are in a situation of over-investment.

One interesting aspect of these derivations relates to the impact of the “importance” of an agent's investment in determining the optimal ownership structure. In particular, we see that increases in an agent's marginal returns to investment have ambiguous effects, even if we restrict attention to the case of self-investments and under-investment, as in Hart [1995]. For example, it is easy to verify that if we have equal-sized increases in α_B , β_{B0} , and β_{B1} , then there is *no effect* on the probability of observing integration. Thus, by having β_{B0} increase by slightly more or slightly less than the other two parameters, we can move the

probability of integration in either direction.^{8,9}

An alternative way to think about the effects of changes in marginal returns is instead to consider changes in the *specificity* of marginal returns. Consider first the case in which i_B is a self-investment. Then we can think of the level of *marginal people specificity* for B of his investment i_B as being given by the difference $(\alpha_B - \beta_{B1})$, which is the amount by which the marginal return for B of i_B is reduced when B has control of the upstream assets but no longer deals with S . In contrast, the level of *marginal asset specificity* for B of i_B is given by $(\beta_{B1} - \beta_{B0})$, which is the degree to which B 's returns are further reduced if he also does not have access to the upstream asset.

A change in the level of marginal people specificity of i_B for B holding the level of asset specificity fixed can therefore be captured by equal-sized reductions in β_{B1} and β_{B0} and has a differential effect on Δ equal to $\frac{1}{2}[i_B^*(1; \cdot) - i_B^*(0; \cdot)]$.¹⁰ This is positive as long as B invests more when he owns the upstream asset. Note that increases in marginal people specificity therefore matter only if there is some marginal asset specificity present – i.e., if $\beta_{B1} > \beta_{B0}$. To understand why the degree of marginal people specificity matters for the integration decision consider first the case in which B under-invests regardless of the ownership structure (as in Hart [1995]). Then the greater is the degree of marginal people specificity of B 's investments, the more distortion there is in B 's investment decision, and the greater is the value of the increase in its level that would be caused by integration; hence, the greater the likelihood that we would observe integration. When instead we have over-investment by B , greater marginal people specificity reduces the distortion in B 's investment level, and so reduces the cost of the increase in B 's investment that would accompany integration.

A change in the level of marginal asset specificity of i_B for B is captured by a decrease in β_{B0} . This leads to a differential change in Δ equal to $\frac{1}{2}[\alpha_B - i_B^*(0; \cdot)]$, which is positive when we are in a case of under-investment.

⁸Readers familiar with Hart's [1995] result concerning relatively unproductive investments [Proposition 2(B), p. 45] may be puzzled by this point, since Hart's result asserts that as a party's investments become relatively unproductive that party should not own assets. The cause of the discrepancy is that when Hart makes an agent's investments relatively unproductive he actually *increases* the marginal returns of investments on disagreement payoffs: in particular, because he makes the marginal returns on investments approach the marginal cost of investment, and because at the equilibrium investment level a weighted average of marginal returns under efficient trade and the disagreement points equals marginal cost, the lower marginal returns on disagreement payoffs must actually be increased by this change. Arguably, it is more natural to think of a more important investment as involving an increase in *all* marginal returns.

⁹In contrast, when i_B is a cross-investment, an increase in its importance that involves equal-sized changes in $\alpha_B, \sigma_{B0}, \sigma_{B1}$ does increase the probability of vertical integration.

¹⁰Alternatively, we can capture this change in marginal people specificity with an increase in α_B .

When i_S is a cross-investment, B 's disagreement payoff will also be affected by S 's investment choice. We can then define the level of marginal people specificity of i_S for B by the difference $(\alpha_S - \beta_{S1})$, and the level of marginal asset specificity of i_S for B by $(\beta_{S1} - \beta_{S0})$.¹¹ The increase in marginal people specificity of i_S for B leads to a differential change in Δ of $\frac{1}{2}[i_S^*(0; \cdot) - i_S^*(1; \cdot)]$, which is positive as long as S invests more when he owns the upstream asset (i.e. when there is marginal asset specificity present). To understand this result, note that such a change increases S 's investments. In the case in which we have under-investment, this reduces the extent of distortion in i_S , and thereby lowers the cost of buyer integration (which reduces S 's investment incentives). Hence, the probability of buyer integration rises. By way of contrast, an increase in the level of marginal asset specificity for B of i_S causes a differential change in Δ of $-\frac{1}{2}[\alpha_S - i_S^*(0; \cdot)]$, which is negative in the under-investment case. This is so because such a change raises S 's investment level under non-integration, which raises the probability of observing that structure.

Parallel definitions can be formulated for the marginal specificity of investments for S . Increases in specificity for S all have the opposite effects from those derived for increases in specificity for B . The results for these cases and those derived above are summarized in Table 2.

2.2. Comparison of the property rights theory with the Williamsonian theory

The foregoing analysis reveals a number of significant distinctions between the property rights theory and the Williamsonian theory. First, and most immediately, while the Williamsonian theory is concerned with the level of quasi-rents, the property rights theory's focus is on the marginal returns to non-contractible investments. These need not be closely related in the data. For example, the level of quasi-rents can vary across situations with absolutely no variation in marginal returns, or even with marginal returns moving in the opposite direction.

Even if marginal returns and the levels of quasi-rents move in the same directions, in the property rights theory the effects of such changes depend delicately on a number of factors. First, changes in marginal returns under different ownership structures have different effects on the probability of observing an integrated structure: in the property rights theory, an increase in the marginal return to a self-investment by B under non-integration has the opposite effect on the probability of integration from the same increase under B ownership.

¹¹The definitions of marginal people specificity are perhaps most natural in the cases in which investments are either purely self-investments or purely cross-investments.

In contrast, such differences do not arise in the Williamsonian theory because quasi-rents are assumed to matter only under non-integration: the owner in a vertically integrated structure is assumed to be able to fully direct the outcome within the integrated firm. In addition, in the property rights theory the effects of changes in marginal returns reverse completely when we focus on cross-investment effects instead of self-investment effects.

Similarly, the responses to changes in the specificity of investments depend on precisely the type of specificity we are considering and whose investment returns are becoming more specific. For example, for self-investment effects, the effect of an increase in either people or asset specificity of B 's investment is the opposite of the effects of similar increases in S 's investment. When we then consider the specificity of cross-investment effects, the effect of greater levels of asset specificity are the same as for the self-investment case, but the effects of greater levels of people specificity are the opposite of those in the self-investment case.

These observations suggest that there are in fact a rich and demanding set of theoretical predictions that in principle can be used to test the property rights theory. However, they also suggest that a great deal of information about the trading environment is necessary to do so.

3. Inferences from Three Prominent Papers

In this section I examine what we can learn about the applicability of the property rights theory from three of the more prominent empirical studies of transaction cost determinants of vertical integration. In turn, I discuss Monteverde and Teece [1982]'s study of automobile assemblers' procurement of automobile components, Masten [1984]'s examination of procurement in the aerospace industry, and Joskow [1985]'s discussion of vertical integration between electric utilities and coal mines.

3.1. Monteverde and Teece [1982]

Monteverde and Teece [1982] (henceforth M&T) provided the first econometric study of the transaction costs determinants of vertical integration. In their path-breaking paper, M&T sought to explain the level of internal versus external procurement for 133 components used by GM and Ford in 1976. M&T focused not on physical asset specificity, but rather on the transaction-specific know-how that would be generated during the design development process:

“We hypothesize that assemblers will vertically integrate when the production process, broadly defined, generates specialized, nonpatentable know-how. ...The existence of transaction-specific know-how and skills and the difficulties of skill transfer mean that it will be costly to switch to an alternative supplier (Teece 1977, 1980). An assembler will tend to choose vertically integrated component production when high switching costs would otherwise lock the assembler into dependence upon a supplier and thereby expose the assembler to opportunistic recontracting or to the loss of transaction-specific know-how.”

M&T used an ordinal measure of the level of engineering effort that went into designing the component to proxy for the likely extent of specialized know-how acquisition. In addition, they included control variables for the specificity of the component to the manufacturer in question (specifically, whether the component can be used directly in a variety of cars), an assembler dummy variable, and subsystem dummy variables. They found statistically significant evidence that both increased levels of engineering effort and increased component specificity raised the likelihood of integration and that GM was more likely to procure internally than Ford, other things equal.¹²

From the standpoint of the Williamsonian theory the results look like a resounding success: the two variables designed to capture the extent of quasi-rents both indicate that greater levels of quasi-rents increase the likelihood of integration. But what do they tell us about the property rights theory? This is not so clear. To begin with, M&T tell us nothing about the extent to which important investments are not contractible: in the absence of non-contractible investments, of course, the property rights theory would predict no effects should be observed (in contradiction to the evidence). More generally, if all of the specificity in this situation is people specificity arising from the acquisition of know-how – that is, if there is no asset specificity for these non-contractible investments – then again the property rights theory tells us that no effects should be observed. Thus, if we are not to reject the property rights theory, we will need to consider models in which non-contractible investments are present whose marginal returns exhibit asset specificity.

To develop such models, we need to think first about how the payoffs for components with a higher level of “know-how” and those with a higher level of component specificity

¹²It is somewhat unfortunate, however, that M&T provided no estimates of the economic magnitude of the engineering and component specificity effects (i.e. the degree to which changes in these variables altered the probability of internal procurement).

differ from those with low levels of each of these variables. In what follows, we shall think of components with a higher level of know-how as having: (i) the same payoff for B in the event he does not reach an agreement with S and does not own the upstream asset, in which case he must use a component not embodying any of this know-how; (ii) a higher level of joint payoff if B and S do trade, since they can then benefit from this know-how; (iii) possibly a higher payoff to B when he does not reach an agreement with S but owns the upstream asset, since some of the know-how may be embodied in the asset; and (iv) possibly a higher level of payoff for S when he fails to reach an agreement with B , since he may be able to use his know-how in sales to other buyers. Thus, we may see increases in some or all of α_B and α_S [point (ii)], $\beta_1, \beta_{B1}, \beta_{S1}$ [point (iii)], $\sigma_0, \sigma_1, \sigma_{B0}, \sigma_{B1}, \sigma_{S0}$, and σ_{S1} [point (iv)].

In contrast, we shall think of an increase in the component specificity variable primarily as reducing the payoffs to S in the event he does not reach an agreement with B , since his component cannot be readily sold to other buyers without modification (possibly leading to reductions in $\beta_0, \beta_1, \beta_{B1}, \beta_{S1}, \beta_{B0}$, and β_{S0}). It is also possible, however, that it may be associated with a decrease in B 's payoffs in the event that he does not reach an agreement with S , since B 's investment may be tailored to the specific component and a more specific component may have fewer alternative sources of supply (possibly leading to reductions in $\sigma_0, \sigma_1, \sigma_{B1}, \sigma_{S1}, \sigma_{B0}$, and σ_{S0}).

With these effects identified, we can imagine a number of plausible property rights models of this situation involving non-contractible investments and asset specificity. As we shall now see, some of these models do produce results that are consistent with the M&T results, while some do not. Consider the following three possibilities:

Model MT1: *Know-how acquisition is exogenous and B makes non-contractible self-investments that are complementary to S 's acquisition of know-how.*

As an example, we can imagine that B invests in marketing and distributing its cars, but the success of these investments depends on the quality of the components that S produces, which is in turn affected by S 's level of know-how. To represent this case, assume that only B has a non-contractible investment, that $\sigma_{B0} = \sigma_{B1} = 0$, and that $\alpha_B > \beta_{B1} > \beta_{B0}$. This last assumption captures that idea that B 's marginal returns to investment are increasing in the level of know-how that is incorporated into the component, and that this is highest when B has access to both S and the upstream asset, and is lowest when B has access to neither S nor the upstream asset. Note that in this situation, B under-invests under either

ownership structure, and invests more when he owns the upstream asset.

Consider first the effects of increasing levels of know-how in such a setting. This would reasonably be expected to increase α_B . Moreover, it might increase β_1 and β_{B1} if S 's know-how is partially embodied into the upstream asset (and so benefits B when B owns this asset and cannot reach an agreement with S). Finally, it might increase σ_0 and σ_1 if S can use its know-how in dealings with other potential buyers in the event that B and S do not trade. In the property rights model, these effects increase the probability of observing integration, and so are consistent with M&T's findings.

Now consider the effects of an increase in the level of component specificity. An increase in component specificity is likely to decrease σ_0 and σ_1 by reducing the degree to which S can use its know-how to serve other buyers in the event of not reaching an agreement with B . This has no effect on the probability of integration. In addition, an increase in component specificity may reduce β_0 , β_1 , β_{B0} and β_{B1} if B 's investment returns are tied to the specific component and more specific components are less likely to be available from an alternative source. While changes in β_0 and β_1 have no effect on the probability of integration, the changes in β_{B0} and β_{B1} have offsetting effects. If they decrease equally – so that the change amounts to an increase in the marginal people specificity of i_B without any affect on its marginal asset specificity – then the probability of integration will increase in the property rights model. Since this reduction in outside sources is more likely to matter when B does not own the upstream asset, we might expect β_{B0} to fall by more than β_{B1} ; that is, asset specificity would increase. This would also lead to an increase in the probability of observing integration.

Thus, the predictions of this first property rights model are fully in accord with M&T's findings.

Model MT2: *B's investments create know-how for S.*

As an example, B may be devoting effort to helping S understand how its component can be more effective in an automobile, where some of this knowledge is specific to B 's automobiles and some applies to all manufacturers' automobiles. To represent this case, assume that only B has a non-contractible investment, that $\alpha_B > \sigma_{B0} > \sigma_{B1} > 0$ (the benefits to S 's know-how are largest when B and S trade, and smallest when S serves other buyers without access to the upstream asset), and that $\beta_{B1} \geq \beta_{B0} = 0$ with $\beta_{B1} > 0$ if some of S 's know-how is embodied in the upstream asset. Under these conditions, B under-invests

and B invests more when he owns the upstream asset.

In this case we expect more know-how to be associated with increases in α_B , in σ_0 , σ_1 , σ_{B0} , and σ_{B1} if know-how can be used by S in his dealings with other buyers when he does not reach an agreement with B , and in β_{B1} if know-how is partially embodied in the asset. The increases in α_B and β_{B1} both raise the likelihood of an integrated outcome under the property rights theory. The changes in σ_{B0} and σ_{B1} have offsetting effects. If more know-how increases σ_{B0} at least as much as σ_{B1} , as would be expected if S is more able to use his know-how when he has access to the upstream asset, then the net effect of the increases in these two parameters is also to increase the probability of integration (when the increases in σ_{B0} and σ_{B1} are equal it amounts to a decrease in marginal people specificity of i_B for S with no change in marginal asset specificity).

In this environment, more component specificity will limit the returns that S can achieve in the event he does not reach an agreement with B . We expect these changes to be associated with decreases in σ_0 , σ_1 , σ_{B0} , and σ_{B1} . It may also reduce β_0 and β_1 if there are fewer alternative sources for a more specific component (we do not expect it to decrease β_{B1} since if this is positive it means that B finds self-production to be optimal when he owns the upstream asset and does not trade with S). Of these parameter changes, only the changes in σ_{B0} and σ_{B1} matter for integration decisions. An equal change amounts to an increase in the marginal people specificity of i_B for S , which *reduces* the likelihood of integration. Moreover, more component specificity may also be expected to decrease σ_{B0} at least as much as it decreases σ_{B1} if the know-how is tied to the specific component and if having access to the upstream asset increases S 's ability to produce the specific component. If so, we would also have a reduction in the marginal asset specificity of i_B for s , which would also serve to reduce the likelihood of integration.

Thus, in this second property rights model, the predicted affects of more component specificty are at odds with M&T's findings.

Model MT3: *S 's investments create know-how for S .*

For example, S 's acquisition of know-how may be determined instead by the effort that S puts into understanding how to produce the component. To represent this case, assume that only S has a non-contractible investment and that $\alpha_S > \sigma_{S0} > \sigma_{S1}$. These inequalities reflect that fact that S 's know-how has the largest return when he has access to the upstream asset and trades with B , and has the smallest return when he has access to neither the

upstream asset nor B as a trading partner. In addition, $\beta_{S1} \geq \beta_{S0} = 0$, with β_{S1} non-zero if some of S 's know-how is embodied in the upstream asset. These assumptions imply that S under-invests under either ownership structure and that he invests more when he owns the upstream asset.

In this case, we expect more know-how to be associated with increases in α_S , σ_0 , σ_1 , σ_{S0} , σ_{S1} , and possibly in β_{S1} if know-how gets embodied in the upstream asset. Increases in α_S and β_{S1} are associated with decreases in the probability of integration. Once again, the increases in σ_{S0} and σ_{S1} have offsetting effects, but if (as we may expect) the increase in α_S is at least as large as the increase in σ_{S0} , which is in turn at least as large as the increase in σ_{S1} , then the net effect of these three changes is to *decrease* the probability of integration (recall that an equal change in all three parameters has no effect, and so the change discussed can be thought of as starting from such a change, and then further increasing both α_S and σ_{S0}).

Increases in component specificity will lead to decreases in σ_0 , σ_1 , σ_{S0} , σ_{S1} , and possibly in β_0 and β_1 if alternative sources for B are more limited when component specificity is higher (again, we don't expect it to lead to a decrease in β_{B1} when this is positive, since if it is positive this means that B 's best alternative when he does not reach an agreement with S and he owns the upstream asset is to self-produce). If σ_{S0} and σ_{S1} decrease equally then we have a pure increase in the marginal people specificity of i_S , which lowers the likelihood of integration. However, we may expect the decrease in σ_{S0} to be at least as large as the decrease in σ_{S1} since his outside alternatives are likely to be hurt more by the increase in specificity when he owns the upstream asset (since he then can produce the specific component). The net effect of this change therefore appears to be ambiguous.

Thus, the predictions of this third property rights model contradict M&T's findings regarding the effects of increased know-how, and possibly also their findings concerning increased component specificity.

The conclusion to be drawn from this discussion seems to be that there is simply not enough information provided in M&T's study to evaluate the predictive power of the property rights model.

3.2. Masten [1984]

Masten [1984] provided the second econometric study of procurement integration decisions. Masten's focus was on the procurement decisions of a large aerospace company over 1,887

components. Masten included as explanatory variables the degree of component complexity (as a measure of the difficulty of complete contracting), the degree to which the component was specialized to this aerospace firm (similar to M&T’s component specificity variable), and the degree to which colocation of facilities or processes was thought to be important (as another measure of quasi-rents). He found that the first two variables had positive and statistically significant effects on the likelihood of integration, while the third variable had a positive but statistically insignificant effect on the likelihood of integration. He also found that the positive effect of complexity seemed to occur only conditional on there being a high level of component specificity, and that the effect of component specificity was much higher when the part was complex.¹³

Once again, the results appear to be a success for the Williamsonian theory, although perhaps a less complete success than the M&T results given the insignificance of the site specificity variable (although the documented importance of the complexity variable adds a distinct supporting piece of evidence). As we have already seen, however, we could readily describe reasonable property rights models of this setting to get the effect of increased component specificity on the probability of integration to go in either direction. Moreover, as I shall discuss in detail when considering Joskow’s [1985] study in the next subsection, a similar conclusion can be drawn about the effects of colocation. Without more detail about the contracting environment, little can be said about the ability of the property rights model to explain the integration patterns found in Masten’s data.

3.3. Joskow [1985]

Joskow [1985] studies the coal procurement decisions of electric utilities. In contrast to the previous two papers, Joskow [1985] is not an econometric exercise, but it does offer its readers a more detailed view of the investment and procurement process than do those papers. Its primary finding regarding vertical integration is that vertical integration appears to be much more likely for “mine-mouth” electric generating plants than for others. This finding is interpreted as being in accord with the Williamsonian theory, since such colocation raises the level of quasi-rents.

What does the property rights theory have to say about the effect of colocation (which, it seems clear, is itself a contractible decision) on the probability of integration? To fix ideas,

¹³One concern, however, is that this finding could be driven by the strong functional form assumptions embodied in the probit model Masten estimated.

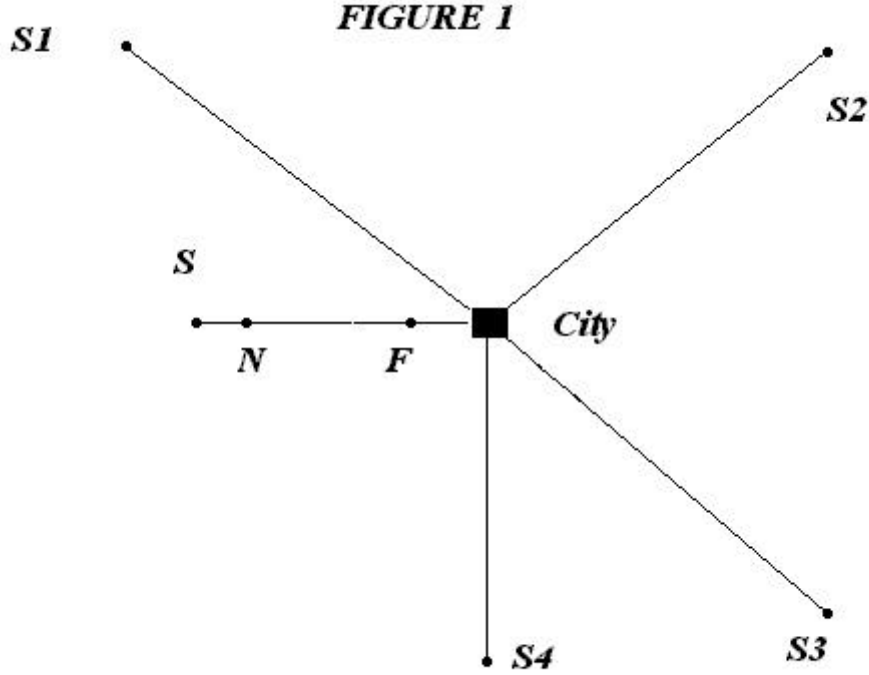


Figure 3.1:

consider Figure 1. There are five potential coal mines, labeled S and $S1$ to $S4$. The buyer, an electric utility plant, serves customers in the city, and the closest coal mine to the city is S . All roads go through the city. Now consider the effect of B moving the location of its plant from F (Far) to N (Near), which is nearer to S and further from all of the other coal mines.¹⁴ Note that it has no effect on S 's payoff when S cannot reach an agreement with B (S 's distance to other electric utilities has not been affected).¹⁵ Thus, in contrast to the component specificity variables in Monteverde and Teece [1982] and in Masten [1984], the colocation variable here affects only B 's disagreement payoffs.

A second difference from the component specificity variable used in those studies is that we can reasonably put much more structure on the effects of colocation. In particular, for given investment choices by the utility and the mine, the effects of colocation on the payoffs when B and S trade, and on their payoffs from each alternative trading possibility in the

¹⁴It is worthwhile noting that the effects derived below would reverse if moving closer to S_1 also moved B closer to the other coal mines.

¹⁵Note that in actual data it could be that colocation decisions do (on average) affect the distance of the coal mine to other electric utility plants, in contrast to our maintained assumptions here.

event of a disagreement, arise solely through the changes it induces in transportation costs (of coal and electricity). As a result, any effects on the marginal returns to investments due to colocation can arise solely through the changes it induces in the identity of B 's next-best alternative in the event that he does not reach an agreement with S . For example, moving closer to S may mean that B 's next-best alternative when it owns S 's asset is to bring in another manager, rather than to procure from another coal mine, which it might find is its next-best alternative if it is located at N .

With this in mind, we can see that the effects of colocation on the probability of observing vertical integration in a property rights model are once again in general ambiguous. To start, note that if B 's next-best alternative under each ownership structure is independent of its location (e.g., if – regardless of his location – B would procure from another mine if he does not own the upstream asset but would bring in a manager to run the mine if he did own it), then colocation has no effect on the probability of integration: in this case, colocation changes transport costs, but not the marginal returns to non-contractible investments. On the other hand, to see that colocation can have effects in either direction, consider the following two models:

Model J1: Suppose that S invests in coal quality (or maintenance of the coal mining equipment) and that when B is at F his next-best alternative in the event he does not reach an agreement with S is to procure from another mine, regardless of whether he owns the mine. However, suppose that when he is located at N his next-best alternative is procuring from another mine if he does not own the mine, but is bringing in a manager to run the mine if he does own it (that is, colocation lowers the payoff to outside procurement, and thus leads B to optimally run the mine when located at N). Formally, we would have $\beta_{S0} = \beta_{S1} = 0$ when B is located at F , but we would have $\beta_{S1} > \beta_{S0} = 0$ when B is located at N . In this case, S always under-invests, and reduces his investment when B is located at N and owns the mine. Our previous results therefore tell us that in this case colocation leads to a reduction in the probability of integration: intuitively, by keeping the mine out of B 's hands when B is located next to the mine, non-integration keeps S from worrying that by investing in coal quality he is improving B 's disagreement position.

Model J2: Now suppose that B invests solely in developing a capability for burning coal from mines S_1, \dots, S_4 . Maintain the same assumption about B 's next-best alternatives as in Model J1. In this case, the social value of his investment is zero: $\alpha_B = 0$. Then we

have $\beta_{B0} = \beta_{B1} > 0$ when B is located at F ; when B is located at N , β_{B0} is unchanged but now $\beta_{B1} = 0$. Here, B over-invests if he is located at F or under nonintegration if he is located at N , while he invests efficiently (i.e. does not invest) when he is located at N and owns the mine. Hence, colocation is associated with an increase in the likelihood of integration.

Once again, despite the relatively greater informativeness of Joskow's paper about the contracting and production environment he studies, there is insufficient information to evaluate the property rights model.

4. Conclusion

Understanding the impacts of the integration of economic activities is a central and important question in economics. It plays a role in matters ranging from optimal corporate organizational strategy, to optimal government procurement policy, to the antitrust evaluation of vertical mergers. The work of the last 20 years has greatly improved our understanding of these issues. Yet, as the discussion here indicates, we still have quite a limited understanding of the determinants of integration. Here I have emphasized the need to devise more demanding tests of our theories, with special reference to identifying the predictive power of the property rights model.¹⁶ These studies will need to examine empirically the quite detailed predictions of the property rights models, and are likely to require more detailed information about the contracting environments being studied than existing studies. At the same time, such studies are likely to put the Williamsonian model to more stringent tests as well. Indeed, although nearly all existing empirical evidence seems consistent with the Williamsonian theory, there appears to be a significant possibility that these more detailed and demanding tests will uncover evidence that is inconsistent with it: After all, in a variety of settings we see firms deliberately increasing the extent of quasi-rents in their trading relationships (for example, by signing exclusive contracts). Some start on this agenda has been made in recent papers by Hanson [1996], Woodruff [1996], and Baker and Hubbard [1999].

¹⁶Despite my focus on the property rights and Williamsonian models here, the evaluation of other theories of vertical integration, such as agency theories in which managers are interested in "empire-building", is of equal importance.

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TABLE 1

Effects of Increases in Marginal Returns on the Probability of Integration
(Under-investment Case)

(a) *Self-Investment Effects:*

		Under:	
		Nonintegration	Integration
Investment by:	B	$(d\beta_{B0} > 0)$ —	$(d\beta_{B1} > 0)$ +
	S	$(d\sigma_{S0} > 0)$ —	$(d\sigma_{S1} > 0)$ +

(b) *Cross-Investment Effects:*

		Under:	
		Nonintegration	Integration
Investment by:	B	$(d\sigma_{B0} > 0)$ +	$(d\sigma_{B1} > 0)$ —
	S	$(d\beta_{S0} > 0)$ +	$(d\beta_{S1} > 0)$ —

TABLE 2

Effects of Increases in Marginal Specificity on the Probability of Integration
(Under-investment and Asset Specificity Case)

(a) *Self-Investment Effects:*

		Type of Marginal Specificity:	
		People	Asset
Investment by:	B	$(d\beta_{B1} = d\beta_{B0} < 0)$ +	$(d\beta_{B0} < 0)$ +
	S	$(d\sigma_{S0} = \partial\sigma_{S1} < 0)$ -	$(d\sigma_{S1} < 0)$ -

(b) *Cross-Investment Effects:*

		Type of Marginal Specificity:	
		People	Asset
Investment by:	B	$(d\sigma_{B0} = d\sigma_{B1} < 0)$ -	$(d\sigma_{B1} < 0)$ +
	S	$(d\beta_{S1} = \partial\beta_{S0} < 0)$ +	$(d\beta_{S0} < 0)$ -