A Costly Contracting Approach to the Organization of Production*

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Abstract

What determines the boundaries of organizations and the cost-based incentives within and between contracting entities? These questions have received much attention, and many approaches have been developed. Building on ideas from transaction cost economics, agency theory and property rights theory, we develop a general procurement model that highlights the trade-off between productive efficiency and the costs of administrating performance contracts. We recast the question of firm boundaries as one of contracting over inputs or outputs, resulting in empirically testable predictions that are consistent with several previous studies. Our results demonstrate why control and cost incentives will shift in complementary ways, laying some foundations to the definition of hierarchy and market transactions within transaction cost economics.

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1 Introduction

The procurement of goods and services is crucial for the functioning of a productive economy. Coase (1937) observed that an important question lies at the center of any procurement decision: should the procurer, or buyer, "make" the good or service internally to his organization, or should he "buy" it through the market from a separate entity? This question was only partially addresses by Coase, but he laid out the framework for future investigation: the economic approach to designing the organization of production must acknowledge that there are costs and benefits from different modes of procurement, and as such, every transaction will be procured in the most efficient manner. However, what determines these costs and benefits was not fleshed out.

More specifically, after Coase (1937) raised the important question of what should the firm "make" and what should it "buy", three main theoretical directions were developed. The first is Transactions Cost Economics (TCE), championed by Williamson (1975, 1985), which following Commons (1932) asserts that "the transaction is the basic unit of analysis and insists that organizational form matters." (1985, p. 18). One basic idea of TCE is that internal organization will allow for more flexible adaptation to events that are hard to contract over, a problem that is severely enhanced in the presence of high levels of quasi-rents that parties have an incentive to appropriate. TCE then develops empirically relevant predictions on ways in which asset-specificity and transaction complexity will affect the make-or-buy decision, and several studies have verified these predictions.

However, as Hart (1995) argues, the mechanisms that change the nature of the transaction from "buy" to 'make" are not well specified by TCE (Hart, 1995 Ch. 1), leaving the theory itself incomplete, and requiring a more rigorous investigation. This theoretical gap is addressed by the second approach to firms developed by Grossman and Hart (1986) and refined by Hart and Moore (1990), now widely known as the Property Rights Theory (PRT). Using a clean and precise definition of ownership as the right to control ex post decisions, PRT offers a theory of integration that rests on the costs and benefits of allocating decision rights to different parties. The theoretical advance of PRT over TCE allowed PRT to be applied in to variety of organizational issues above and beyond the traditional make or buy question. This, however, comes at a cost that Whinston (2003) convincingly expressed, which is that the empirical content of PRT is all but impossible to take to available data.

The third approach to firms is the applications of agency theory, most notably Holmstrom and Milgrom (1991, 2004), who investigate the reasons that clusters of attributes seem to co-move together in describing the organization of production. That is, the employment relationship is characterized by restrictions on activities, low powered incentives (or output-insensitive pay) and no ownership of assets, whereas external transactions have the opposite attributes. Their theory is consistent with stylized facts, but like other agency models has a rich set of predictions on observed outcomes that is hard to take to data, and the exogenous parameters of these models are hard to measure.

Our theoretical approach offers a useful contribution to the vast literature on the theory of organizing productive activities. The procurement problem we investigate is generally applicable, be that of an automobile manufacturer who needs to procure a braking system, or an accounting firm who needs to procure information technology services. A natural question that scholars of organization economics should ask is whether we need to develop a theory of our own given the availability of not one, but many theories of the firm. Our answer lies in the observation that the most common approaches to the theory of the firm suffer from deficiencies that encourage the development of a somewhat different theoretical approach.

Our theory builds on insights from TCE in that we consider contractual costs that are transaction specific, but we expand this to include the Property Rights definition of control over decisions. As such, we define the make-or-buy comparison by focusing on whether the buyer (make) or the seller (buy) control decisions that are not contractible. We then augment this with the buyers choice of how much to invest in completing the design and specification, and the resulting contracting framework ties together both incentives and control endogenously.

The contractual arrangements between the contracting parties is in the spirit of Holmstrom and Milgrom (1994), but departs from most of the agency literature that focuses on the strengths of incentives, and instead focus on the choice of contracting over inputs or outputs, a point that has been explored by Lazear (1986, 2000), but has not been explored in the context of procurement methods and the optimal organization of production. The strengths of incentives, however, are well aligned with the optimal contracting choices in that the choice of “make” has the seller face no cost-incentives, whereas the choice of a “buy” arrangement has the seller facing the strongest possible cost incentives.

The merits of our approach are twofold. First, we offer a parsimonious model that, building on much of the seminal work mentioned above, is able to offer a simple alternative view to the make-or-buy decision as one that distinguishes between contracting on inputs versus contracting on outputs, where decisions are an input into production. Second, our focus is common with TCE in that we take the transaction to be the basic unit of analysis, and as such, are interested in identifying characteristics of transactions that will be empirically measurable, giving our approach the advantage of being more applicable to empirical scrutiny.

We proceed by laying out the formal model, and continue to analyze the way in which control over decisions go hand in hand with which party faces string cost-reducing incentives. We then tie the optimal contracting choice to the measurable characteristics of transactions, and describe several empirical studies that are consistent with our approach. We conclude with a brief discussion of where else the approach can be taken.

2 A Contracting Model

Builds on Levin and Tadelis (2006), Bajari and Tadelis (2001), and Grossman and Hart (1986). I need to check to see how this relates to Riordan and Williamson (1985).

2.1 Technology, Endowments and Preferences

Consider a transaction in which a buyer wishes to procure one unit of a good or service from a seller. For simplicity, we will assume that labor and decisions are the only variable inputs relevant for the ex post performance of the good or service that is provided.[1]

We consider the good or service to have a one dimensional “quality” measure that summarizes how good the final product fits the needs of the seller. Generally, the good may have many attributes, but we assume that these can be scored in a way that results in a sort of

[1] It is possible to include yet another natural input, capital, which affects the final output. The main results will be maintained if capital des not alter the separable qualities of the production function.

summary score $q \geq 0$ for which more is better. Specifically, we assume that quality is given by the production function

$$q = (\rho + e) f(d, \varepsilon) t,$$

where $t \geq 0$ is labor time spent the seller spends on the job, $\rho > 0$ is some baseline productivity, $e \geq 0$ is the seller's effort intensity (e.g. attention to detail, problem-solving activities, or physical exertion), and $f(d, \varepsilon)$ is the total productivity that is a function of the production decision $d \in D$ that are made, and some noise ε. For simplicity, the noise $\varepsilon \in [\underline{\varepsilon}, \overline{\varepsilon}]$ is uniformly distributed, where $\overline{\varepsilon}$ is a measure of ex post uncertainty – a higher $\overline{\varepsilon}$ means that ex post there is more randomness on the optimal decision d.

For concreteness, it is useful to think of the possible set of decisions D as how to allocate time and effort among a variety of non-contractible activities, and the noise is an ex post realization that affects the optimal decision. We assume that D is a compact subset of $\mathbb{R}$. We also assume that $f(\cdot, \cdot)$ is continuously differentiable in both dimensions. Also, we simplify further by assuming that for any $\varepsilon \in [\underline{\varepsilon}, \overline{\varepsilon}]$, there is a unique $d(\varepsilon) \in D$ that maximizes $f(d, \varepsilon)$, and that for any two $\varepsilon, \varepsilon'$, $f(d(\varepsilon), \varepsilon) = f(d(\varepsilon'), \varepsilon') > \max\{f(d(\varepsilon'), \varepsilon), f(d(\varepsilon), \varepsilon')\}$. This assumption basically posits that for any disturbance, there is an optimal decision response, that guarantees the best productivity, and any other response is suboptimal.

The seller is endowed with T units of time that can be allocated between working for the buyer and working in an outside competitive labor market. When working for the buyer, the seller bears a personal cost of effort equal to $c(e, d)$ per unit of time, where $c_e, c_{ee} > 0$.[2] We also assume that for any choice e, there is a unique $d^S(e) \in D$ that minimizes $c(e, d)$. The outside job requires no effort intensity and pays a wage $w > 0$ per unit of time.

The seller has preferences over income and labor costs. If he is paid $\overline{w} \geq 0$ by the buyer, if the decision made is $d \in D$ and he spends t hours on the job at an effort intensity e, his utility is

$$U = \overline{w} - c(e, d)t + (T - t)w.$$

The buyer cares about performance-quality and the costs of the good or service. To

[2] We treat labor intensity as a one-time choice, but this involves no loss of generality. If instead the agent were to choose a complete time path of effort, the convexity of $c(\cdot, \cdot)$ in e would still make it optimal to work at a constant labor intensity e.

capture the idea that higher specificity implies that the agent's effort is more productive, we let $s \in [0,1]$ denote the level of specificity. If the quality provided is q, the specificity is s and the payment to the seller is $\overline{w}$, the buyer's net benefit is

$$V = v(Eq),$$

where $v'(\cdot) > 0$. To guarantee a unique optimal contract, we also assume that there are decreasing returns to expected quality, so $v''(\cdot) < 0$.

2.2 Contracting on Decision Rights, Time and Performance

Following Grossman and Hart (1986), we assume that decisions cannot be contracted for ex ante, and we take the extra step as in Hart and Holmstrom (2004) and assume that they cannot be contracted for ex post. We assume, however, that the parties can contract on who has control over the decisions. That is, we consider d to be decisions made during the process of production that are aimed to adapt the design and specification process to better achieve the outcome q.

We also assume that payments from the buyer to the seller can be made contractually conditional on two requirements: performance, q, and time spent on the job, t. For instance, if the buyer wanted the seller to provide a software package that controls some part of the buyer's ultimate product, the contract could specify performance requirements such as the parameters that are used by the program, the general algorithms that need to be used, and other key features of the program. Alternatively, the contract could specify that the seller spends forty hours a week for six weeks providing programming services as directed by the buyer. While time and performance requirements are contractible, however, we assume that labor intensity, e, is not. This implies that a contract cannot precisely specify what is to be done at every moment in time, and the seller will always have some discretion over his efforts.

A contract therefore is a collection $(\overline{w}, \overline{q}, \overline{t}, i)$, where $i \in \{B, S\}$ specifies whether the buyer or seller have control over which production decision $d \in D$ to choose, $\overline{t}$ specifies a minimum amount of time the seller must spend on the job, $\overline{q}$ specifies is a minimum quality standard, and $\overline{w}$ specifies the amount the buyer will pay the seller if the time and performance standards are met.

Following the premise of transaction cost economics, we assume that there are costs both to specify and enforce contracts, and that these depend on the complexity and uncertainty that are inherent to the transacted good or service. To keep things simple, we assume that the costs of specifying and monitoring compliance with $\overline{t}$ are minimal, but it is costly to specify and/or verify compliance with a quality standard $\overline{q}$. For example, to meet certain quality thresholds several things may need to be described in advance, like lists of instructions and ex post measurement procedures (Bajari and Tadelis, 2001). Furthermore, when the job is delivered, then to verify the delivery of $\overline{q}$ the buyer will usually have to rely on a certain monitoring and measurement technology that has its own set-up costs and operating costs (Barzel, 1982). Thus, both the "front end" of contracting (design and specification) and the "back end" (measurement and monitoring) induce contracting costs that vary with the complexity of the good or service.

We assume that to specify a minimal standard of $\overline{q}$, the buyer must expend costs equal to $z(\overline{q}, h)$. The parameter h is intended to capture how "hard" contracting is due to complexity and uncertainty. For example, h might capture the difficulty of describing performance requirements ex ante, or adjusting them over time. Alternatively, h might describe the difficulty of measuring or monitoring quality. Accordingly, we assume that $z_h > 0$. We also assume that $z(0, h) = 0$ and $z_{\overline{q}} > 0$, so that specifying and monitoring a higher standard is more costly, but there is no cost if no standard is specified. Finally, we assume that $z_{\overline{q}\overline{q}} > 0$, so that for a given service each increase in performance standards comes at increasing cost. This seems natural if specifying and monitoring basic issues is rather simple, but for refined issues it is increasingly difficult to specify standards and verify compliance. (See Bajari and Tadelis, 2001, for a more fundamental model along these lines.)

3 Incentives and Control

3.1 Employment versus Contracting

We define two modes of governance that are determined by which party has control over the decisions $d \in D$. In the mode of governance we call a "employment" the buyer dictates decisions to the seller, so that $i = B$. Similarly, we define "contracting" to have $i = S$ so that the seller makes production decisions. This is in line with the seminal works of Coase (1937), Simon (1951) and Williamson (1975, 1985).

Suppose the buyer and seller agree to a employment contract $(\overline{w}, \overline{q}, \overline{t}, B)$. If the seller intends to honor the contractual requirements, and if he expects the buyer to choose $d^B \in D$, he chooses his effort e and time on the job t to solve

$$\begin{array}{lll} \max_{e,t} & \overline{w} - c(e, d^B)t + w(T - t) & \\ \text{s.t.} & t \geq \overline{t} & (EC) \\ & (\rho + e)\, f(d^B)t \geq \overline{q} & (PC) \end{array}$$

Similarly, with a contracting contract $(\overline{w}, \overline{q}, \overline{t}, B)$, the seller chooses $d^S \in D$, effort e and time on the job t to solve

$$\begin{array}{lll} \max_{e,t,d^S} & \overline{w} - c(e, d^S)t + w(T - t) & \\ \text{s.t.} & t \geq \overline{t} & (EC) \\ & (\rho + e)\, f(d^S)t \geq \overline{q} & (PC) \end{array}$$

In either case, the seller faces two constraints. The *employment constraint* (EC) states that he must spent at least the specified amount of time on the job; the *performance constraint* (PC) states that he must deliver at least the specified quality $\overline{q}$. Given our assumptions, the seller's problem has a unique solution which is independent of the contingent payment $\overline{w}$. We denote the best response to the contract $(\overline{w}, \overline{q}, \overline{t}, i)$ as $e^E(\overline{q}, \overline{t}, d^B)$ and $t^E(\overline{q}, \overline{t}, d^B)$ when $i = B$ (employment), and $e^C(\overline{q}, \overline{t}, d^B)$ and $t^C(\overline{q}, \overline{t}, d^B)$ when $i = S$ (contracting).

Now consider the optimal employment contract from the point of view of the buyer. This contract solves

$$\begin{array}{lll} \max_{(\overline{w},\overline{q},\overline{t},d^B)} & E[v(\overline{q})] - \overline{w} - z(\overline{q},h) & \\ \text{s.t.} & (e,t) = (e^*(\overline{q},\overline{t},d^B), t^*(\overline{q},\overline{t},d^B)) & (IC) \\ & \overline{w} - c(e,d^B)t + w(T-t) \geq wT & (IR) \end{array}$$

The *incentive compatibility* constraint (IC) states that the seller will allocate his effort and time optimally given the contract. The *individual rationality* constraint (IR) states that the seller prefers to accept and honor the contract rather than not. This second constraint will bind for any optimal contract.

Similarly, the optimal contracting contract solves

$$\begin{array}{lll} \max_{(\overline{w},\overline{q},\overline{t})} & E[v(\overline{q})] - \overline{w} - z(\overline{q},h) & \\ \text{s.t.} & (e,t,d^S) = (e^*(\overline{q},\overline{t}), t^*(\overline{q},\overline{t}), d^S(e^*)) & (IC) \\ & \overline{w} - c(e,d^S)t + w(T-t) \geq wT & (IR) \end{array}$$

where again, the (IR) constraint must bind.

We now use the buyer's and seller's optimization problems to prove our first main result. The optimal contract will specify either time on the job or a performance standard, but never both. Furthermore, if the optimal employment contract specifies performance, then employment is not optimal, while a contracting contract that specifies only performance is. The intuition is as follows. Because contracting is costly, it could only be optimal to specify both requirements $\overline{q}$ and $\overline{t}$ if this resulted in both the employment and performance constraints binding for the seller. But if both constraints were to bind, then by revealed preference, the seller could deliver the same quality at lower utility cost by substituting effort for time. As the buyer cares only about performance and money, he would do better to drop the time requirement and lower the wage. But then, he would do even better by letting the agent choose $d \in D$ to further reduce the costs of provision for the same quality $\overline{q}$.

Proposition 1 If employment is optimal, then the optimal contract $(\overline{w},\overline{q},\overline{t},i)$ has the form $(\overline{w},0,\overline{t},B)$. If contracting is optimal then the optimal contract has the form $(\overline{w},\overline{q},0,S)$.

Proof. By way of contradiction, suppose the optimal contract $(\overline{w}, \overline{q}, \overline{t}, i)$ has $\overline{q} > 0$ and $\overline{t} > 0$. If (PC) binds at the solution to the seller's problem, then the contract $(\overline{w}, \overline{q}, 0, i)$ will result in the same quality $\overline{q}$ at a marginally lower contracting cost. If instead (PC) does not bind at the solution to the seller's problem, then the contract $(\overline{w}, 0, \overline{t}, i)$ will result in the same quality at lower contracting cost. Hence, the optimal contract can take on one of two forms: $(\overline{w}, \overline{q}, 0, i)$ or $(\overline{w}, 0, \overline{t}, i)$. We need to show that that it cannot be $(\overline{w}, 0, \overline{t}, S)$ nor can it be $(\overline{w}, \overline{q}, 0, B)$. By way of contradiction, assume first that the optimal contract is $(\overline{w}, \overline{q}, 0, B)$. Since the buyer chooses $d^B(\varepsilon) \neq d^S$, by letting the seller choose d, the seller can lower his costs of labor, and in turn the buyer can obtain the same quality $\overline{q}$ at a lower cost $\overline{w}$. Similarly, by way of contradiction, assume second that the optimal contract is $(\overline{w}, 0, \overline{t}, S)$. Since the seller always chooses $e = 0$ and $d = d^S(0)$, the buyer can increase his productivity by taking control over the decision of d without having a higher cost of compensating the seller. *Q.E.D.*

This result not only simplifies the problem, but adds meaning to the seller's contractual constraints, and to the way these constraints will bind in equilibrium. Namely, if (EC) binds but (PC) does not, then the optimal contract $(\overline{w}, 0, \overline{t}, B)$ looks very much like an *employment relationship* in which the seller agrees to spend a fixed amount of time on the job, and cares little about what needs to be done as long as he is not asked to provide costly effort intensity. In contrast, when (PC) binds but (EC) does not, the optimal contract $(\overline{w}, \overline{q}, 0, S)$ looks very much like a *contracting relationship* (or specific-performance relationship) in which the seller has all the discretion over how to allocate his time and effort, and he is bound by the performance specifications of the contract.[3]

There is a further contribution that this result offers. The existing literature on the organization of production typically separates its focus of attention between "incentives," how much of the costs and benefits are born by the seller, and "control," who has the power to make decisions regarding the production process. As Williamson (1985) argued, empirical observation suggests that incentives and control seem to be tied together. Our framework

[3] The view of employment that we adopt here is reminiscent of Holmstrom and Milgrom (1991), who emphasize that employment is characterized by *exclusion*. In our model, a salaried employee is excluded from working in the outside market by the specified time on the job $\overline{t}$, meaning that on the job he will do what is desired, only at a low baseline productivity.

offers a simple intuitive insight about why these contracting dimensions would indeed be tied together.

When a performance specification $\overline{q}$ is contractually binding, the buyer is effectively specifying the "output" that the seller is obliged to deliver. By controlling decisions, or specifying constraints on labor inputs such as time, the buyer is unnecessarily meddling with the inputs into the production process because it would just interfere with the sellers ability to optimize and deliver $\overline{q}$ at the lowest possible cost. Thus, when performance is called for by the contract, the seller bares all the costs (high incentives) and is not directly compensated for time on the job, and at the same time he also controls all decisions regarding the production process as uncertainty is resolved.

When instead of performance the contract specifies time on the job, the buyer is compensating the seller for the input of his labor time. Since the seller does not bare the costs of production, and is not bound to a performance delivery of $\overline{q}$, he will not be responsive to making decisions that best adapt to the resolution of uncertainty. As such, it is in the buyers best interest to maintain control over the decisions d.

We next turn to analyze how the characteristics of the transaction, namely the complexity and uncertainty, will affect the optimal choice of contracts.

3.2 Optimal Governance

We start by identifying the least cost way to procure an arbitrary level of quality q. We then consider the optimal choice of quality. With an employment contract $(\overline{w}, 0, \overline{t}, B)$, recall that the seller chooses $e = 0$ and the buyer controls decisions so that for any realization ε he chooses $d(\varepsilon)$. Letting $\overline{f} = f(d(\varepsilon), \varepsilon)$, which is by assumption independent of ε, to obtain quality q the buyer must specify $\overline{t} = q/\rho\overline{f}$ and pay the seller

$$q = (\rho + e)f(d, \varepsilon)t,$$

$$W(q|EC) = \frac{w}{\rho\overline{f}}q.$$

To obtain quality q with a performance contract $(\overline{w}, q, 0, S)$, the seller's problem is

$$\max_{e,t,d^S} \overline{w} - c(e,d)t + w(T-t)$$
$$\text{s.t. } (\rho+e)f(d,\varepsilon)t \geq q.$$

and letting λ denote the multiplier, the three first order conditions are:

$$\begin{aligned} \lambda f(d,\varepsilon) &= c_e(e,d) \\ \lambda((\rho+e)f(d,\varepsilon)) &= c(e,d)+w \\ \lambda(\rho+e)f_d(d,\varepsilon)t &= c_d(e,d)t \end{aligned}$$

Notice that the optimal effort level and the optimal decision is independent of q, so we denote these by $e^S(\varepsilon)$ and $d^S(\varepsilon)$. The optimal time allocation is $t^S(\varepsilon) = q/\left(\rho + e^S(\varepsilon)\right) f(d^S(\varepsilon), \varepsilon)$. To make the contract acceptable, the buyer must pay the seller

$$W(q|PC) = E\left[\frac{w + c(e^S(\varepsilon), d^S(\varepsilon))}{(\rho + Ee^S(\varepsilon))f(d^S(\varepsilon), \varepsilon)}\right] q.$$

Because the seller's choice of production inputs is constrained under an employment contract, the labor cost of producing quality q is lower under a contract that simply specifies a performance requirement. Consequently, we have the following result.

Proposition 2 For all $q > 0$, $W(q|PC) < W(q|EC)$ and $\frac{dW(q|PC)}{dq} < \frac{dW(q|EC)}{dq}$.

Proof. The first inequality follows from revealed preference. The input mix $e^S(\varepsilon)$, $t^S(\varepsilon)$, and $d^S(\varepsilon)$ is the seller's least cost way of producing quality q, so it must be that $W(q|M) < W(q|H)$. The second inequality follows directly from the first. *Q.E.D.*

Proposition 2 states that ignoring contracting costs, performance contracts will result in more efficient production. Accounting for contracting costs, however, an employment contract can implement quality q at cost $W(q|EC)$, while the cost is $W(q|PC) + z(q,h)$ with a performance contract. The cost of implementing q is therefore

$$C(q,h) = \min\{W(q|EC), W(q|PC) + z(q,h)\}.$$

The cost function $C(q, h)$ is the lower envelope of $W(q|EC)$ and $W(q|PC) + z(q, h)$. A useful observation is that because labor costs are linear, the latter cost function will cross the former at most once, from below, provided that $z_{qq} > 0$, i.e. that the costs are contracting are convex. This implies that if an employment contract is the most effective way to implement quality q, it will be most effective for all higher quality levels. Recall that our interpretation of q is "better matches" the buyers needs, hence it is a form of how complete the contract really is.

The optimal contract quality is the solution to the problem

$$\max_{q} \quad v(q) - C(q, h).$$

We are interested in how the optimal contract varies with the difficulty of specifying and enforcing performance standards h. Our next result provides a characterization.

Proposition 3 If contracting difficulty h increases, the buyer will be more likely to use an employment contract, while the optimal quality may increase or decrease.

Proof. Consider an increase from h to h'. The costs of implementing any quality q with an employment contract are unchanged, but the costs of implement any q with a performance contract are higher for h' than for h. Therefore an increase from h to h' makes a performance contract less likely to be optimal. The optimal quality could move up or down however. To see this, suppose the optimal contract under h is a performance contract. If the same is true under h' and $z_{qh} > 0$ then it is optimal to reduce quality. On the other hand, if the optimal contract under h' is now an employment contract, it will involve an increase in quality. *Q.E.D.*

The proposition is straightforward: increased costs of specifying performance standards will reduce the use of specific performance contracts. Notice that requiring convexity of $z(\cdot, \cdot)$ in q ($z_{qq} > 0$) is not necessary for the comparative static result.

Remark 1 *We have only one comparative static parameter, h. It is possible to add another common parameter like relationship specificity by modifying the value function of the buyer to be $sv(q) + (1 - s)\overline{v}$ where $\overline{v}$ is the "market value" that the buyer can obtain and $v(q) > \overline{v}$.*

Then, $s \in [0,1]$ would be a measure of specificity. Such a change would leave he analysis above valid, but would add an obvious comparative static: an increase in s will make it more valuable to increase q, and if $z_{qq} > 0$ then this leads to employment contracts being more desirable. Thus, the common prediction of TCE in which relationship specificity favors "make" will be provided, together with the results described above.

4 Empirical Applications

As mentioned above, one of our main goals has been to offer a framework that lends itself to empirical investigation, much in the spirit of TCE. As such, it is easy to refer to some of the empirical literature that investigates the premises of TCE, such as the well known papers by Kirk Monteverde and David Teece (1982), who investigate the automobile industry, and Scott Masten (1984), who investigates procurement in aerospace. Both studies show that more complex components, measured by a variety of engineering inputs, are procured internally, whereas simpler components are bought through the market. More recent work has further supported these empirical regularities .(See, e.g., Novak and Eppinger (2001) and Simester and Knez (2001).)

[**more to be added from other studies**]

The forces that favor internal versus external production that we emphasize are not unique to the private sector. Government procurement is a large part of GDP in many, if not all developed economies. As such, the government too is faced with the decision of which services and goods it should provide by itself, and which should be contracted out to external contractors? In Levin and Tadelis (2006), we build on the framework developed here to test the behavior of US cities with respect to the choice of which services to provide with their own employees, and which to contract from external sources. In that paper we find that services that are characterized by high transactions costs due to the complexity of their nature are less likely to be privatized, consistent with our theoretical predictions.

[**to be completed**]

5 Concluding Remarks

[to be completed]

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