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Transaction Cost Economics*

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1 Introduction

The study of the governance of economic organization has become a lively and diverse field of research over the last four decades. This chapter describes the fundamental ideas of Transaction Cost Economics (TCE) as these evolved in the 1970's to offer a methodology through which to analyze how the governance of economic organization has economizing consequences. Our view, as well as the general outlook of TCE, is that organization matters for economists *if and as organization is made susceptible to analysis* by the application of economic reasoning.

As such, TCE is part of a broader effort to study the economics of organization, which includes agency/mechanism-design theory, team theory, property rights theory, and resource-based/competency theories. Many of these are explored in this handbook and, as appropriate, we make references to the similarities and difference between them and TCE. Lest we be misunderstood, we do not regard TCE as an all-purpose theory of firm and market organization. Instead, we subscribe to pluralism – on the conditions that all candidate theories (1) name the phenomena to which they apply and (2) derive refutable implications that lend themselves to empirical testing. Subject to these provisos, we are certain that a richer, deeper, better understanding of complex economic organization is well-served by the spirit of pluralism.

We begin in Section 2 by sketching early contributions upon which TCE builds and describe how TCE differs from the orthodoxy of the 1960s in three crucial respects: moving from the *lens of choice* to the *lens of contract*; taking *adaptation* to be the main problem of economic organization; and taking *transaction cost economizing* to be the main case for deriving refutable implications.

In Section 3 we lay out the working parts by which TCE was transformed into an operational methodology by taking the "make-or-buy" decision to be the focal transaction. We thereafter introduce the key idea that transactions, which differ in their attributes, will be implemented by different modes of governance, which differ in their adaptive strengths and weaknesses. Section 4 presents a simple formal model of TCE that parallels the less formal arguments of Section 3, with emphasis on how the choice of governance implements different contractual incentives. Extensions and applications – to include hybrid contracting, reality testing, variations on a theme, empirical TCE, and ramifications for public policy – are sketched in Section 5. Section 6 relates TCE to other economic theories of organization. Section 7 concludes.

2 Background and Essential Ideas

TCE traces its origins to a series of developments between 1930 and 1970 in economics (Commons, 1932; Coase, 1937, 1960; Hayek, 1945; Simon, 1951; Arrow, 1969), organization theory (Barnard, 1938; Simon, 1947; Selznick, 1949), contract law (Llewellyn, 1931; Summers, 1969), and business history (Chandler, 1962). Because this chapter is mainly directed to an economics audience and since organization theory, contract law, and business history are addressed elsewhere,[1] we focus in this section, as well as this chapter, mainly on the economic arguments.

[1] On organization theory, contract law, and business history, see Williamson (1993, 2005b, and 1985, chap. 11, respectively).

2.1 Transactions and Transaction Costs

Albeit largely ignored in textbook micro-economic theory, John R. Commons early perceived the need to move beyond simple market exchange (e.g., exchanging nuts for berries on the edge of the forest or buying a can of coke at a vending machine), to include transactions for which the *continuity* of an exchange relationship was often important. He furthermore described the fundamental problem of economic organization as follows: "the ultimate unit of activity ... must contain in itself the three principles of conflict, mutuality, and order. This unit is a transaction." (Commons, 1932, p.4). As developed in section 3, TCE concurs that the transaction is the basic unit of analysis and treats governance as the means by which to infuse order, thereby to mitigate conflict and realize mutual gain.[2]

Ronald Coase, in his classic 1937 paper on "The Nature of the Firm," both introduced the concept of transaction costs to the study of firm and market organization[3] and uncovered a serious lapse in the accepted textbook theory of firm and market organization. Upon viewing firm and market as "alternative methods of coordinating production" (1937, p. 388), Coase observed that the decision to use one mode rather than the other should not be taken as given (as was the prevailing practice) but should be derived. Accordingly, economists were advised "to bridge what appears to be a gap in [standard] economic theory between the

[2]Whereas Commons viewed organization and the continuity of contractual relations as important, the economic paradigm of resource allocation, which dominated the field all through the 1970s, made negligible provision for either. Instead, It focused on prices and output, supply and demand. The institutional economics of the 1930s was mainly relegated to the history of thought because it failed to advance a positive research agenda that was replete with predictions and empirical testing.

[3]Though Coase did not use the term "transaction costs" in his 1937 article, he did suggest that employment relations were especially susceptible to transaction costs.

assumption (made for some purposes) that resources are allocated by means of the price mechanism and the assumption (made for other purposes) that that allocation is dependent on the entrepreneur-coordinator. We have to explain the basis on which, in practice, this choice between alternatives is effected" (Coase,1937, p. 389). Although this challenge was ignored over the next 20 years, two important articles in the 1960s would upset this dismissive state of affairs. Upon pushing the logic of zero transaction costs to completion, the unforeseen and disconcerting implications of the standard assumption of zero transaction cost were displayed for all to see.

Coase's 1960 article on "The Problem of Social Cost." reformulated the externality problem in contractual terms and pushed the logic of zero transaction cost reasoning to completion, with an astonishing result: "Pigou's conclusion (and that of most economists of that era) that some kind of government action (usually the imposition of taxes) was required to restrain those whose actions had harmful effects on others (often termed negative externalities)" was incorrect (Coase, 1992, p. 717). That is because with zero transaction costs, parties will costlessly bargain to an efficient result whichever way property rights are assigned at the outset. In that event, externalities and frictions of other kinds would vanish. But the real message was this: hereafter "study the world of positive transaction costs" (Coase, 1992, p. 717). Kenneth Arrow's 1969 examination of "The Organization of Economic Activity: Issues Pertinent to the Choice of Market versus Non-market Allocation" likewise revealed a need to make a place for positive transaction costs, both with respect to market failures and in conjunction with intermediate product market contracting: "the existence of vertical integration may suggest that the costs of operating competitive markets are not zero, as is usually assumed in our

theoretical analysis" (1969, p. 48).

Introducing positive transaction costs, however, posed three problems. First, upon opening the "black box" of firm and market organization and looking inside, the black box turned out to be Pandora's Box: positive transaction costs were perceived to be everywhere. Since some form of transaction cost could be invoked to explain any condition whatsoever after the fact, the appeal to transaction costs acquired a "well deserved bad name" (Fischer, 1977, p. 322). Second, transaction costs take on comparative institutional significance only as they can be shown to differ among modes of governance (say, as between markets and hierarchies). Third, transaction costs that pass the test of comparative contractual significance need to be embedded in a conceptual framework from which predictions can be derived and empirically tested. The unmet need was to focus attention on key features and provide operational content for the intriguing concept of positive transaction costs.

2.2 Governance and the Lens of Contract

James Buchanan distinguished between the lens of choice and lens of contract approaches to economic organization and argued that economics as a discipline went "wrong" in its preoccupation with the science of choice and the optimization apparatus associated therewith (1975, p. 225). If "mutuality of advantage from voluntary exchange is ... the most fundamental of all understandings in economics" (Buchanan, 2001, p. 29), then the lens of contract approach is an under-used perspective. Thus, in order to analyze the inner working of institutions such as markets and hierarchies, the orthodox lens of choice (the resource allocation paradigm, with emphasis on prices and output, supply and demand)

would need to give way to the evolving lens of contract. This position was implicit in Commons (1932) and Coase (1937) and was explicit in Coase (1960) and Arrow (1969). Upon examining governance and organization through the lens of contract, the firm was no longer a black box for transforming inputs into outputs according to the laws of technology but was interpreted instead as an alternative mode of contracting.

Indeed, this shift to the lens of contract was adopted not only by TCE but more generally – in mechanism design, agency theory, information economics, and formal property rights theory. But there were also differences (described in more detail in Section 6). Whereas the aforementioned theories located the analytical action in the ex-ante incentive alignment stage of contract, TCE concentrated the main action in the ex-post governance of contractual relations. This emphasis on ex-post governance is congruent with TCE's taking adaptation to be the main problem of economic organization.

2.3 Adaptation as the Central Problem

Hayek (1945) suggested that "economic problems arise always and only in consequence of change" (1945, p. 523), whereupon "rapid adaptation to changes in the particular circumstances of time and place" was taken to be the main problem of economic organization (1945, p. 524). Interestingly, Chester Barnard (1938), who was an organization theorist rather than an economist, likewise regarded adaptation as the central problem of organization. But while Barnard and Hayek were in agreement on the importance of adaptation, each had reference to different types of adaptation.

Hayek focused on the adaptations of autonomous economic actors who adjusted

spontaneously to changes in the market, mainly as signaled by changes in relative prices. An illustrative recent example is the increase in the demand for fossil fuels that caused gasoline prices to rise sharply in 2008. As a result, automobile firms adapted their strategies to invest in alternative energy vehicles and create new products, which in turn will affect the demand for fuel. Prices will shift to equilibrate the new choices, and consumers and producers will adapt their consumption and production behavior as part of the equilibrium. The marvel of the market thus resides in "how little the individual participants need to know to be able to take the right action" (1945, pp. 526-527).

By contrast, Barnard featured coordinated adaptation among economic actors working through administration. In his view, the marvel of hierarchy is that coordinated adaptation is accomplished not spontaneously but in a "conscious, deliberate, purposeful" way through administration (1938, p. 4). As an illustration, Boeing experienced major malcoordination problems in the last quarter of 2007 because its outside suppliers were preoccupied and sometimes overwhelmed with their own problems to the neglect of Boeing's systems concerns. Serious delays in the production of their most important future aircraft, the 787 Dreamliner, resulted. Boeing, in effect, bet on the efficacy of outsourcing on a scale that they had never previously been attempted to the neglect of the benefits of ongoing coordinated adaptation to which Barnard ascribed to hierarchy. The problem was relieved when Boeing acquired the fuselage supplier in the summer of 2009.

TCE takes adaptation to be the central problem of economic organization and makes provision for adaptations of *both* autonomous and coordinated kinds. The "marvel of the market" (Hayek) and the "marvel of hierarchy" (Barnard) are now therefore joined. The upshot is that the old ideological divide of markets or hier-

archies now gives way to the combined use of markets *and* hierarchies.

2.4 Efficiency

TCE holds that adaptations of both kinds are undertaken principally in the service of efficiency. Specifically, the choice among alternative modes of governance mainly has the purpose of *economizing on transaction costs*.

However, although TCE claims that nonstandard and unfamiliar contracting practices mainly operate in the service of efficiency, other purposes, of which market dominance (monopoly) is one, are sometimes responsible for nonstandard practices. Making allowance for monopoly is very different, however, than presuming that monopoly is mainly responsible for nonstandard and unfamiliar contracting practices and modes of organization. As discussed in Section 5.5, this preoccupation with monopoly was wrong-headed and gave rise to convoluted antitrust enforcement, which in the 1960s sometimes spun out of control.

3 Making TCE Operational: Vertical Integration

As developed elsewhere (Williamson, 1971, 1975, 1985, 1991), and as described in this section, TCE was made operational by taking three basic steps. First, it took the transaction to be the basic unit of analysis and named the key attributes across which transactions differ. Second, it described the properties of alternative modes of governance. Third, these two were joined by applying the "discriminating alignment" hypothesis: different kinds of transactions are more efficiently governed by different modes of governance.(see 3.3, below).

Conceivably, these ideas could be implemented in the abstract. But rather than develop a "general theory" from the outset, TCE was built from the ground up by examining the particulars. Taking vertical integration (more generally, the intermediate product market transaction – the "make-or-buy" decision) to be the focal transaction led quickly and easily into an interpretation of many other phenomena as variations on a theme.

The other obvious candidate to serve as a focal transaction was the employment relation (as in Coase (1937) and Simon (1951)). But while both of these papers were influential, the employment relation never led to a theory of firm and market organization where other transactions were interpreted as variations on a theme. One possible reason is that the employment contract possessed "peculiarities... that distinguish it from other types of contracts" (Simon, !951, p. 293). Indeed Coase, in the first of his lectures at the conference organized in 1987 to celebrated the 50th anniversary of his 1937 paper identified a "weakness in my [1937] exposition... that hampered further developments" (1988, p.37). Specifically, "the main weakness of my article stems from use of the employer-employee relationship... [in that it both] gives an incomplete picture of the nature of the firm ... [and] more important... it misdirects attention" (1988, p. 37).[4]

Once a focal transaction has been decided, the three key operational moves are to (1) name the attributes of the unit of analysis, (2) do the same for modes of governance, and (3) advance the efficient alignment hypothesis.

[4]Coase appealed to labor law to support the primacy of labor: because "the fact of direction is the essence of the legal concept of 'employer and employee' just as it was in the economic concept which was developed above ... [we can] conclude that the definition we have given is one which approximates closely to the firm as it is considered in the real world" (1937, p. 404).

3.1 Unit of Analysis: Classifying Transaction Attributes

The obvious place to start is with the ideal transaction of simple market exchange where identity does not matter and the terms of trade are completely specified. Competition and market mediated exchange can be presumed to prevail in such circumstances. A simple example would be the market for standard thread screws, but any well defined, standardized commodity that is readily and competitively supplied through anonymous spot market transactions will do.

Whereas simple market exchange works well for transactions where *identity does not matter*, transactions where identity *does* matter pose complications for which added governance might be warranted. Longer term contracts for which the parties value continuity come under scrutiny in this way.

3.1.1 Asset specificity and the Fundamental Transformation

TCE gave early prominence to the relatively neglected condition of *asset specificity*, which became a *crucial* defining attribute of transactions. Asset specificity describes the condition where the *identity of the parties matters* for the continuity of a relationship and it can take a variety of forms – physical, human, site specific, dedicated, brand name capital, and episodic (sometimes described as temporal specificity) – the optimal response to which varies somewhat but involves greater reliance on "administration." Whatever the form, these assets cannot be redeployed to alternative uses or users without loss of productive value (Williamson, 1971, 1975, 1976, 1985; Klein, Crawford, and Alchian, 1978). Although asset specificity is often purposeful, it can also arise spontaneously, without conscious and costly investments, as with knowledge and skills that are incidentally acquired by the parties while working together.

By transaction specific assets we mean ones for which a *bilateral dependency relationship develops between the parties.* Even though a large number of qualified suppliers could compete for the initial contract, investments in transaction specific assets made by the initial winning bidder, either at the outset or during contact implementation, effectively transforms this large numbers bidding competition into a small numbers supply relationship thereafter. A *Fundamental Transformation* in the contractual relation thus sets in as bilateral dependency builds up.[5] Identity thereafter matters.

3.1.2 Uncertainty, Complexity and Incomplete Contracts

Asset specificity, in any of its forms, does not by itself pose contractual hazards that require non-market governance. In principle, a long-term contract could stipulate how future contingent decisions will be made and proper compensation accomplished. In fact, contractual hazards arise if and as long-term contracts *are incomplete* (by reason of the prohibitive cost (Dye (1985), Bajari and Tadelis (2001)) or the impossibility of contractual completeness) and are subject to (1) *disturbances* (or contingencies) during the contract implementation phase for which (2) *defection* from the spirit of cooperation to insist on the letter of the contract can be projected for outliers (where the stakes are great), and (3) *the courts* are unable to fill gaps and settle disputes in a timely, knowledgeable, and efficient fashion.

Accordingly, in addition to a condition of bilateral dependency (a consequence of asset specificity), factors that contribute to contractual hazards for which added governance measures can sometimes provide relief include (1) uncertainty and con-

[5]Note that because asset specificity is a design variable, the good or service to be delivered could be redesigned by reducing asset specific features, albeit at a sacrifice in performance of the good or service in question (Riordan and Williamson, 1995).

tractual incompleteness,[6](2) strategic defection (when the stakes are large), and (3) the serious limits of court ordering. On the assumption that contractual incompleteness, strategic propensities, and the limits of court ordering are all consequential, *asset specificity and disturbances for which unprogrammed adaptations are needed* are the key attributes of transactions for understanding the governance of contractual relations.[7]

3.2 Governance Structures

Problems with outsourcing become more severe as assets are more specific and contracts are more incomplete. An obvious solution is to introduce governance safeguards that mitigate these contractual hazards. This poses the challenge of naming and describing alternative modes of governance and explaining the strengths and weaknesses that are associated with each. Following our discussion in Section 2, we focus principally on the two conventional polar modes of governance, markets ("buy") and hierarchies ("make").

TCE maintains that each polar mode of governance – market and hierarchy – is described as an internally consistent pattern of attributes which describe its "core adaptive competence." Although Williamson (1985, 1991, 2010) makes provision

[6]Incompleteness becomes more severe as the number of features of transactions (precision, linkages, compatibility) across which adaptations are needed increases and as the number of consequential disturbances that impinge upon these features increases. These features can be thought of as a measure of complexity (see Section 4.1.2).

[7]A related factor, which we pass over here because of its ambiguous implications, is the frequency with which transactions recur. On one hand, if a transaction seldom recurs, it may not be cost effective to develop a specialized internal structure. If instead it recurs frequently, then recovering the costs of creating a specialized management infrastructure is possible. On the other hand, recurrent contracting implies that future business is at stake, for which a good reputation figures in. Market contracting, if supported by good reputation effects, thus becomes part of the comparative contractual calculus.

for three main attributes by which to describe each mode of governance – (1) *incentive intensity* (which is measured by the extent to which a technologically separable stage of economic activity appropriates its net profits), (2) *administrative authority and control* (which has a bearing on the autonomy of a stage in both operating and investment respects as well as on procedural controls (routines, accounting procedures)), and (3) *contract law regime* – our focus in this chapter, especially in the formal model of section 4, is on the first two attributes: incentive intensity and administrative control.[8]

Assuming that incentive intensity and administrative control can take on either of two values, strong or weak, we describe the market mode (independent ownership) as having strong incentive intensity within each stage and weak administrative controls at the contractual interface whereas hierarchy (unified ownership) has weak incentives within each stage and strong administrative control at the interface. Recall, moreover, that TCE takes the main problem of economic organization to be that of adaptation, of which autonomous and coordinated adaptation are distinguished. The question of which transactions are organized by which mode of governance turns on how the attributes of different transactions pose different adaptation needs, on the one hand, and how alternative modes of governance are, by reason of their attribute differences, well or poorly qualified to respond to different adaptation needs, on the other.

[8]The important consideration of supporting legal regimes is set aside due to the challenge of modeling this aspect of governance. By and large the formal literature – be it mechanism design or the property rights approach – assumes that whatever is contractually verifiable will be enforced by some unmodeled third party. In this regard one can view this chapter as a bit schizophrenic: we recognize here that contract law regime can and will vary along the choice of governance, yet in section 4 we follow the standard modeling approach and focus only on incentive intensity and administrative control.

Getting this "right" is what efficient alignment is all about. Specifically, the market mode is superior in dealing with transactions of the generic kind for which autonomous adaptations suffice (the so-called "marvel of the market" (Hayek, 1945)) whereas transactions where the parties are bilaterally dependent benefit from coordinated adaptation (the "marvel of hierarchy" (Barnard, 1938)).

Note with respect to this last point that low powered incentives in firms are not to be thought of as a "cost" of hierarchy (bureaucracy burdens aside, see 5.2 below) but as a purposeful attribute of hierarchy without which coordinated adaptation would be compromised. To repeat, low powered incentives in combination with administrative control at the interface (as implemented by the interface coordinator, as shown in Figure 1) is what hierarchy is all about. There is a place for each generic mode; and each should be kept in its place.

Note that two other configurations can be described. Strong incentives at each stage and strong administrative control at the interface is an incendiary combination that leads to conflict. Strong incentives are accomplished if each stage has claims on its own net receipts. Strong administrative control accomplishes cooperative adaptation at the interface provided that compliance by each stage can be presumed – which entails the sacrifice by each stage of its own net receipts.

Weak incentives at each stage and weak administrative control at the interface leads to what is more akin to noncommercial organization but is approximated among commercial firms by cost-plus outside procurement where, within some bounds, the supplier does what the buyer asks because it is assured of reimbursement, although some auditing by the buyer will usually attend such relations.[9]

[9]For a formal treatment of relative benefit of cost-plus contracts over fixed price contracts with respect to adaptation see Bajari and Tadelis (2001).

Table 1 summarizes the four implied governance modes.[10]

		Incentive Intensity Strong	Weak
Administrative Control	Weak	Market (buy)	Cost-Plus Contracts (less common)
	Strong	Recipe for Conflict (empty)	Hierarchy (make)

Table 1: Alternative Modes of Governance

As stated above, market mediated exchange takes place between independently owned and operated stages whereas hierarchy mediated exchange is accomplished by unified ownership and coordinated interface mediation. These operating differences are truly consequential and warrant elaboration.

The upper and lower panels of Figure 1 illustrate how market and hierarchy differ in mediating the exchange between successive stages of production in trading, adaptation, and dispute settlement respects. The upper panel corresponds to market mediated exchange where the supplier receives a fixed payment for delivery of the prescribed goods and services, changes require renegotiation, and disputes are dealt with by courts which apply the appropriate legal rule to award money damages. The parties to simple market exchange play hard ball.

[10] To briefly relate legal rules to the choices of incentives and administrative control, a contract law regime must be supportive of the attribute that is strong (incentive intensity or administrative control). For strong incentives to be effective, parties should have control over their processes and the letter of the contract should be expected o be enforced (strong legal rules). In contrast, forbearance law contract regime (private ordering with weak legal rules) is supportive of strong administrative control since interference by courts would undermine the value of having control by fiat. For more on this see Williamson (1991).

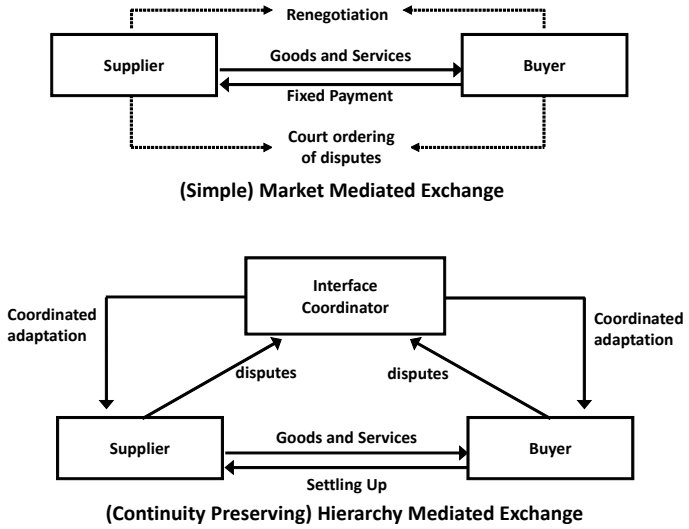

Figure 1: Interface Mediation: Market Versus Hierarchy

By contrast, coordinated adaptation under hierarchy, as shown in the lower panel of Figure 1, is promoted by unified ownership of the two stages coupled with the creation of a new actor, *the interface coordinator*, to which each stage reports and receives administrative direction and control. Consequential disturbances that would give rise to poor coordination are dealt with by the interface coordinator, who has ultimate responsibility for coordinated responses; and internal disputes between stages are likewise settled by the interface coordinator with reference to mutual gain (private ordering).[11]

[11] To tie this briefly to legal rules and regimes, the efficacy of internal dispute resolution and of coordinated adaptations, as decided by the interface coordinator, would be severely compromised if disgruntled managers could go over the coordinators' heads and appeal to the courts.

3.3 Efficient Alignment

The "discriminating alignment hypothesis" to which TCE owes much of its predictive content is this: transactions, which differ in their attributes, are aligned with governance structures, which differ in their adaptive capacities, so as to realize an efficient result. Note that (1) markets enjoy the advantage of autonomous adaptation for transactions that are supported by generic assets, (2) the importance of coordinated adaptation increases as the supporting assets become more specific, and (3) the loss of incentive intensity and the bureaucratic costs of hierarchy are a deterrent to integration except as coordinated adaptation benefits are more than offsetting.

Figure 2 further illustrates the trade-offs using σ is an index of asset specificity. Efficient alignment is accomplished by assigning transactions for which asset specificity is low to markets and transactions for which asset specificity is high are assigned to hierarchy.[12]

The previously discussed adaptation differences that distinguish market and hierarchy (where the market has the advantage for autonomous adaptations and hierarchy has the advantage for coordinated adaptations) are implicit in Figure 2.

Thus the market enjoys the advantage when asset specificity is negligible (σ close to 0) because the disturbances for which adaptations are needed are signaled by changes in relative prices to which buyers and sellers respond autonomously (the "marvel of the market"). The use of hierarchy in these circumstances would entail a loss of incentive intensity and the added costs of mediating the interface

[12] In this binary setup, transactions for which asset specificity is in the neighborhood of σ^* can go either way, since it does not matter very much; but see the discussion of hybrids in Section 5.1.

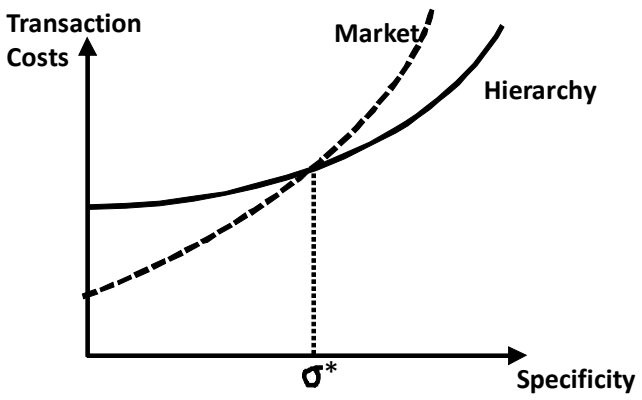

Figure 2: Efficient Governance

with a coordinator (as shown in Figure 1) is quite without purpose.

The affirmative case for unified ownership of successive stages builds up as bilateral dependency progressively increases due to asset specificity (increases of σ). Because the need for coordinated adaptations now presents itself, unified ownership becomes the governance structure of choice for values of σ that exceed σ^*.

Note, moreover, that the associated lowering of incentives is not an unwanted consequence of unified ownership but it is purposeful – in that it predisposes each stage to respond cooperatively to a succession of adaptive needs as perceived by the interface coordinator. This lowering of internal incentives nevertheless incurs added bureaucratic costs and reduces productive efficiency. For one thing, because the pecuniary rewards that attend autonomous adaptation are absent, the individual stages have less incentive to pursue efficient actions. And there are system consequences as well. As additional stages are integrated, the oversight and control of the operating units by the top management is compromised. Sometimes

this can be mitigated by "organizational innovations," of which the move from a unitary to a multidivisional structure – as discussed by Alfred Chandler (1966) and interpreted by transaction cost economics in efficiency terms (Williamson, 1981) – is an example.

Note, however, that whereas transaction cost economics can help to interpret the efficiency benefits that accrue to major changes in the structure of bureaucracy in large corporations, these are not matters that TCE can address as variations on the basic contractual theme of which vertical integration is the paradigmatic case. As this Handbook demonstrates, economic organization is a big house – to which transaction cost economics relates but is not an all-purpose construction.

3.4 The Impossibility of Combining Replication with Selective Intervention

Sections 3.1-3.3 outline the main logic of transaction cost economics as applied to the make-or-buy problem. We discuss here a related but different puzzle posed by Frank Knight (1921) and Ronald Coase (1937): Why can't a large firm do everything that a collection of smaller firms can do and more? Tracy Lewis (1983, p. 1092) argues that an established firm can always realize greater value because it can "use the input exactly as the new entrant would have used it ... [and can furthermore] improve on this by coordinating production from his new and existing inputs." Transaction cost economics takes exception with this argument by examining the efficacy of the two mechanisms on which Lewis's formulation implicitly relies: *replication* and *selective intervention*.

Imagine, without loss, that the buyer stage acquires the supplier stage with the understanding that (1) the supplier will operate in the same autonomous way post-

acquisition as in the pre-acquisition status (by replication) except as (2) the buyer intervenes selectively when expected net gains can be achieved through coordinated adaptations. The combined firm can then never do worse (by replication) and will sometimes do better (by selective intervention). Therefore, more integration is always better than less, and repeating this logic implies that everything will be organized in one large firm.

This logic breaks down upon examining four implicit assumptions upon which the implementation of replication and selective intervention rely: (1) the buyer (owner) promises the acquired supplier its net receipts in all state realizations – thereby preserving strong incentives; (2) the supplier promises to use the supply stage assets that the buyer now owns with "due care"; (3) the buyer promises to exercise authority (fiat) only when expected net gains can be ascribed to selective intervention; and (4) the buyer promises to reveal and divide the net gains from selective intervention as stipulated in the original agreement. The problem is that none of these promises is self-enforcing. To the contrary, in the absence of perfect information (to include a costless arbiter), each condition will be compromised. An elaboration upon why each of the four conditions above fails is reported elsewhere (Williamson, 1985, Chap. 6).[13]

Note the recurrent theme: the action resides in the application of a focused

[13] Contributing factors include (1) the owner (buyer) controls the accounting system and, within limits, can declare depreciation, transfer prices, and benefits so as to shift net receipts to its advantage, (2) failures of due care become known only with delay and are difficult to prove, (3) the buyer can also falsely declare state realizations to favor its own stream of net receipts, and (4) in consideration of the foregoing, the division of benefits under selective intervention can be compromised. Also, (5) the political game is now played in a larger firm that is more susceptible to bureaucratic ploys and political positioning than in smaller firms. Suffice it to observe that the breakdowns to which we refer are not beyond the grasp of intelligent businessmen and their lawyers, who recognize the tradeoffs and factor them into the integration calculus.

lens to identify and examine the mechanisms of alternative modes of economic organization in a comparative institutional way – which reveals that markets and hierarchies differ in discrete structural respects, each with its strengths and weaknesses.

4 A Simple Model of Governance

Building upon Tadelis (2002), we construct a model of contractual choice that parallels the arguments in Section 3. Despite its extreme reduced form, the model relies on micro-foundations developed by Grossman and Hart (1986), Holmstrom and Milgrom (1991), and Bajari and Tadelis (2001).[14] The model contributes by exposing complementarities between cost incentives and governance that helps clarify the underpinnings of the TCE framework outlined in section 3.

The model parallels Section 3 in that (1) exchange takes place between successive (technologically separable) stages of production; (2) spot markets aside, all contracts are incomplete to varying degrees; (3) the critical attributes of transactions are asset specificity and contractual incompleteness (disturbances), where the former is responsible for bilateral dependency and the latter creates the adaptive need; (4) if the parties are independent and if a disturbance occurs for which the contract is not adequate, adaptation is accomplished by renegotiation and/or court ordering; and (5) efficiency is served by aligning transaction with governance structures in a transaction cost economizing way.

To simplify, however, there are two differences between the formal model and Section 3 that are worth noting, and more discussion will follow. First, adaptation

[14] An early step in formalizing transaction cost economics can be found in Riordan and Williamson (1985).

costs are incurred only by the buyer. (The efficient alignment result does not depend on this asymmetry.) Second, asset specificity is treated as a probability of finding an alternative seller without incurring adaptation costs, rather than as an actual loss in surplus if the seller is replaced. This is done for simplicity purposes.

4.1 Transactions and Governance

Consider a transaction where a buyer achieves value $v > 0$ if it procures a good (or service) from a supplier and successfully incorporates it into its own output. The transaction is characterized by the degrees of asset specificity and contractual incompleteness.

4.1.1 Asset Specificity

Recall from section 3.2 that asset specificity can manifest itself in several ways: physical, human, site, dedicated assets and brand name capital. Asset specificity can arise from both purposeful investments and spontaneously, where the latter take the form of knowledge and skills that are incidentally acquired by the parties while working together. Whatever the form, these assets cannot be redeployed to alternative uses and users without some loss of productive value.

Asset specificity is modeled by $\sigma \in [0, 1]$, where higher values of σ represent higher degrees of asset specificity. It will be technically convenient to interpret σ as the probability that the supplier cannot be replaced by a competitor when disturbances occur, and adaptation costs will be incurred . With probability $(1-\sigma)$, however, there exists an alternative supplier who will compete to perform any adaptations that are needed and adaptation costs will be avoided.

Though we believe that more asset specificity does imply that more value is lost

when an alternative supplier is used, from an ex ante perspective the probabilistic nature of our measure of asset specificity is equivalent: when σ is higher, the *expected loss* from having to switch suppliers will be larger, making the fundamental transformation more severe.

4.1.2 Complexity and Incomplete Contracts

Let $\rho \in [0, 1]$ be the probability that the contract will need to be renegotiated due to a significant disturbance, at which point the contract's ex ante design will fail to achieve the value v. In this event, ex post adaptation at some extra cost will be needed to achieve v.[15] Bajari and Tadelis (2001) consider a model where it is possible to invest more or less resources in design ex ante, making design (i.e., contractual incompleteness) an endogenous variable that responds to project complexity. They show that transactions characterized by higher degrees of exogenous complexity result in endogenously chosen contracts that are more incomplete. We thus treat ρ as exogenous and interpret it as the *contractual incompleteness* of the transaction, a characteristic discussed in section 3.2, where higher values of ρ correspond to transactions with higher degrees of contractual incompleteness.

4.1.3 Markets and Hierarchies

Two modes of governance are considered: *market* and *hierarchy*. Recall from Section 3.2 that TCE identifies *markets* with two features: high-powered cost incentives and retention of administrative control by each party. In contrast, *hierarchy* is identified with low-powered cost incentives and the parties relinquishing administrative control to an "interface-coordinator". We proceed to formally de-

[15] For simplicity we keep v constant so that any loss from adaptation is captured by adaptation costs, to be defined precisely later.

fine market versus hierarchy using only one of these attributes: the assignment of administrative control over production and adaptation processes. The strength of incentives will be endogenously derived.[16]

Define market governance (M) to be the choice in which each party retains autonomy over its own production process decisions, and the supplier is expected to deliver a product that meets the contractual specifications. Any adaptation to adjust the ex ante design due to disturbances needs to be renegotiated by the the autonomous parties. For simplicity, we assume that adaptation will be required only for the supplier's production process. Our asymmetric treatment of disturbances simplifies the analysis and offers a first step in formalizing the ideas described in section 3. Naturally, the buyer may have to adapt its process to accommodate some disturbances as well. Symmetric disturbances on both sides of the transaction will result in a more cumbersome analysis, obscuring the main insights.

Define hierarchy (H) to be the choice in which the parties relinquish administrative control to a third party, the interface coordinator. This means that routine tasks are followed as planned, but when disturbances arise, the decisions are made by the interface-coordinator who possesses unified ownership and control over production and adaptation for both stages of buyer and supplier.

It is important to note that our notion of hierarchy as unified control and coordinated adaptation differs from a "directional" integration argument of whether the buyer integrates the supplier into its business and becomes the interface-

[16] The model ignores conflict resolution law and follows the common approach in contract theory that the courts will enforce whatever the contract stipulates. This is also the approach taken by Grossman and Hart (1986). It is important to note, however, that current business law, which is very much commensurate with the brief description in Section 3.3, would further strengthen the conclusions of our theoretical modelling exercise.

coordinator, or the reverse, which is a novel and central feature of the Property Rights Theory (PRT) that is presented in chapter X of this handbook. In contrast, our notion of integration assigns responsibility for implementing routines to the managers at each stage, whereas disturbances for which coordinated adaptations are required are done at the direction of the interface coordinator (see Figure 1). TCE identifies this interface-coordinator as often being a third party whose incentives are aligned with total profit maximization. That is, instead of a preexisting buyer and supplier, the transaction is a *de novo* investment whose governance needs to be determined. Efficiency considerations will determine whether the transaction is integrated (controlled by a interface-coordinator) or if it is not integrated (controlled by the contract and mutually agreed upon adaptations). PRT, in contrast, identifies integration with the situation in which one of the two parties becomes the owner of all productive assets, and controls the decisions related to their use. The predictions of PRT are as much about *which of the two parties* maintains control as about when unified ownership is called for.

Aside from the allocation of administrative control, a compensation scheme that the buyer (or interface-coordinator) uses to compensate the supplier must also be chosen as part of the inter-firm contract (or intra-firm compensation scheme). This will influence the supplier's incentives to reduce costs. Denote the supplier's production costs by c, which includes material and other expenses (lost opportunities, possibly the wages of laborers under its direction, etc.). We restrict attention to linear compensation schemes that have a fixed component, F, and a share of production costs, $(1-z) \in [0,1]$. A supplier that incurs cost c is paid $F + (1-z)c$, where $z \in [0,1]$ is the share of production costs that are borne by the supplier, often referred to as the "strength" of cost-incentives that the supplier faces. For

example, if $z = 1$ and $F > 0$ then the supplier receives a "fixed-price" payment of F and bears all of the production costs, which seems to be the norm for almost all market transactions. The supplier will have strong incentives to reduce production costs. In contrast, if $z = 0$ and $F > 0$ then a "cost-plus" contract is in place where the supplier receives some fixed compensation F and bears none of the production costs c, which seems to be the case for most hierarchical structures (of course, in this case the chosen level of F will be different from the case in which $z = 1$). The supplier has no gain from engaging in activities that reduce production costs. Both F and z will be endogenously chosen in our analysis.

4.2 Production Costs

The supplier's production costs are given by the function $c(e, G) = \overline{c} - Ge$, where $e \geq 0$ is the effort intensity that the supplier puts into the project, and $G \in \{M, H\}$ denotes the mode of governance where $M > H > 0$. Effort is the extra time and attention that the supplier puts into directing production of other employees, into choosing production alternatives that reduce costs, etc. The (opportunity) cost to the supplier of effort e is equal to $y(e)$, where $y'(e) > 0$, $y''(e) > 0$ and $y'''(e) \leq 0$.[17] To guarantee an interior solution to the seller's optimization problem we assume that $y'(0) = 0$. We also impose the standard agency assumption that contracting on effort is impossible.

As is apparent, we assume that more effort reduces production costs, and effort is more effective in reducing production costs when market governance is chosen. This assumption seems intuitive because *decisions* about how to produce or adapt

[17] As shown in the proof of our main proposition, this is a sufficient, but not necessary condition for monotone comparative statics.

the production process are an *input* into this process. If the supplier has complete control of its production process then the ability to control all the inputs, including effort *and* decisions, should make the supplier more effective in cutting costs. If, however, decisions are in the hands of the interface coordinator then the supplier's lack of autonomy will make its effort less effective.[18]

In addition to its intuitive appeal, the assumption that effort is more effective when the supplier maintains control has some established micro-foundations.[19] Note also that this is an assumption about a marginal reaction, namely, the effect of the allocation of administrative control on the slope of the cost function with respect to effort, which is a common assumption in the PRT literature.[20]

[18] Expanding the model to have buyer effort and a role for buyer incentives is easy, with each stage's effort being more effective for that stage when the stage has control over all aspects of production. Our asymmetric simplification relates this to the supplier stage alone.

[19] First, Grossman and Hart (1986) model ex post decisions that need to be made after a state of nature is realized, yet contingent contracts cannot be written ex ante. The state of nature is very much like our ex post disturbances that are not contracted for. If the decisions themselves affect the way in which effort reduces production costs, then when the supplier controls both decisions and effort, he is better able to reduce his costs. Ownership of productive assets–as defined by PRT–gives the supplier control over the allocation of productive assets ex post, and this makes his cost-reducing effort more effective. Indeed, this assumption is our parallel of Assumption 6 in Hart and Moore (1990). Second, A1 is also consistent with the models of Holmstrom and Milgrom (1991, 1994). They show that the supplier's effort may be misdirected when he does not own the productive assets, where ownership is associated with having control over the use *and sale* of assets. If the productive assets are not owned by the supplier then he will not necessarily take the asset's long run value into account, imposing additional long-run costs on production. (This idea is discussed explicitly in Williamson, 1985, pp. 137-138.)

[20] Thus, we make use of the method developed by Grossman and Hart (1986) to model the effect of administrative control. They modelled changes in the ownership of assets as changing the marginal effect of effort. Despite that the driving forces and economic insights that we derive are different than those in PRT, the PRT modelling method will prove useful in formalizing the original ideas developed by TCE.

4.3 Adaptation Costs

If a disturbance occurs then additional costly adaptations must be made to obtain the value v. Adaptation costs can have at least two sources. The first involves activities that were wasted and redone, or modifying initially planned production processes that fit the original design. These adaptation costs stem from contractual incompleteness and could have been spared if a complete contract and accurate design were in place. The second source of adaptation costs result from haggling, rent seeking and other renegotiation costs that parties expend in order to get a better deal, which are a pure dead-weight loss.[21] We are agnostic as to which of these two sources of adaptation costs dominate and we will aggregate them together as total adaptation costs denoted by $k(z, G) > 0$.

Adaptation costs are incurred if and only if two events happen. First, a disturbance must happen, which occurs with probability ρ, the incompleteness of the contract. Second, a new supplier from the competitive market cannot do the work, which occurs with probability σ, our measure of specificity. Indeed, if the required adaptation is not specific then other suppliers can compete to perform the adaptation, and no loss from haggling will occur.

We simplify and assume that adaptation costs are borne only by the buyer.

[21] These haggling costs can be generated from a rent seeking game in the spirit of Tullock (1980) or Skaperdas (1992). As a simple example imagine that the surplus to be split is 10 and that without hiring lawyers, a court (or arbitrator) would direct the parties to split the surplus equally. Assume that if a party hires a lawyer to argue in court then it would get $\frac{3}{4}$ of the surplus if the other party has no lawyer, but symmetrically, would get $\frac{1}{2}$ of the surplus if the other party has a lawyer. If the lawyer costs are $k < 2.5$ then this game a prisoner's dilemma in which hiring a lawyer is a dominant strategy, the parties split the 10 equally but each pays k and is left with $5 - k$. Hence, as far as the relationship is considered, rents were dissipated. This idea is explored in Ashenfelter and Bloom (1993) who show that parties to disputes indeed have an incentive to engage in legal representation, and this suggests that some excessive legal expenses are incurred.

We can easily have the supplier also bear some adaptation costs, which would add symmetry to the problem of adaptation without changing the qualitative results.[22] We also assume that $v - k(z, G) > 0$, implying that adaptation costs are worth incurring ex post to achieve v. Hence, the expected gross benefit from the transaction is given by $v - \rho\sigma k(z, G) > 0$, and *expected* adaptation costs are increasing in both contractual incompleteness, ρ, and asset specificity σ.[23]

We assume further that the choice of governance affects adaptation costs.[24] Bilateral dependence causes a conflict of interest between the buyer (or the interface-coordinator) and the supplier when adaptation is required. With autonomy (market), the supplier is in a stronger position to hold-up the buyer and direct activities in its interest. Furthermore, if the supplier controls the adaptation process then it has more power to choose actions that direct rents towards it, which would impose added costs on the buyer even at the expense of total surplus. In a hierarchy, however, the interface coordinator has control over the adaptation process. This reduces the adaptation costs that the supplier can impose.[25] Summarizing:

[22] For instance, if ex-ante competition pushes expected rents ex ante to zero, then any adaptation costs (or renegotiation income) that the supplier expects to spend (or gain) will be incorporated into his bid and will fall back on the buyer (see, e.g., Bajari, Houghton and Tadelis, 2012).

[23] One can model the effects of adaptation as lowering the payoff v to some $v' < v$, above and beyond any additional adaptation costs of k, as in Tadelis (2002). This is redundant because the expected gross benefit (ignoring production costs) to the buyer would be $(1-\rho)v + \rho[(1-\sigma)v + \sigma(v'-k)] = v - \rho\sigma(v - v' + k)$, and since $v - v' > 0$ then this is just part of the adaptation costs as we define them above. Also, it is without loss that we assume that adaptation is always efficient. It is easy to incorporate a more involved setting where adaptation costs are random, and that they may sometimes be inefficient in that some projects are sometimes terminated. (See, e.g., Bajari and Tadelis, 2001.)

[24] This general idea appears already in Williamson (1985) chapter 6, and is also realted to the work of Milgrom and Roberts (1988).

[25] In a symmetric model where the buyer can impose adaptation costs on the supplier (or interface coordinator) then with autonomy, the buyer can impose adaptation costs to redirect

A1: Adaptation costs are lower in hierarchy: $k(z, M) > k(z, H)$ for all z.

The intuitive justification of A2 is further supported by the micro-foundations of the hold-up problem. The more specific assets of any kind are concentrated under an independent supply stage, the worse is the fundamental transformation. When the supplier owns the dedicated assets then the *temporal lock-in* is stronger because the aggregate degree of bilateral dependency has increased.[26]

The choice of incentives will also affect adaptation costs. Williamson proposed that "low powered incentives have well known adaptability advantages. That, after all, is what commends cost plus contracting." (1985 p.140). Indeed, if the supplier bears less of the production costs then it has less to gain from haggling with the buyer (or interface-coordinator) over the adaptation. Formally:

A2: Adaptation costs are lower when cost-incentives are weaker: $\frac{\partial k(z,G)}{\partial z} > 0$.

The micro-foundations for A3 are explored in Bajari and Tadelis (2001). In a buyer-supplier contracting model with bilateral dependency they show that if the supplier's incentives are stronger then the rents dissipated during adaptation are larger. Intuitively, when the supplier incurs more of the costs then the conflict of interest between buyer and supplier is intensified: the buyer wants a change that maximizes its net benefit, while the supplier will be motivated by reducing its costs.[27] This insight should carry over to an integrated setting where an interface-coordinator directs adaptation: if the interface-coordinator mediates both stages

rents towards himself. Adaptation costs imposed by both sides would be reduced under hierarchy.

[26] Furthermore, consistent with the assumptions of PRT, giving the supplier ownership over assets (or simply control over adaptation decisions) will strengthen its bargaining position (outside option) and increase its renegotiations rents.

[27] Bajari and Tadelis (2001) show that ex ante competition between potential suppliers will cause any adaptation costs borne by the supplier to be passed on to the buyer. This idea is used by Bajari, Houghton and Tadelis (2012) to measure adaptation costs in highway procurement.)

of production and seeks to maximize combined surplus then both supplier and buyer will impose more resistance if they face stronger cost incentives.

Bajari and Tadelis (2001) do not include governance in their analysis of contracts, so we need to consider ways in which changes in governance will change the marginal effect of incentives on adaptation costs. To fix ideas, begin with a fixed price contract, $z = 1$, where adaptation costs are highest, and consider a reduction in incentives (a decrease in z) that will in turn reduce adaptation costs. From A2, adaptation costs in a hierarchy are lower than in market governance. From A3, a decrease in supplier incentives will reduce adaptation costs. We add a third assumption that the marginal reductions in adaptation costs are higher when hierarchy is chosen. Formally we assume:

A3: Reducing adaptation costs by weakening incentives is more effective under hierarchy: $\frac{\partial k(z,H)}{\partial z} > \frac{\partial k(z,M)}{\partial z} > 0$.

This assumption lacks microfoundations, but seems reasonable in light of the argument that hierarchy makes adaptation less rivalrous. To keep things simple, we assume that when adaptation happens then we are not affecting the utility of the supplier (he is exactly compensated for any extra costs that adaptation imposes on him). As such, adaptation causes extra costs and inefficiencies that are imposed on the buyer or the interface-coordinator, but no extra rents are gained or lost by the supplier. This is not an important assumption but it conveniently simplifies the analysis.[28]

[28] In Bajari and Tadelis (2001), when adaptation occurs then there is some expected rents to the supplier due to lock-in, and they are competed away *ex ante*. This could be included here with a more sophisticated focus on *ex post* adaptation with asymmetric information, but it would not shed light on the forces we wish to illuminate.

4.4 Selective Intervention

Assumptions A1 through A4 imply that supplier autonomy defined by market governance reduces production costs but increases adaptation costs, while hierarchy does the opposite. There is, perhaps, an obvious solution: let the supplier retain control of production decisions related to the original design, and let the interface-coordinator (or possibly the buyer) retain control over adaptation decisions. This, however, is ruled out by the assumption that *selective intervention* is severely limited:

A4: Administrative control is allocated over both production and adaptation, and the two processes cannot be separated to allow for selective intervention.

This is in line with the discussion in section 3.4 where it was argued that it is impossible to combine replication and selective intervention (Williamson, 1985, chap.6). The model takes an extreme position on the inability to have selective intervention, but clearly what matters is that at the margin some selective intervention is impossible. Realistically, a contract may specify some domains of control that each party may have. As long as contracts are incomplete, however, the impossibility of perfect selective intervention will persist.

4.5 Markets versus Hierarchies

We proceed with the analysis of endogenously choosing governance and incentives. First consider the objective of the supplier,

$$\max_{e \geq 0} \quad u_S(e; z, G) = F - z(\overline{c} - Ge) - y(e).$$

Lemma: Given the pair (z, G), the supplier's optimal choice $e^G(z)$ is increasing in z, $e^G(z) = 0$ for $G \in \{M, H\}$, and $e^M(z) > e^H(z) > 0$ for any $z \in (0, 1]$. Furthermore, $\frac{de^M(z)}{dz} > \frac{de^H(z)}{dz}$ for any $z \in [0, 1]$.

This result is derived in the appendix and follows from the rather standard assumptions made in section 4.2. It says that stronger incentives increase effort, which is expected, and that given a fixed strength of incentives, effort is higher under market governance. This is a consequence of the assumption that the supplier's effort is more effective when he maintains control over decisions. Finally, the marginal response of the supplier to incentives is stronger under market governance.

Given the optimal response of the supplier, surplus maximization is given by the following program:[29]

$$\max_{\substack{G\in\{H,M\}\\ z\in[0,1]}} S(z, G; \tau, \sigma) = v - \overbrace{\underbrace{(\overline{c} - Ge^*(z, G))}_{\text{Production Costs}} - \underbrace{y(e^*(z, G))}_{\text{Compensation}} - \underbrace{\sigma\rho k(z, G)}_{\text{Expected Adaptation Costs}}}^{\text{Total Transaction Costs}}$$

The components of this program are easy to see. The benefit is the value to the buyer, and the costs have three components. The first is the production cost, the second is the compensation needed to cover the seller's opportunity costs of effort, and the third is the expected adaptation cost. Solving this program leads to the central result of this section:

Proposition: *When Asset specificity increases (higher σ), or when contracts are*

[29] We substitute $e^*(s, G)$ in place of e into the objective function to take account of the supplier's incentive compatibility constraint. We assume that the participation constraint does not impose a problem, which in itself is innocuous. The buyer's expected utility is $u_B(z, G; \tau) = v - F - (1 - z)c(e^*(z, G), G) - (1 - \tau)k(z, G)$, and total surplus is just $U(\cdot) = u_B(\cdot) + u_S(\cdot)$.

more incomplete (higher ρ), the relative benefits of hierarchy over markets increase. Furthermore, optimal incentives become weaker.

In the appendix we show that the program exhibits increasing differences in all of its arguments, resulting in monotone comparative statics (see, e.g., Milgrom and Shannon, 1994). The intuition for this result is quite straightforward. Strong cost-reducing incentives reduce production costs at the expense of raising adaptation costs (assumption A2). Market governance makes cost-reducing incentives more effective at the expense of raising adaptation costs (assumption A1). Hence, more asset specificity and more contractual incompleteness, which increase the expected costs of adaptations, favor the use of hierarchies with weak cost-reducing incentives. Because at the margin, controlling adaptation costs through incentives is more effective under hierarchy (assumption A3), incentives and governance choices are *complements* in the organizational design. This result is not transparent in the less formal arguments of TCE. Finally, all this rests on the impossibility of selective intervention (assumption A4). Without it, one can assign control of different processes selectively to the agent who is most impacted, reducing adaptation costs dramatically without the sacrifice of lower productivity. Illuminating the complemetarity between governance and incentives is a useful contribution of the formal model with respect to the semi-formal arguments in section 3.[30]

[30] The appropriate legal rules would strengthen our result. Namely, if the contract stipulates that the supplier retains control of supply processes, then the courts will enforce the letter of the contract that defines performance (design) and payments. This gives the supplier more bargaining power when adaptation is requested – he can use the original contract as a threat. This imposes extra costs due to haggling during the renegotiation process. If, however, the contract stipulates that both stages implement adaptations at the direction of the interface coordinator, then the courts will not enforce the performance measures under the doctrine that if the interface-coordinator maintains control and can direct the parties as it wishes, then the supplier (or buyer) cannot be made accountable for detailed design based performance. This is the situation where

It is useful to illustrate the result through a simple numerical example. Let $k(z,G) = G + 4z$ and $y(e) = \frac{e^2}{2}$ where $G = 1$ represents hierarchy, and $G = 2$ represents market. Given an incentive scheme $F + (1-z)c$, the supplier chooses $e^*(z,G)$ to maximize $F - z(2 - Ge) - \frac{e^2}{2}$, resulting in the optimal choice $e^*(z,G) = zG$. Substituting this into the objective function of surplus maximization yields,

$$\max_{\substack{z\in[0,1]\\ G\in\{1,2\}}} S = v - (\overline{c} - G^2 z) - \sigma\rho(G + 4z) - \frac{z^2G^2}{2}$$

Since $G \in \{1,2\}$ corresponds to $\{H, M\}$, we can separately solve for $z^*_H(\sigma,\rho) = \max\{0, 1 - 4\sigma\rho\}$ and $z^*_M(\sigma,\rho) = 1 - \sigma\rho$. The resulting optimal surplus for market is $S^*_M(\sigma,\rho) = v - \overline{c} - 6\sigma\rho + 2(\sigma\rho)^2 + 2$ and for hierarchy is

$$S^*_H(\sigma,\tau) = \begin{cases} v - \overline{c} - 5\sigma\rho + 8(\sigma\rho^2 + \frac{1}{2} & \text{if } 0 \le \sigma\rho \le \frac{1}{4} \\ v - \overline{c} - \sigma\rho & \text{if } \frac{1}{4} \le \sigma\rho \le 1 \end{cases}$$

Comparing the expressions for total surplus we obtain that $S^*_H(\sigma,\rho) > S^*_M(\sigma,\rho)$ if and only if $\sigma\rho > 0.5$. For example, if the contract is not too incomplete ($\rho < 0.5$) or if the transaction is not too specific ($\sigma < 0.5$) then markets are always optimal. If, however, the contract is totally incomplete ($\rho = 1$) then for $\sigma > 0.5$ hierarchy will dominate market because it has lower total transaction costs. This corresponds exactly to figure 2 with $\sigma^* = 0.5$.

In reference to Figure 2, as contractual incompleteness increases, total transaction costs increase for both markets and hierarchies, causing both functions to rise. However, market transactions costs increase faster, making hierarchies better for a larger range of specificity σ. This is a point that the model illuminates. Since σ and ρ are multiplied, contractual incompleteness and asset specificity are

courts will defer to the power of fiat, as is common in employment relationships. As such, adaptation is further facilitated when hierarchy is selected.

complementary. This in turn implies that the negative effects that incompleteness has on adaptation costs are exacerbated when asset specificity is higher. One can consider other specifications where this would not be the case, yet interestingly, this specification is consistent with the empirical results of Masten (1984).

5 Extensions and Applications

5.1 Hybrids

The advantages of the two polar modes, simple market exchange and hierarchy, are pronounced for transactions that deviate significantly from the crossover value σ^* as shown in Figure 2. "Hybrid" contracting arrangements, however, that are located between hierarchy and simple spot market transactions, appear to be common and thus warrant brief consideration. We interpret the hybrid as an intermediate mode of organization that uses *credible commitments* to support exchange for transactions that pose an intermediate range of hazards (close to the value σ^*).

In some instances credible commitments are contractually agreed upon by the parties to help provide additional assurances, of which the thirty-two year coal supply agreement between the Nevada Power Company and the Northwest Trading Company is illustrative (Williamson, 1991, pp. 272-273).[31] These may include additional supports such as formal auditing and information disclosure procedures, as well as reliance on private ordering dispute resolution mechanisms that are outside the formal courts (Llewellyn, 1931; Macaulay, 1963; Summers, 1969; Macneil, 1974, Galanter, 1981). The use of "hostages to support exchange" (Williamson,

[31] In other instances credible commitments come into place spontaneously, which is the case when a supplier's good (poor) history becomes a reputational asset (liability). See, e.g., Bar Isaac and Tadelis (2008).

1983) is both an ancient and contemporary example that can be interpreted in credible contracting terms, in that defection from cooperation is deterred by reciprocal exposure of specific assets that experience positively correlated disturbances.

5.2 Reality Testing

TCE addresses itself to issues of scaling up, remediableness, and bureaucracy and recommends that other theories of firm and market organization consider doing likewise.

Scaling up: The object of a simple model is to capture the essence, thereby to explain puzzling practices and make predictions that are subjected to empirical testing. But that is not the only relevant test. Simple models can also be "tested" with respect to scaling up. Does repeated application of the basic mechanism out of which the simple model works yield a result that recognizably describes the phenomenon in question?

The test of scaling up is often ignored, possibly out of awareness that scaling up of the model in question is very demanding. Sometimes it is recognized but deferred,[32]possibly in the belief that scaling up can be accomplished easily. We advise that claims of real world relevance, including public policy relevance, of any candidate theory of the firm that cannot be shown to scale up from toy model status to approximate the phenomenon of interest (usually, the modern corporation) should be regarded with caution.

With reference to the theory of the firm as governance structure the question

[32]Michael Jensen and William Meckling expressly recognized the importance of scaling up from a single owner-manager to a multitude of owners in a modern corporation and stated that this was an issue that they planned to deal with it in a later paper (1976, p. 356). That paper never materialized, presumably because of the difficulties. (Their 1976 paper has nonetheless been influential.)

is this: Does successive application of the make-or-buy decision, as it is applied to individual transactions in the TCE setup, scale up to describe something that approximates a multi-stage firm? Note that, as described previously, TCE assumes that the transactions of principal interest are those that take place *at the interface between* (rather than within) technologically separable stages, which is the "boundary of the firm" issue as described elsewhere (Williamson, 1985, p. 96-98). Upon taking the technological "core" as given, attention is focused as a series of separable make-or-buy decisions - backward, forward, and lateral – to ascertain which should be outsourced and which should be incorporated within the ownership boundary of the firm. So described, the firm is the inclusive set of transactions for which the decision is to make rather than buy – which does implement scaling up, or at least is an approximation thereto (Williamson, 1985, pp. 96-98).[33]

Indeed, whereas examining whether to make or buy a series of technologically separable components is a relatively straight forward process where stages, if acquired, are all under unified ownership, it is not at all obvious how scaling up applies to the employment relationship (where successive employees have different propensities – say for risk aversion) or to directional integration (as opposed to unified ownership) in the modern property rights setup.

Remediableness. Public policy analysts have often assumed that transaction costs in the public sector are zero. That is unrealistic, yet standard public policy proceeded in an asymmetric way: private sector contracting experienced market failures, by reason of positive transaction costs, but there was no corresponding

[33] In the context of a multi-divisional firm (Chandler, 1962) the scaling up to which we refer corresponds more nearly to that of an operating division (which could be a freestanding firm that has been acquired by a diversified enterprise) than the entire multidivisional enterprise – where the "general office" provides an additional level of strategic participation.

concept for public sector failures.[34] Little surprise, then, that convoluted public policy prescriptions were often (unwittingly) anchored in the asymmetric application of zero transaction cost reasoning, of which public policy on regulation was an example: only private sector supply was burdened with positive transaction costs; regulation was a zero transaction cost alternative (Coase, 1964).

The remediableness criterion is an effort to deal symmetrically with real world institutions, both public and private. The criterion is this: an existing mode of organization for which no superior feasible form of organization can be described and implemented with expected net gains is presumed to be efficient (Williamson, 1996, Chap. 8). In other words, a "revealed preference" approach is applied to the choice of governance.

Because all feasible modes of organization are flawed, the feasibility stipulation precludes all appeals to the fiction of zero transaction costs (in any sector whatsoever – public, private, nonprofit, etc.) from the very outset. The implementation stipulation requires that the costs of implementing a proposed feasible alternative (one that is judged to be superior to an extant mode in a de novo side-by-side comparison) be included in the net gain calculus.[35]

The upshot is that the remediableness criterion is an effort to disallow asymmetric efficiency reasoning of a zero transaction cost kind, thereby to force the relevant efficiency issues for the making of public policy (Dixit, 1996) to the surface.

[34] Albeit a caricature, "normative public policy analysis began by supposing that ... policy was made by an omnipotent, omniscient, and benevolent dictator" (Dixit, 1996, p. 8) – which, in transaction cost terms, assumes the absence of implementation obstacles, bounds on rationality, and opportunism, respectively.

[35] The presumption that a chosen mode is efficient if the expected net gain is negative is nevertheless rebuttable: it can be challenged by showing that the obstacles to implementing an otherwise superior feasible alternative are "unfair." See Williamson (1996) for a discussion.

Burdens of Bureaucracy. The impossibility of implementing either replication or selective intervention is partly attributable to the incentive distortions that arise when successive stages of production that had previously been independent are placed under unified ownership (to include the control over accounting practices that accrues thereto). But there is more to it than that.

Reaching beyond the scope of the analysis in sections 3 and 4, some of the more insidious burdens of bureaucracy arise because "integration affects the internal politics of the corporation with systematic performance consequences" (Williamson, 1985, p. 145). These include tilting the managerial promotion game away from merit in favor of politics (subgoal pursuit), the increased propensity to intervene (over-manage and over-control), limits upon internal incentives due to internal equity considerations, and operating and investment decisions are distorted (Williamson, 1985, pp. 147-152). The appearance of what Paul Milgrom and John Roberts refer to as "influence costs" (1988) are also in the bureaucratic burden spirit.

Understanding of the strengths and weaknesses of bureaucracy is very underdeveloped as compared with understanding of the strengths and weaknesses of markets – mainly because bureaucracy is both a comparatively neglected and a formidably difficult subject. Robert Michels nevertheless taught us how to proceed. Rather than end his study with the finding that "Who says organization, says oligarchy" (1962 [1911], p. 365), Michels advises instead that, upon recognition of this prospect, we take the next step and push the logic to completion: "nothing but a serene and frank examination of the oligarchical dangers of [organization] will enable us to [mitigate] these dangers" (1962 [1911], p. 370). The corresponding lesson for our purposes here is this: a more informed assessment of markets

and hierarchies will result as we uncover the basic regularities and work out *the ramifications* for economic organization in a candid, disciplined, and microanalytic way.

5.3 Variations on a Theme

Many of the regularities that are associated with the intermediate product market transaction recur, in variable degree, as variations on a theme. Transaction cost economics not only has many applications within the field of industrial organization but within most applied fields of economics as well – to include labor, public finance, comparative economic systems, and economic development and reform. Applications to business – to the fields of strategy, organizational behavior, marketing, finance, operations management, and accounting – are likewise numerous. Many applications to the contiguous social sciences (especially sociology, political science, social psychology, and aspects of the law) have also been made. More generally, transaction cost economics has broad reach because any problem that arises as or can be reformulated as a contracting problem can be examined to advantage in transaction cost economics terms. (See Macher and Richman (2008) for a discussion of the applications with references to the relevant literature.)

5.4 Empirical Evidence

Shortly after the main ideas of TCE were laid out, several seminal empirical papers confirmed the main prediction of the theory, including Monteverde and Teece (1982), Masten (1984), Joskow (1985); also see Shelanski and Klein (2005) and Lafontaine and Slade (2007). Macher and Richman (2008) report that there were over 900 published empirical papers on TCE over the period 1980 to 2004, with

more in progress. Indeed, "despite what almost 30 years ago may have appeared to be insurmountable obstacles to acquiring the relevant data [which are often primary data of a microanalytic kind], today transaction cost economics stands on a remarkably broad empirical foundation" (Geyskens, Steenkamp and Kumar 2006). As Michael Whinston puts it: TCE has been "one of the great [empirical] success stories in industrial organization over the past [30] years" (Whinston, 2001, p. 185). There is no gainsaying that TCE has been much more influential because of its broad and varied applications and the empirical work that it has engendered. Most recently, new empirical studies have focused attention on the importance of adaptation to empirically validate the central themes of TCE (e.g., Forbes and Lederman, 2009, 2010, and Costinot, Oldenski and Rauch, 2011).

5.5 Antitrust and Regulation

TCE was stimulated in part by the disarray in antitrust enforcement and regulation during the 1960s. As Coase observed, "If an economist finds something – a business practice of one sort or another that he does not understand, he looks for a monopoly explanation. And as in this field we are very ignorant, the number of ununderstandable practices tends to be very large, and the reliance on a monopoly explanation, frequent" (1972, p. 67). The possibility that complex contract and organization had beneficial governance purposes was ignored. The implausibility of such monopoly reasoning coupled with a small but growing interest in transaction cost economizing would eventually help to bring relief from such excesses.[36]

[36] Interestingly, Timothy Muris, during his term as chair of the Federal Trade Commission, held that much of the New Institutional Economics "literature has significant potential to improve antitrust analysis and policy. In particular, ... [the transaction cost branch has] focused on demystifying the 'black box' firm and on clarifying important determinants of vertical relationships" (2003, p. 15). Opening the black box and acquiring an understanding of the mechanisms

As applied to regulation and deregulation, more attention to the details and to strategic behavior on the part of participants in regulated/deregulated sectors needs to be factored in.[37] As Paul Joskow observes of efforts to deregulate electricity in California, too much deference was given to the (assumed) efficacy of smoothly functioning markets and insufficient attention to potential investment and contractual hazards and appropriate governance responses thereto: "Many policy makers and fellow travelers have been surprised by how difficult it has been to create wholesale electricity markets.... Had policy makers viewed the restructuring challenge using a TCE framework, these potential problems are more likely to have been identified and mechanisms adopted ex ante to fix them" (2000, p. 51).

6 Some Challenges

As Williamson (2010) observes, transaction cost economics, like many other theories, has undergone a natural progression from informal (1930-1970), to pre-formal (1970s), to semi-formal (1980s and beyond), of which full formalization is the last step.

The path breaking paper by Sanford Grossman and Oliver Hart (1986) and the

inside has had an impact, moreover, on practice (Muris, 2003, p. 11; emphasis in original): "The most impressive recent competition policy work I have seen reflects the NIE's teachings about the appropriate approach to antitrust analysis. Much of the FTC's best work follows the tenets of the NIE and reflects careful, fact-based analyses that properly account for institutions and all relevant theories, not just market structures and [monopoly] power theories."

[37] Interestingly, the first "empirical" application of TCE was to regulation. The issue was the purported efficacy of franchise bidding for natural monopoly, as advanced by Demsetz (1968) and applied to the cable television industry by Richard Posner (1972). Missing from both of these sanguine assessments of the efficacy of franchise bidding were (1) an examination of the details by which franchise bidding would be implemented and (2) an awareness that the nonredeployability of asset specific investments would pose serious (but unexamined) problems (Williamson, 1976).

follow-on paper by Hart and John Moore (1990), which founded the "property-rights theory" (PRT) literature, have been very influential. They have established the modeling apparatus used in section 4 above in which governance choices affect the incentives of parties to a transaction. That said, there are three fundamental differences between the PRT and TCE approaches.

First, while transaction cost economics emphasizes ex post adaptation as the main problem of organization, the property rights approach has focused more on the problem of ex ante alignment of incentives to invest in specific assets, mainly of the intangible (human asset) kind. This same focus on ex ante incentives is also at the core of most agency-based theories.

Second, PRT and agency based theories are silent about how transactions differ with respect to complexity, uncertainty and contractual incompleteness. Instead, agency theory and property rights theory explore the consequences of incomplete information in that some aspects of the transaction have zero costs of contracting while others have infinite costs. Namely, in standard agency models, output measures of the transaction (say the component's functionality, quality, or a signal of these) can be specified at no cost, while the effort and actions of people who work towards achieving the desired goals cannot be specified at any cost. The PRT paradigm assumes that contingent decisions related to how to do the job or how to respond to changes in the environment cannot be specified at any cost, while it is costless to decide who has the rights to make decisions and execute them, and it is costless to enforce these rights. TCE, by contrast, focuses on measurable dimensions over which transactions differ, with emphasis on identifying how different kinds of transactions are discriminately allocated to different governance structures. This accounts for much of its predictive content and empirical success

described in section 5.4.[38]

Third, PRT identifies ownership of assets as the critical variable, and takes the view that ownership determines who has the residual right to decide how to use the productive assets. As such, changes in ownership of assets from *one party to another* will change the incentives of the parties to invest in the specific relationship, implying a unified framework for the costs and benefits of integration. The implications are that separable, well defined assets ought to be owned by the individuals whose incentives are most affected by ownership. But there is more: *directional* ownership is predicted. PRT asserts that either buyer or seller should own the assets, and it matters who the owner is. In fact, however, bundles of assets are owned by firms, not by individuals. Holmstrom (1999), who raises this important critique, argues that owning bundles of assets allows the firm to internalize many of the externalities that are associated with incentive designs in a world characterized by informational imperfections, which are responsible for contractual incompleteness. By associating the decision maker with more assets under his control, his administrative control is expanded, and he possesses more levers through which to implement coordinated adaptation. This observation is very much in line with our notion of the interface coordinator is the executive

[38] Despite TCE being an empirical success story, there is an interesting challenge in making more progress on the empirical front. As discussed in Section 5.2, a complete understanding of the pros and cons of bureaucracy is still underdeveloped. Indeed, "distortion-free internal exchange is a fiction and is not to be regarded as the relevant organizational alternative in circumstances where market exchange predictably experiences nontrivial frictions" (Williamson, 1975, pp.124-5). Most empirical studies of TCE show that relative to internal organization, market transactions do worse when there is either more asset specificity or more transaction complexity (which leads to contractual incompleteness.) What these studies cannot usually measure is by how much do the costs of each mode of governance change with changes in a transaction's attributes. A first step in this direction was made by Masten, Meehan and Snyder (1991), who use a censored regression approach to study the procurement of components and services by a large naval shipbuilder.

who has the authority to coordinate adaptation as needed, even though he as an individual need not own the assets.

Still, the Grossman-Hart methodology is an instrumental contribution. Building on their methods and the insights in Bajari and Tadelis (2001), Tadelis (2002) makes a step towards formalizing some of the central ideas of TCE. Additional efforts have been made by Gibbons (2005). The model we offer in section 4 is an attempt to push the full formalization of TCE yet another modest step forward. More work, however, still needs to be done, and a full incorporation of the role of law in formal models is indeed very challenging.

7 Conclusions

As compared with the top-down neoclassical theory of the firm as production function, the theory of the firm as governance structure is a bottom-up construction in the following respects: (1) rather than work out of the price theoretic lens of choice, TCE examines economic activity through the lens of contract; (2) rather than focus on composite goods and services (supply and demand; prices and output), TCE focuses on transactions and the organization thereof; (3) rather than take the boundary of the firm as given by technology, TCE derives the boundary in comparative contractual terms; (4) the resulting contractual strategy for examining economic organization in terms of the microanalytics of transactions and governance structures has broad reach, in that a large number of contractual phenomena turn out to be variations on a few key contractual themes to which the discriminating alignment hypothesis applies; (5) transaction level analysis opens up a whole new range of activities to which empirical analysis can be applied; and (6) public policy analysis is more nuanced and more objectively comparative in the

process. Also, although fully formal TCE analysis is a work-in-progress, headway has been made and more is in prospect.

Indeed, headway in the future will be realized as it has in the past – not by the creation of a general theory but by proceeding in a modest, slow, molecular, definitive way, placing block upon block until the value added cannot be denied. It is both noteworthy and encouraging that so many young scholars have found productive ways to relate. More generally, the economics of organization has benefited from rival and complementary perspectives – especially those that subscribe to the four precepts of pragmatic methodology. Such pluralism brings energy to the elusive ambition of realizing the "science of organization" to which Chester Barnard (1938) made reference 75 years ago and to which this *Handbook of Organizational Economics* speaks.

Appendix

Proof of Lemma: It follows from $y(e)$ being convex with $y'(0) = 0$ that there is a unique solution $e^G(z)$ to the first-order condition, $zG - y'(e^G(z)) = 0$, with $e^G(0) = 0$. Because $M > H > 0$ it immediately follows that $e^M(z) > e^H(z) > 0$ for all $z \in (0, 1]$. Now consider the derivative of the first-order condition with respect to z,

$$G - y''(e^G(z))\frac{de^G(z)}{dz} = 0, \text{ or } \frac{de^G(z)}{dz} = \frac{G}{y''(e^G(z))}.$$

Since $M > G > 0$ and $e^M(z) \geq e^H(z)$, then the assumption that $y'''(e) \leq 0$ is a sufficient condition for $\frac{de^M(z)}{dz} > \frac{de^H(z)}{dz}$. ■

Proof of Proposition: The proposition states that as σ or ρ increase, both solutions $z^*(\sigma, \rho)$ and $G^*(\sigma, \rho)$ will (weakly) decrease. It therefore suffices to prove that the objective function of maximizing total surplus exhibits increasing differences (Milgrom and Shannon, 1994). In particular, we need to show that $\frac{\partial^2 S}{\partial z \partial \rho} < 0$ and $\frac{\partial^2 S}{\partial z \partial \sigma} < 0$, that $\frac{\partial S}{\partial \rho}$ and $\frac{\partial S}{\partial \sigma}$ are decreasing in G, and that $\frac{\partial S}{\partial z}$ is increasing in G. Observe that,

$$\frac{\partial S}{\partial z} = G\frac{\partial e^G(z)}{\partial z} - y'(e^*(z, G))\frac{\partial e^G(z)}{\partial z} - \sigma\rho\frac{\partial k(z, G)}{\partial z}, \tag{1}$$

and in turn,

$$\frac{\partial^2 S}{\partial z \partial \rho} = -\sigma\frac{\partial k(z, G)}{\partial z} < 0, \text{ and } \frac{\partial^2 S}{\partial z \partial \sigma} = -\rho\frac{\partial k(z, G)}{\partial z} < 0,$$

which both follow from $\frac{\partial k(z,G)}{\partial z} > 0$ (assumption A2). To show that $\frac{\partial S}{\partial \rho}$ is decreasing in G we need to show that $\frac{\partial S}{\partial \rho}\Big|_{G=M} - \frac{\partial S}{\partial \rho}\Big|_{G=H} < 0$. Observe that $\frac{\partial S}{\partial \rho} = -\sigma k(z, G)$, so that

$$\frac{\partial S}{\partial \rho}\Big|_{G=M} - \frac{\partial S}{\partial \rho}\Big|_{G=H} = -\sigma k(z, M) + \sigma k(z, H) < 0,$$

which follows from assumption A1. Showing that $\frac{\partial S}{\partial \sigma}$ is decreasing in G follows the same steps (where σ is replaced with ρ). We are left to show that $\frac{\partial S}{\partial z}$ is increasing in G we need to show that $\frac{\partial S}{\partial z}\big|_{G=M} - \frac{\partial S}{\partial z}\big|_{G=H} > 0$ or, using (1) above,

$$[M-y'(e^M(z))]\frac{\partial e^M(z)}{\partial z}-[H-y'(e^H(z))]\frac{\partial e^H(z)}{\partial z}+\sigma\rho\left(\frac{\partial k(z,M)}{\partial z}-\frac{\partial k(z,M)}{\partial z}\right)>0.$$

Assumption A2 implies that $\sigma\rho\left(\frac{\partial k(z,M)}{\partial z}-\frac{\partial k(z,M)}{\partial z}\right)>0$ so it suffices to show that

$$[M-y'(e^M(z))]\frac{\partial e^M(z)}{\partial z}-[H-y'(e^H(z))]\frac{\partial e^H(z)}{\partial z}>0. \tag{2}$$

From the supplier's first-order condition we can substitute $y'(e^G(z)) = zG$ into the left-hand side of (2) to obtain,

$$(1-z)M\frac{\partial e^M(z)}{\partial z}-(1-z)H\frac{\partial e^H(z)}{\partial z}>0,$$

which is satisfied because $M > H$ and from Lemma 1, $\frac{\partial e^M(z)}{\partial z} > \frac{\partial e^H(z)}{\partial z}$. ■

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