Incomplete Contract Theory and Contracts Between Firms: A Preliminary Empirical Study

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Abstract

The theory of incomplete contracts has been much developed over the last few years, but it has failed to generate any empirical work. In part, this is due to the way models have been developed with a view to foundational rigour, and with little effort to draw out the empirical implications. It is also due to the difficulty in gathering relevant data. In this paper, we draw out some of the testable assumptions and predictions of incomplete contract theory with respect to the design of contracts between firms. Drawing on an earlier questionnaire study of UK manufacturing procurement contracts, we are able to cast light on the empirical relevance of some of the distinctive ideas from ICT. The evidence suggests that firms do use contracts with the expectation of legal sanction, and they are willing to renegotiate under conditions assumed by the theory. However, there is no support for the strategic use of contracts to encourage specific investments or to frame renegotiation. We conclude that firms develop alternative modes of governance to achieve this. One implication is that it is misleading to use one-shot classical contracting ICT, as a foundation for the theory of the firm.

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1. Introduction

Since the late 1980s (Grossman & Hart, 1986; Hart & Moore 1989), there has been a considerable growth in the literature known as incomplete contract theory (ICT). This literature sets about formalising and extending some of the insights from transaction cost theory (Williamson, 1975, 1985; Klein et al 1978). These include the ideas: that parties to trade fear opportunistic behaviour in the presence of specific investment;[1] that insufficient contractual safeguards can result in inefficient levels of such investment; and that the avoidance of such inefficiencies provides a key element in the theory of the boundaries of the firm.[2] Two assumptions are axiomatic of ICT. The first closely follows transaction cost theory (TCT) in that many important investments are observable *ex post* by economic agents close to a trade, but they are not verifiable in a court of law. In the jargon, they are not contractible. In particular, a contract cannot condition prices (or anything else) on *ex post* investments. The second is that parties to a contract cannot prevent themselves from renegotiating the terms if it is mutually beneficial to do so (Hart & Moore, 1988). Anticipating this, the parties use the contract in the context of an effective legal system to frame these renegotiations.[3]

The name, *incomplete* contract theory suggests that the theory's main concern is to consider the limitations of contracts that fail to specify not only investment levels, but also many of the other contingencies that a complete contract might wish to include in

[1] A specific investment is one that is more valuable when applied to a specific pair of trading partners than it is to trade with an alternative buyer or seller.

[2] There are no contractual problems with non-specific investments. In that case, one party cannot be 'held up' by the other, as alternative trading partners can be found with no loss on the value of investment.

[3] Renegotiation is also crucial in TCT, but the emphasis can be importantly different. ICT maintains the same mode of classical law governing contracts for all market transactions, while TCT suggests

an Arrow-Debreu world. The reason for this failure might be due to bounded rationality such that some contingencies cannot be imagined, or to the cost of writing complex contracts.[4] The theory might then ask, for example: how efficient are simple contracts that can specify, at most, only one price, one product specification and one quantity? An efficient contract is one that gives the optimal incentives for both investment and trade. This characterisation of the approach suggests a fairly *ad hoc* limit on the ability of rational agents to write contracts. However, in practice, much of the literature has avoided this potential criticism (or aspect of reality, depending on your point of view) by adopting one of two directions that finesse the need to specify arbitrary restrictions on the content of contracts.

The first direction asks: what is the minimum that must be written into a contract that would allow it to achieve efficiency in a particular, well specified game, defined according to the types of investment, nature of uncertainty, *ex post* bargaining procedures, etc? If the answer is that a very simple contract can achieve efficiency, then one efficient contract has been identified. There may be a multitude of other equally efficient contracts, but the one identified by the modeller typically has the added virtue of simplicity. Since it is efficient, it might be thought to be a misnomer to call such a contract 'incomplete'.

The alternative direction asks: why can *no* contract achieve efficiency in a particular situation? In essence, there is little to distinguish this approach formally from the more traditional complete contract agency theory, except ICT puts great stress on the

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circumstances where relational contracts are more appropriate. Relational contracts have less precise performance obligations and more emphasis on informal procedures for adapting terms.

[4] On the costs of complexity, see MacLeod (2000).

constraints that renegotiation places on what can and cannot be written into a contract.[5]

What sort of empirical predictions emerge from these two directions taken by ICT modellers? The second suggests situations in which market contracts may fail, and so which encourage some alternative form of governance. The main organisational alternative is an integrated firm.[6] Integration may not itself be fully efficient, and the degree of inefficiency may differ according to who has residual rights of control over physical capital. Nevertheless, it is possible to find at least a second best form of organisation characterised by a contract that allocates only ownership rights (Grossman & Hart, 1986). Although intra-firm organisation and the integration decision are beyond the direct scope of this paper, there is an important link because the ICT theory of the firm necessarily has the theory of market contracts as the counterweight against which intra-firm contracting compared. If the market side of the story is inappropriate, then so too must be the theory of the firm (at least with respect to the integration decision).

Our direct concern is with the light that ICT can shed on the nature of contractual relations between firms, given that they have chosen not to integrate. In the next section, we review the theoretical literature with a view to identifying both the empirical assumptions of ICT, and its predictions as to the content of actual contracts

[5] This emphasis has been reinforced by a critique by Maskin and Tirole (1999) which argues roughly that if agents are sufficiently rational to think in terms of dynamic programming (i.e. writing contracts strategically with a view to how they will constrain future behaviour), they should also be sufficiently rational to be able to describe states of nature (see long footnote in section 2B). This has led to a recent definition of an incomplete contract as 'an optimal complete contract subject to commitment and incentive constraints (and possibly also describability constraints)' (Hart and Moore, 1999, p135).

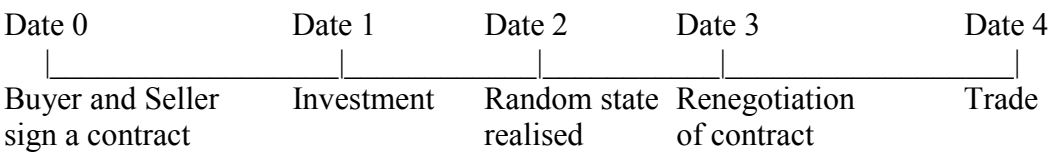
[6] ICT can also be applied to joint ventures (e.g. Noldeke & Schmidt, 1998; Edlin & Hermalin, 2000), financial structure (e.g. Hart, 1995), etc.

between independent firms. Possibly surprisingly, there has been almost no empirical work on this. ICT theorists frequently motivate their work by reference to a 'preliminary' study of non-contractual relations written by a sociologist nearly 40 years ago (Macauley, 1963), and to a more recent case study of a regulated industry (Joskow, 1987). However, neither study is in any way fine tuned to the contribution of ICT.[7] Of course, more widely, transaction cost theory has developed in a much more interactive way with empirical evidence, so there is now a considerable body of econometric evidence on contracts that is of some relevance. However, the aim of such empirical work has typically been to investigate much simpler and broader issues, which do not pick up the more subtle additional contribution of ICT.[8]

In section 3 of this paper, we revisit some survey data, originally collected to investigate some of the broader TCT issues in inter-firm contracting, to see what evidence this provides to support some of the more particular concerns of ICT.

2. Empirical Assumptions and Predictions from the Theory of Incomplete Contracts

Figure 1: Typical Time Line



A typical time line for an ICT model is given in Figure 1. At date 0, different models suggest different forms of contract and particular limitations on what it might contain,

[7] Both are outstanding pieces of empirical work. My point is that this is a very limited basis of evidence if we want to cast genuine light on the theory.
[8] See the recent reviews by Lyons (1996) and Masten and Saussier (2000).

most importantly in relation to what would be verifiable in court.[9] Most often, price, specification, quantity, delivery dates and penalty clauses are all assumed to be verifiable. The date 1 investment may be either 1-sided (only Buyer or Seller invests) or 2-sided (both invest); and it may benefit only the investor (self investment) or the other party (co-operative investment). The uncertainty that is resolved at date 2 may relate to the transacted product's specification (which may be potentially describable, or undescribable), the quantity required of a pre-specified product, production costs, market values or the effectiveness of investment. At date 3, the renegotiation may be subject to exogenous bargaining powers, or parties may have had the ability to specify a renegotiation procedure in the contract. At date 4, trade may or may not be optimal, and efficiency may require a revised quantity or a specification other than that in the contract.

It is worth highlighting two essential assumptions of ICT, for both of which we have some empirical evidence in section 3. The second is necessary if a contract is to be used to alter the disagreement point in bargaining.

Assumption A: If it is mutually beneficial to renegotiate a contract, then the parties will do so.

Assumption B: Each party believes that the terms of a contract would be enforced in the absence of renegotiation.

We adopt the following notation. v(i) is the value of the purchased product to the Buyer and c(j) is the Seller's cost, with $v_i \geq 0$, $c_j \leq 0$, $v_{ii} < 0$, and $c_{jj} > 0$; $i, j \in \{\sigma, \beta\}$. The Buyer's investment is β and the Seller's investment is σ, so for self-investment, i

[9] In this paper, we do not investigate the feasibility of relying on elaborate revelation mechanisms.

= β and j = σ, while for co-operative investments, i = σ and j = β. Price per unit is p, and the quantity is q. Investments are specific and, for simplicity, have zero value outside the relationship. Similarly, in the absence of trade and investment, both parties make zero profits (i.e. they have no outside options). In the event of renegotiation, the seller receives a share $\theta \in [0, 1]$ of the gross surplus from trade, [v(i) – c(j)], and the buyer receives share (1 - θ).[10]

A) Self-Investment When Specification and Quantity are Certain

Consider the case of 1-sided self-investment by the seller, where the product can be pre-specified and q=1 is certain at date 0 to be the efficient trade. The social optimum investment, σ^*, maximises $v - c(\sigma) - \sigma$; i.e. $-c'(\sigma^*) = 1$.

In the absence of a contract, the incentive to invest depends on relative bargaining power in price negotiations at date 3 (i.e. immediately before trade). If the seller were to have all the bargaining power, she would be able to extract all the surplus and so would have the optimal incentive to invest. However, if the buyer has any bargaining power, $\theta<1$, the seller can expect only $\theta[v - c(\sigma)] - \sigma$. This results in under-investment because $-c'(\hat{\sigma}) = \theta^{-1}$. The marginal product of investment exceeds its marginal cost, so $\hat{\sigma} < \sigma^*$.

[10] Thus, the gains from trade are shared in full, so bargaining is assumed to be efficient. Such efficiency is standard in ICT models. It is often assumed either $\theta = 0$ or ½ or 1. The assumption of $\theta = 0$ or 1 has very strong efficiency (or inefficiency) implications because there is no surplus sharing. In some models, *effectively* the same result is achieved if an outside option is binding in a Rubinstein type bargaining game because the party whose outside option does not bind receives all the *marginal* surplus.

However, a simple contract specifying p and q can restore optimal investment, because the seller maximises $p - c(\sigma) - \sigma$.[11] If the courts can enforce the contracted price and force delivery,[12] there is no incentive to renegotiate this contract *ex post* because there are no mutually beneficial changes to the original terms. If one party tries to renegotiate, the other can appeal straight to the courts and it is fundamental to ICT that the courts are expected to enforce the contract.[13] Although there is no explicit modelling of time in this model, it is implicit that the duration of the contract should be for the economic life of the investment. [14]

It makes no difference to the nature of the contract if both parties make self-investments. The absence of a contract would result in under-investment by both, while a fixed price and quantity are sufficient to attain full efficiency because each reaps the full benefit of their own investment. For example, at date 1, the buyer would anticipate receiving only $[1 - \theta][v(\beta) - c(\sigma)] - \beta$ in the absence of a contract, but $v(\beta) - p - \beta$ with a contract.

Prediction A (Self-Investments and No Uncertainty)): For a transaction where demand, cost and specification are known, and there are specific self-investments, then a simple contract specifying price, quantity and product specification is efficient. It makes no difference if one or both parties invest. No further safeguards are necessary.

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[11] $v \leq p \leq c(\sigma) - \sigma$

[12] In terms of legal remedy, this is known as 'specific performance', which means both parties are forced to fulfil contracted terms unless there is mutual agreement otherwise. This is discussed more fully below.

[13] The form of remedy used by the courts makes no difference in the case of certainty, so the discussion of expectation damages versus specific performance in section C has no impact here.

[14] Following Williamson (1985), specific investments may include capacity that would be under-utilised for a period if the other party were to hold them up. In such cases of temporal specificity, contract duration should cover the period of underutilisation.

This and the following predictions should be understood in the context of what would be a sufficient contract in the absence of investment specificity. In such cases, spot contracts are efficient.

B) Uncertain Specification

Next, suppose that the exact specification of the product is not known at date 0. Tirole (1999) suggests three sources of transaction cost that might be faced in this case (and, indeed, more widely): i) unforeseen contingencies; ii) cost of writing contracts; iii) cost of enforcing contracts. Most emphasis in ICT has been on the first. If a single specification can be foreseen and described, then it is straightforward to write a specific performance contract, and it is reasonable to expect the courts to be able to interpret it and verify the terms. However, if it cannot be described at date 0, or if there are numerous potential, describable specifications, each of which is equally likely but only one of which will be optimal once the uncertainty has been resolved at date 2, then a contract is unlikely to induce efficient investment (Hart & Moore, 1999).[15] This is because renegotiation must be expected at date 3 in order for the appropriate specification to be traded (i.e. for efficient trade) and this will result in surplus sharing unless the investor has all the bargaining power.[16] If the contract can

[15] We must assume that the investment is specific to the relationship (e.g. in understanding how a component would fit into the buyer's machine), and not just to the precise specification that is later revealed as optimal. It matters whether the investment is expected to reduce costs for just the optimal specification (*ex post*) or if it is also expected to reduce the costs of a wider class of specifications. In the latter case, the seller might invest to attain better bargaining power in a later renegotiation. See next footnote.

[16] There is a technical debate about what precise circumstances create a problem when the specification is not certain at date 0. Maskin and Tirole (1999) argue that ICT requires rational agents who are able to calculate the payoff consequences of their contracts and investments (see also Tirole, 1999). While parties may have difficulty describing the actions that will bring such payoffs about, they argue that this is no more than a garbling of information. In such circumstances, a clever contract can achieve the same investment as when all contingencies can be described (e.g. by contracting on other contingencies that *can* be described and which arise with similar probability). Hart and Moore (1999)

allocate all the bargaining power to the investor, or if the investment is useful across an appropriate class of specifications, then a contract for a single specification within this class, together with a fixed price, contributes some positive investment incentives even if the optimum is not achievable.

Prediction B (Uncertain Specification): If product specification is very uncertain, there are circumstance when 'no contract' can be (weakly) optimal. For some types of investment, a simple contract for one specification may be helpful for incentives but only as a device to affect bargaining during the anticipated renegotiation. This contrasts sharply with a complete contracting view that would suggest the inclusion of an elaborate set of contingencies in an optimal contract. In the case of one-sided investments, another function of the contract may be to allocate bargaining power to the investor.

C) Uncertain Quantity

Suppose demand is unknown at date 0, and depends on some state ϕ revealed at date 2 (i.e. only after investment decisions). The gross surplus from trade can be written: $v(q, \phi) - c(\sigma, q, \phi)$, where $c_{q\sigma} < 0$. The optimal quantity to trade, q^*, maximises this *ex post* gross surplus. If $F(\phi)$ is the cumulative distribution function for contingencies ϕ, and parties are risk neutral, then the optimal level of investment, σ^* maximises: $\int [v(q^*, \phi) - c(\sigma, q^*, \phi)]\, dF - \sigma$.

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and Segal (1999) respond that, given renegotiation, even when contingencies are describable, a contract may not be able to encourage optimal investment if there is a large number of alternative possible specifications, only one of which will benefit from the investment. In the limit, as the number of potential specifications goes to infinity, a contract cannot improve on 'no contract' as an incentive to invest. However, if one possible specification can be written into a fixed price contract, and if this and the later revealed optimal specification *both* benefit from the investment, then this raises the payoff to investment. In this way, a contract can be beneficial, even though it contracts on a specification that everyone knows is almost certain not to be wanted.

In this context, Edlin and Reichelstein (1996) show that the following contract can often attain efficiency in both investment and trade. The contract fixes a unit price, p^c which is sufficiently attractive for one party, say the seller, to wish to trade *ex post* whatever the ϕ or σ.[17] The contract also fixes a quantity, q^c. This provides a crucial instrument to modify expectations of what will happen following renegotiation. Finally, some additional transfer payment, independent of q or σ, is necessary to share the expected gains from trade. Suppose the legal system adopts the remedy known as 'specific performance': in the absence of out-of-court renegotiation agreeable to both parties, the courts would require the exact letter of the contract to be performed.

Trade of the contracted quantity is unlikely to be efficient *ex post*, but the optimal quantity, q*, is always achieved by renegotiation at date 3, because. The difference between the surplus generated by optimal trade and that which would transpire if the contracted quantity were traded, provides a renegotiation surplus, $RS = [v(q^*, \phi) - c(\sigma, q^*, \phi)] - [v(q^c, \phi) - c(\sigma, q^c, \phi)]$. The seller can expect a share θ of this. In practice, the sharing of RS may show itself in a transfer payment, or in a new unit price, or in some other form of compensation.

If $q^*(\sigma, \phi) = q^c$, then it is as if we were in a world of certainty where a fixed price and quantity do not need modifying from contract. The seller receives the full benefits of her investment in this state. If $q^*(\sigma, \phi) > q^c$, then because $\theta < 1$, the seller only receives a fraction of the social gains from the investment. Edlin and Reichelstein call the $(1 - \theta)$RS going to the buyer a 'hold-up tax'. It creates exactly the same sort

[17] This means that the seller can always credibly threaten court action during renegotiations.

of incentive problems as when there is a known demand but no contracted quantity. It might seem that such under-investment could be avoided by setting a sufficiently high q^c. However, this would create the opposite problem. If the uncertainty is resolved as a low demand state, such that $q^*(\sigma, \phi) < q^c$, then the sharing of RS provides a bounty for the seller. This gives the seller an incentive to *over*-invest in order to raise RS. E&R call this the 'breach subsidy'.[18] The optimal incentive to invest can be achieved by choosing the q^c which exactly balances the hold-up tax and the breach subsidy.

In practice, specific performance is little used by the courts in commercial cases, except for the sale of unique assets like works of art. More typically, courts impose 'expectation damages', which attempt to calculate the *ex post* value of the transaction to the party who is the victim of unilateral breach by the other.[19] The precise optimal q^c depends on the breach remedy applied, but the general design of an optimal contract in the presence of one-sided self-investments carries through. The contract should set quantity in order to balance the hold-up tax and the breach subsidy.

However, there is an important qualitative difference between the two remedies in the presence of two-sided self-investments. Under specific performance, since the same contingencies encourage over-investment for both buyer and seller, and if $v_{q\beta}$ and $c_{q\sigma}$ are independent of q and ϕ, E&R show that contracting for the unbiased estimate of expected demand provides optimal incentives for both parties. This looks like a very

[18] Because if the buyer did not renegotiate to the seller's satisfaction, the seller could sue him for breach of contract.

[19] Under expectation damages, if $q' < q^c$ at date 2, the buyer can inform the seller that he wants delivery of only q', and the courts will require the seller to mitigate damages by only producing q'. The courts will still compensate her such that her profits will be the same as if the contract were fulfilled, but this is achieved if the buyer pays the contracted revenue *less* the cost saving; i.e. $p^c q^c - [c(\sigma, q^c, \phi) - c(\sigma, q', \phi)]$. This is obviously different from the share of RS achieved under the specific performance remedy.

attractive contract. Unfortunately, the same optimality property does not hold under the more usual expectation damages remedy. This is because, when demand is low, the breacher receives no breach subsidy, so when demand is high they can receive no over-compensation to counter the hold-up tax.

MacLeod & Malcolmson (1993) model the case where parties contract for one unit of a good, but date 2 may reveal that trade is not efficient (i.e. a simplified uncertain quantity model). Both parties have outside options but the payoffs to these are not expected to be as beneficial as trade between the parties. This leaves a range of prices at which trade is mutually beneficial, though the contract price may need renegotiating if trade between the contracting parties remains the most beneficial even when the date 2 state makes trade unattractive for one of them. Even with two-sided investment, contracts are efficient as long as they can condition the price on sufficient external variables to ensure that renegotiation never occurs (e.g. escalator clauses). If there is ever any anticipated renegotiation, contracts cannot be efficient.

Other models with two-sided self-investments also manage to achieve optimality with simple contracts (Aghion et al, 1994, Chung, 1991 and Noldeke & Schmidt, 1995). As in M&M, this is only achieved if there is a renegotiation procedure that leaves all the residual bargaining power in the hands of one party. This may be fortuitous in that one party happens to have such power, or it may be achieved, for example, by putting sufficient penalties in the contract.[20]

[20] Chung (1991) assumes that renegotiation automatically gives all the bargaining power to one party, who can make a take-it-or-leave-it offer. This does not seem plausible since, if the other party rejects the offer, we are back to a situation where there is a choice between no trade or a further renegotiation which would result in mutually beneficial trade. Noldeke & Schmidt (1995) assume each party can send a signed alternative contract to the other, who can then lodge it with the court if the revised terms are agreed. As long as trade is privately and socially efficient, there will be no renegotiation, but this

Prediction C (Uncertain Quantity): If quantity is uncertain, a contract for a fixed quantity and price is efficient as long as both parties believe that the courts are effective in the case of breach. The contracted price must offer a premium to one party, and a fixed transfer payment is necessary to share the gains from trade appropriately. It will almost always be necessary to renegotiate quantity, and financial compensation must be expected following the renegotiation. In the presence of two-sided investment, escalator clauses may be a part of efficient contracting. Alternatively, the contract may be supplemented by heavy penalty clauses ('liquidated damages') for one party in order to give all the effective bargaining power to the investor; or there may be other devices aimed to give all the residual bargaining power to just one side.

D) Co-operative Investment

Suppose the investment is one-sided but co-operative (e.g. made by the buyer, but to the seller's benefit). Quantity (q = 1) and specification are known at date 0 with certainty. The social optimum investment, β^*, maximises $v - c(\beta) - \beta$; i.e. $-c'(\beta^*) = 1$. In the absence of a contract, and unless $\theta = 1$, there is an identical source of inefficiency to that with self-investment, because the buyer receives [1 -

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may not hold if there is sufficient uncertainty. They have to assume that the sending of revised contracts is simultaneous and takes place at only one moment of time, after which the original contract is enforced if a revision is not agreed. In effect, this rules out the threat not to deliver the good as a way to bring about renegotiation. Aghion et al (1994) suggest that the renegotiation can be designed into the contract in order to give one party all the power. In the context of an infinite horizon Rubinstein game, this requires substantial interest free deposits to act like hostages which change the relative degree of impatience of the parties, and thus alter their relative bargaining power. For high enough transfers, one party ends up being residual claimant. While analytically rigorous, this mechanism does not appear to be used empirically, at least with any significant frequency, possibly because of the costs incurred if bargaining gets delayed for some reason. MacLeod & Malcolmson (1993) achieve the same effect either if the non-investor has a binding outside option such that the investor receives the marginal benefit of investment, or if large enough liquidated damages are

$\theta][v - c(\beta)] - \beta$ *ex post*. However, in the presence of co-operative investment, a simple 'fixed price and fixed quantity' contract would not help. This is because the buyer receives no premium for investing. Maximising $v - p - \beta$ gives a zero incentive for the buyer to invest. *Note that there would be more investment in the absence of a contract*. An incorrectly specified contract is worse than nothing.

Nevertheless, a slightly more complex contract might restore full efficiency. Suppose that the contract does not require the seller to produce the good, but leaves production (and delivery) at her discretion. In other words, this is an option contract.[21] Then, she will not produce the good unless she has received sufficient help from the buyer to reduce her costs. If the contract sets p^* such that $p^* = c(\beta^*)$, then the seller will wish to supply if and only if the buyer has invested at least as much as is optimal; and the seller will invest exactly optimally as she will gain $v - p^* - \beta > 0$ if the seller exercises her option, but $-\beta < 0$ otherwise. Note that the price has to be chosen carefully. If contracted $p > p^*$ there will be over-investment, and if $p < p^*$ there will be under-investment. This contract also results in the buyer getting all the gains from trade, but this can be remedied straightforwardly by adding a transfer payment to the seller independent of whether trade takes place or not (so that it does not affect the incentive to invest). In practice, this looks like a take-or-pay contract, where one payment is agreed for when delivery takes place, and a lower payment is made when it does not.[22] Note that the option to deliver must lie with the *non*-investor (i.e. with the beneficiary of the investment).

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specified (i.e. damages written into the contract, and not damages implied by its other terms as determined by the courts applying the remedy of specific performance or expectation damages).

[21] See Chung (1991) and Noldeke & Schmidt (1995).

[22] There is a symmetry with the case where the seller invests on behalf of the buyer (e.g. an R&D project). In that case, the option to reject delivery must be given to the buyer, who will take delivery only if $v(\sigma) \geq p = v(\sigma^*)$.

However, this contract works only as long as both parties believe there would be no renegotiation following the seller's refusal to supply. If renegotiation cannot be prevented, and when trade is optimal this seems plausible, then the option contract runs into problems. Suppose the seller refuses to supply at the contracted price (possibly even though β^* has been invested), then either both parties walk away from a potentially profitable trade, or they renegotiate.[23] Given that it would be churlish not to renegotiate, the buyer can expect $[1 - \theta][v - c(\beta)] - \beta$, *ex post*, and this will govern his investment decision. This is exactly the same incentive as in the absence of any contract, so with renegotiation a contract is at best worthless (Che and Hausch, 1999).

The value of a contract in the presence of co-operative investment can be restored if the bargaining power at the renegotiation stage can somehow be allocated appropriately. In particular, if all the power lies with the investor, so $\theta = 0$ in the case of buyer investment, then the option contract attains efficiency. It is possible that this can be achieved either by luck or by writing it into the contract (e.g. by writing a penalty clause; or an arbitrator expected to operate according to appropriate criteria). Although such arguments are not altogether convincing, they do provide another justification for following up the empirical prediction of option contracts being used

[23] There is a potentially important moral point that appears to have been missed in the literature. The contracts in the previous section where quantity is specified in the full expectation that it would be renegotiated once uncertainties over mutually observed states of nature have been resolved. Renegotiation is both expected and mutually beneficial, and must be seen as honest business. In contrast, renegotiation following a mutually observed investment that is unfortunately not verifiable in court might be seen as a breach of faith. One party gains at the expense of the other. Because of this, renegotiation in such circumstances, while plausible, is much less likely. Thus, fixed price, option-to-deliver contracts may remain optimal.

in the presence of co-operative investments.[24] In the presence of two-sided co-operative investments, no simple contract can achieve efficiency.[25]

Prediction D (Co-operative Investment): In the presence of co-operative investment, it may be strongly optimal to trade without a contract. Fixed quantity contracts have a negative value, though a 'fixed price, option-to-supply' contract may be efficient in some cases. A contract may also be used to allocate as much renegotiation bargaining power at the margin to the investing party; for example by specifying large liquidated damages on the non-investor, or by allocating the right to determine specification. If both sides are required to make co-operative investments, contracts can provide little protection.

3. Empirical Results

The questionnaire data on inter-firm contracts are described in the Appendix. The main purpose of section 3.1 is to test the coherence of these data. By examining some expected links between measures of specific investment and the characteristics of transactions, we argue that we do have data worth employing in the current context. Section 3.2 considers the empirical support for some of the assumptions and predictions of ICT highlighted in section 2.

3.1 Transaction Characteristics and Specific Investment

[24] See the long footnote in section C.

[25] MacLeod & Malcolmson (1993) point out that if it is possible for either side to make the same investments, and taking into account the escalator clauses that must be incorporated in a contract to sustain two-sided self-investments, it may be simpler to agree that one party should do all the investing on behalf of both. This idea goes against the intuition that 'balanced' investments might give equal hostages (the problem with this intuition is that the 'balance' may also give each other a share of the gains from the other's investment).

The four main types of specific investment originally identified by Williamson are: human asset specificity (e.g. learning the needs of the buyer); physical asset specificity (e.g. specialised dies); dedicated assets (e.g. discrete investments in general purpose plant); and site specificity (e.g. nearby location to save on transport costs). It is natural to expect that different transactions will require different types of specific investment for efficient production, and numerous empirical studies have attempted to proxy some of these dimensions for particular cases. It is not possible to capture the full range of possible specific assets in a broad based survey of the nature undertaken here, especially as we had to use language that would be understood by business people. This means that our questions do not necessarily map precisely into the theoretical concepts.

Respondents were asked to circle a scale from 7 (strongly agree) to 1 (strongly disagree) for a series of statements of the form "We made a substantial investment in capital equipment specifically to meet our Customer's requirements". In order to report the results with respect to these scale variables as clearly as possible, we report only the more extreme responses. Thus, the column headed "Yes" in Table 1 corresponds to the percentage of those circling either 7 or 6, while the "No" column corresonds to 1 or 2. This simplified presentation captures the essential spirit of our results, and avoids the influence of weak, mid-rank responses that afflicts average and dispersion measures of scale variables. The last two columns disaggregate the "Yes" responses by Supplier and Customer.[26]

Table 1 Here

26 The disaggregation of 'No' answers presents an almost identical picture, so these are excluded in order to preserve clarity.

While the questionnaire was not designed to distinguish self-investments from co-operative ones, some types of investment more naturally reduce own costs, while others are more likely to have a substantial co-operative element. In particular, we expect supplier investments in capital equipment and in capacity to be predominantly self-investments, while buyer on-site advice is naturally co-operative. Investments in time and effort, location, or the existence of buyer switching costs, are much harder to characterise as either one category or the other. Finally, the loan of specialist equipment is an effective way of eliminating specificity, because the buyer retains ownership and so can transfer such equipment to any new supplier he chooses.

In order to investigate whether our data on specific investment are meaningful, we conduct an econometric analysis of the determinants of various categories of specific investment (using the full 1 – 7 scale values). The scale responses for Seller time and effort, specific equipment and capacity are added together to construct *Selspec*. Similarly, the Buyer's time and effort and switching cost scales are added to construct *Buyspec*. Since both Buyer and Seller specific investments are influenced by similar transaction characteristics, we also construct *Totspec* = *Selspec* + *Buyspec*. As specific location is important only for a few firms in the sample, but since it is potentially a very major specific investment, we investigate Seller and Buyer location separately (*Selloc* and *Buyloc*).

As an additional category, we aggregated buyer investments on behalf of the seller. We asked questions about the provision of on-site personnel to advise on design and/or production, and the loan of specialised equipment. For the purpose of reporting results, these were combined into a single variable (*Buyloan*).

Turning to the transaction characteristics that determine specific investment, the most obvious is the annual value of the transaction (*Value*) and the expectation that similar transactions will continue into future years (*Future trade*). These follow from the fact that one of the most important determinants of any investment return is the size of the market over which it can be applied.[27]

Another natural determinant of specific investment is the specificity of the product (*Prod. specificity*). The potential for specific investments is also likely to be greater if the product being exchanged is subject to fast moving high technology (*Tech. change*), so there needs to be work done to communicate with the buyer and to adapt her final product to benefit from any new developments.

The returns on specific investments might be tempered by risk aversion if there is uncertainty in relation to either input costs (*Ucost*), quantity requirements (*Uquantity*) or product specification (*Uspecification*). Each may to reduce the willingness to invest in specific assets. Finally, even holding the expected value of trade constant, the *Frequency* with which the product is delivered will affect specific investment if it facilitates feedback and so opportunities to make specific improvements.

All regressions are estimated by OLS, with standard errors adjusted for heteroscedasticity using White's method. The results are reported in Table 2. Begin by considering the *Selspec* regression. As expected, specific investments by the seller increase with the annual value of the transaction, and the expectation that similar

transactions will continue into the future. Products subject to technical change are associated with more specific investment, and a seller uncertain about input costs will invest less. However, other forms of uncertainty do not seem to matter. Our *Frequency* variable ranges between 1 for annual transactions, 2 for monthly, 3 for weekly and 4 for daily deliveries. Bearing in mind that there are only three annual deliveries in our sample, it is quite striking that frequency still matters in enhancing investments.

Table 2 here

Remarkably similar results are found in relation to *Buyspec* (with the exception of *Future trade*). Combining the two into *Totspec*, we have a model that explains just under half the variance in specific investments associated with these transactions. This is a very high R^2 for scale data taken from a questionnaire aimed at such a broad cross-section of firms. The motivation for site specific investment is much harder to tie down, which is not surprising given the few firms for which this was thought important. Nevertheless, seller location near the buyer (*Selloc*) is strongly correlated with technical change in the seller's product, which is consistent with the importance of proximity in facilitating the exchange of technical information. The evidence on *Buyloc* is extremely weak, but it seems that buyers will only locate near to an important supplier if they have a fairly clear idea of their own procurement needs.

Finally, buyer investments on behalf of the seller are strongly associated with product specificity, presumably including items like engineering dies. The association with relative certainty in quantity requirements and, albeit very weakly, with future trade, suggests loans are used in classic subcontracting relationships. Although not reported

[27] Future trade and other variables described below are all measured as responses on the full 1 to 7

separately here, the regression results for personnel and equipment loans are very similar, and little is lost in aggregation. The only exception is that the expectation of future trade promotes advice from loaned personnel, but not equipment loans. This is only to be expected given that equipment can be reclaimed in the event of bankruptcy or a trading relationship breaking down, while human capital cannot.

Overall, in addition to the intrinsic interest of these regressions, the fact that they tell such a plausible story provides considerable reassurance that our measures of investment specificity do indeed measure what we claim.

3.2 Incomplete Contract Theory and Real Contracts Between Firms

There are two main purposes behind the following empirical work. First, the ICT theory of the firm suggests that firms will integrate if incomplete contracts cannot protect specific investments (i.e. if there is a potential hold-up problem), but they will stay separate if integration provides worse incentives. Given that we observe transactions between firms, and that there are specific investments associated with many of these transactions, consistency of the theory suggests that contracts should be designed to minimise the disincentives caused by hold-up. If they are not, then this must lead us to question the empirical relevance of the ICT theory of the firm.

Second, some very specific contract clauses are suggested by the more precise models of optimal incomplete contracts, reviewed in section 2, as remedies to the hold-up problem. It is known that some of these have been used in the context of very long

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scale.

term energy contracts where whole power stations or major gas pipelines are at risk (Joskow, 1987; Crocker and Masten, 1988), but do they have a wider relevance?

We begin by examining two of the basic assumptions of ICT.

Assumption A: If it is mutually beneficial to renegotiate a contract, then the parties will do so.

Assumption B: Each party believes that the terms of a contract would be enforced in the absence of renegotiation.

We offered respondents the following statement to be evaluated on a 7-point scale: 'The terms of the agreement would automatically be renegotiated if this was mutually advantageous'. Similar statements related to the cases of renegotiation in the event of hardship by one party, and for the prospects of future trade. The first half of Table 4 shows that 76% of respondents would certainly renegotiate if that was mutually beneficial. Although there were still 3% who said they definitely would not, this is generally supportive of Assumption A. Broadening the idea of mutual benefit to include continuing trade beyond the current contract and into the future also induces support for renegotiation. However, the idea that firms would renegotiate because of hardship is a little more troubling for ICT, because it limits the ability of the contract to provide a firm base from which to form expectations (for example, of the return to investment). Of course, if the hardship was such that one firm might go bankrupt, this would be rational, but the survey throws no direct light on this.[28]

[28] ICT models do not normally reveal any inherent asymmetries between buyers and sellers, but these may develop if, for example, buyers are more likely to make co-operative investments, or if sellers make more specific self-investments. If these two speculations are true, then this may explain the

Tables 3 and 4 here

In Table 4, we report the significant variables in a regression of the willingness to renegotiate against the specific investments made by each party. The regression relating to mutually beneficial renegotiation is not particularly informative because nearly all buyers are willing to do so. Nevertheless, it seems that those few who are not, have also not invested co-operatively in their time with the supplier. Much more interesting, though not particularly well determined, are the regressions relating to renegotiation motivated by future trade and hardship. A clear pattern is established whereby parties to a contract are *more* flexible, the *more* they have invested in the relationship. This is exactly consistent with vulnerability to hold-up. Once an investment has been made, the terms of the contract become more vulnerable to 'voluntary' renegotiation.

One further piece of evidence relates to attitudes to the law of contract. It is essential that parties believe in the ultimate sanction of the law if a contract is to be able to affect renegotiation. A clear majority (54%) strongly agree that written contracts are legally binding (and few would say the same of unwritten agreements). A clear balance of opinion also suggests that legal force is a major role of written agreements. Although confidence in the law of contract is far from unanimous, 32% had strong confidence, which is more than many sceptics might have anticipated. We conclude that there is support for assumption B. Looking beyond the law, however, the predominantly agreed role of written agreements seems to be as a clear record.

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greater flexibility of suppliers over buyers. Alternatively, buyers may be less easily substituted than

Overall, the evidence suggests that business people do see their written agreements as having legal sanction, though that is not their only role. Also, they are willing to renegotiate where that is mutually beneficial. More subtly but also more speculatively, they are particularly open to renegotiation if they are locked in by having made specific investments. Although this type of survey is never going to provide unambiguous proof, it does lend support to the basic assumptions of ICT. This is enough to make it worthwhile investigating some of the more detailed predictions from ICT models with respect to the precise terms entered into a contract.

ICT models gain their bite mainly by distinguishing between self and co-operative investments, and in the use of the contract strategically to frame renegotiation. In the presence of an effective legal system, the latter may be achieved simply by setting price *and* quantity for a sufficient duration of contract. In the presence of co-operative investments, fixing quantity can be positively harmful. Strong uncertainty in specification can make null contracts weakly dominant. Uncertain quantitiy, however, should not reduce the benefits of contracting for a fixed quantity, even in the knowledge that this will almost certainly be renegotiated. In the presence of two-sided investment, there are often reasons to write more complex contracts, such as an option type contract with part of the payment made independently of the quantity actually delivered. In practice, this may look like some form of non-linear pricing. Alternatively, contracts may be augmented by specifying penalties on one party or the other. This is a potentially important instrument with which to frame renegotiation and to apportion bargaining power.

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suppliers more generally.

We proceed by estimating a series of probit regressions with the existence of various contract clauses being 'explained' by our Table 1 measures of specific investment supplemented by three measures of uncertainty with respect to specification, quantity and cost.[29] An immediate question raised by this methodology is that investments are expected to be endogenous to the success of the contract, so it might be thought that there is simultaneous equation bias. However, our method is justifiable on four grounds: ICT models suggest that appropriate contracts are usually fairly effective in supporting investment incentives, in which case measures of actual investment are unbiased and the basis of an appropriate null hypothesis; the models discussed assume a continuous marginal investment incentive as much for analytic convenience as for a representation of reality, whereas the real choice may be discrete between a general and a specific technology – this would result in bias of our investment measure only where contracts are inadequate; our measures of specific investment are admittedly crude, and may not be able to pick up marginal under-investments; and with zero-one dependent variables, any bias is less pervasive, and operates only at the margin of indifference.[30]

Table 5 reports the 'significant' variables (i.e. those close to significance of at least the 10% level on a 2-tailed test). Only just over half the contracts were for at least a year's duration, and if contracts are designed to encourage and then protect specific investments, we would expect these longer term contracts to be associated with higher levels of specific investments than are shorter duration contracts. In fact, the only

[29] Quantity uncertainty is measured by the buyer's knowledge of his requirements, and not by the seller's expectation of her sales. The latter would, of course, be heavily influenced by the contract. All uncertainties relate to an expectation over the next twelve months.

[30] Nevertheless, we did instrument the Table 1 investments with the Table 2 variables, and re-run the probit analyses. The instrumented estimates of investment were not very precise, and they revealed no more systematic pattern in explaining contract terms than in Table 5.

significant variable in the duration equation is buyer switching costs, and these may well have no investment element at all – they may just be exogenous costs of finding a new supplier. Only a sixth of transactions specified either an actual or a minimum quantity over an annual period. Once again, this is associated with switching costs and difficulties in specifying an annual amount due to uncertainty in either the specification or the quantity required of the product. Uncertain quantity is also implicated in not specifying even a monthly quantity (fixed or minimum) for half of the contracts. None of this is supportive of ICT models of contract, which imply that a fixed quantity serves the important purpose of providing investment incentives, even though it is expected to be renegotiated later, to achieve efficient trade once uncertainty is resolved. There is no evidence to support the key prediction that quantity contracts are important in the presence of self-investments, but counterproductive in the case of co-operative investments.

Table 5 here

Amongst all our measures of specific investments, we have just one that is definitely is not specific. Equipment loan by the buyer to the seller is a way in which what might otherwise be a specific investment by one party is transferred to the other. By retaining ownership, the buyer can relocate it with an alternative supplier and so avoid hold-up problems. As such, it should reduce the need to use quantity setting strategically. In contrast to expectation, it is positively associated with monthly quantity contracts. We return to this shortly.

Most contracts specify payment either by simple price per unit (34%) or by an average price that declines with quantity (48%).[31] Because this almost exhausts the range of pricing methods, they are explained by close to the same set of significant variables but with opposite signs. Non-linear price schedules are more likely than constant prices: when the buyer has loaned equipment, when the seller has chosen location to be near the buyer, and when quantity is more certain. In addition, non-linear prices are less likely when the supplier has invested in specific equipment, and a fixed unit price is more likely when the buyer has invested his time. There is no evidence that non-linear pricing is associated with uncertain quantity or two-sided self-investments (Prediction C).

An option contract includes a payment for a specified quantity as well as a transfer payment independent of quantity. The essential characteristics should be picked up in contracts that specify both an annual quantity (exact or minimum) and some form of non-linear pricing. Although the latter is not necessary, it would be a way of achieving much the same end while reducing the need to renegotiate. We call this an option (annual), but such contracts are only associated with equipment loans. None of this analysis of pricing schedules is suggestive that contracts are being used to create incentives to evade hold-up.

Next, we look at supplementary contract clauses that can be used to frame renegotiation. Raw material and wage escalators might allow parties to avoid the need to renegotiate for as long as possible. Similarly, a clause to specify the compensation for a change in specification requested by the buyer would be another

[31] This includes where a separate payment is made for development costs.

way to reduce the need for renegotiation. The evidence does not support their use for this purpose. The use of escalation clauses is actually lessened when costs are uncertain; and compensation for a change in the buyer's desired specification, which might limit the hold-up in the presence of seller investments, is most strongly associated with equipment loan.

Finally, we consider the use of penalties specified within the contract, or the use of an independent arbitrator, as mechanisms for assigning bargaining power. These are little used in short-term contracts, so we include our duration dummy in the probit regressions. Uncertain quantity militates against the use of these mechanisms, and penalties on the buyer are unlikely if he may have to change his required specification. However, once again, there is little to suggest that these clauses are used to encourage and protect specific investment. For example, the more important is the buyer to the seller, in the sense that the seller could be left with excess capacity, then the *less* likely is the buyer to face liquidated damages.

4. Conclusions

Overall, a pattern of contract terms emerges that suggests these contracts between manufacturing firms for regular inputs have little to do with the current concerns of ICT models. For example, the loan of equipment to a supplier, which effectively eliminates investment specificity, still results in a more deeply specified contract; while a co-operative investment in advice on design or production by a supplier is associated with no clear contractual response. The explanatory power of the econometrics if low, but certain patterns do emerge. For example, the contractual response to uncertainty is *not* to try to write down more complex contracts (as in

complete, contingent contracts), *nor* is it neutral using a particular quantity and specification as a base from which to renegotiate (as in ICT), but it is to write down *less*.

Perhaps these results should not be surprising. Contracts between manufacturing firms are typically quite short term, even for substantial recurrent requirements. However, relationships between these firms are much longer term, and specific investments are made. These investments almost certainly have a lifespan in excess of a typical contract. Current ICT models are mainly of one-shot contracting, and while this makes them tractable, this seems to miss the essential point. Expectations and reputation are almost certainly more important than the contracts that superficially govern the current transaction.[32] Given that models of repeated contracting are likely to have multiple equilibria, this may require a more careful analysis of the norms of business culture. This is also likely to mean that the equilibria may vary across industries and countries.

Transaction cost theory has long been sensitive to the importance of repetition, and the qualitative change it makes to the mode of contracting (relational instead of classical contracts). However, it is less easy to formalise a model of relational contracting. Of course, long-term classical contracts to encourage specific investments are used in some well documented cases (e.g. Joskow, 1987; Crocker and Masten, 1988), but these often apply to cases where vertical integration would have been the clearly preferred option if not ruled out by regulation. They are not the norm for most stages of production and distribution that are on the margin of the make-or-

buy decision. Importantly, this undermines the application of current one-shot ICT models to the theory of the firm, because without a clear model of how the market works, it is not possible to compare institutions. On the current evidence, ICT models have made only a very limited contribution to our understanding to the market alternatives to integration.

[32] MacLeod and Malcolmson (1993) and Bernheim and Whinston (1999) make a start on analysing repeat transactions. A key result of the latter is that some predictions are exactly reversed when compared with the one-shot game.

References

Aghion, P., M. Dewatripont and P. Rey, March 1994, "Renegotiation Design with Unverifiable Information", *Econometrica*, Vol.62 No.2, 257-282.

Aghion, P., M. Dewatripont, P. Rey, 1990, "On Renegotiation Design", *European Economic Review 34"*, 322-329. North-Holland.

Bernheim, B.D., and M.D. Whinston, 1998, "Incomplete Contracts and Strategic Ambiguity", *The American Economic Review*, 88.4, 902-32.

Bolton, P., 1990, "Renegotiation and the Dynamics of Contract Design", *European Economic Review 34*, 303-310. North-Holland.

Che, Y-K, D.B. Hausch, 1999, "Cooperative Investments and the Value of Contracting", *The American Economic Review,* Vol.89.1, 125-147.

Chung, T-Y, 1991, "Incomplete Contracts, Specific Investments, and Risk Sharing", *Review of Economic Studies* 58, 1031-1042.

Crocker, K.J. and S.E. Masten, 1988, "Mitigating Contractual Hazards: Unilateral Options and Contract Length", *RAND Journal of Economics*, 19.3, 327-43.

Dewatripont, M., E. Maskin, 1990, "Contract Renegotiation in Models of Asymmetric Information", *European Economic Review 34*, 311-321. North-Holland.

Edlin, A.S, B.E. Hermalin, 2000, "Contract Renegotiation and Options in Agency Problems", *Journal of Law, Economics and Organization,*16.2, 395-423.

Edlin, A.S. and S. Reichelstein, 1996, "Holdups, Standard Breach Remedies, and Optimal Investment", *The American Economic Review,* 86.3, 478-501.

Epstein, L.G., T. Wang, 1994, "Intertemporal Asset Pricing under Knightian Uncertainty", Econometrica, Vol.62, No. 3, 283-322.

Grossman, S.J. and O. Hart, 1986, "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration", *Journal of Political Economy*, 94, 691-719.

Hart, O., 1995, *Firms, Contracts and Financial Structure*, Oxford University Press

Hart, O. and J. Moore, 1988 "Incomplete Contracts and Renegotiation", *Econometrica,* Vol.56, No.4, 755-7785.

Hart, O., J. Moore, 1999, "Foundations of Incomplete Contracts", *Review of Economic Studies* 66, 115-138.

Joskow, P.L., 1987, "Contract Duration and Relationship-Specific Investments: Empirical Evidence from Coal Markets", *American Economic Review*, 77.1, 168-85.

Klein, B., 2000, "The Role of Incomplete Contracts in Self-Enforcing Relationships", *Revue D'Économie Industrielle*, 92, 67-80.

Lyons, B.R., 1996, "Empirical Relevance of Efficient Contract Theory: Inter-Firm Contracts", *Oxford Review of Economic Policy,* Vol.12, No.4. 27-52.

Macaulay, S., 1963, "Non-Contractual Relations in Business: A Preliminary Study", *American Sociological Review*, 28, 55-67.

MacLeod, W.B., and J.M. Malcolmson, 1993, "Investments, Holdup, and the Form of Market Contracts", *American Economic Review*, 83.4, 811-37.

MacLeod, W.B., 2000, "Complexity and Contracting", *Revue D'Économie Industrielle*, 92, 149-78.

Maskin, E. and J. Tirole, 1999, "Unforeseen Contingencies and Incomplete Contracts", *Review of Economic Studies*, 66, 83-114

Masten, S.E. and S. Saussier, 2000, "Econometrics of Contracts: An Assessment of Developments in the Empirical Literature on Contracting", *Revue D'Économie Industrielle*, 92, 215-36.

Nöldeke G. and K.M. Schmidt, 1995, "Option Contracts and Renegotiation: A Solution to the Hold-Up Problem", *The RAND Journal of Economics*, 26.2, 163-79.

Nöldeke G. and K.M. Schmidt, 1998, "Sequential Investments and Options to Own", *The RAND Journal of Economics*, 29.4, 633-53.

Rogerson, W.P., 1992, "Contractual Solutions to the Hold-Up Problem", *Review of Economic Studies*, 59, 777-794.

Segal, I., 1999, "Complexity and Renegotiation: A Foundation for Incomplete Contracts", *Review of Economic Studies*, 66, 57-82

Tirole, J., 1999, "Incomplete Contracts: Where Do We Stand?", *Econometrica,* Vol.67, No.4, 741-781.

Appendix: **The Survey**

Section A1 reports the questionnaire design. In section A2, we argue that the results are representative of substantial inter-firm transactions in UK manufacturing.

A1 Questionnaire Design

The aim of the postal questionnaire was to gather information on a broad cross-section of inter-firm contractual relations in manufacturing industry. We restricted attention to manufacturing firms because, for example, the service industries would find a standardised questionnaire unintelligible. However, within manufacturing we wanted to gather information on a wide range of transactions in order to provide a sample with variance. We also wanted to be representative of the range of firm sizes. Finally, we did not want to restrict attention to only one side of the relationship (i.e. customer or supplier), nor did we want two separate samples.[33] Respondents were asked to answer the questions "with respect to one particular customer [or supplier] who is not part of your organization". They were free to self-select any business relationship, and were not required to name the customer [or supplier]. To make the two questionnaires compatible, the questionnaires for customer and supplier respondents asked exactly paired questions.

The questionnaire was piloted initially by twelve face-to-face interviews, in order to see what language and questions would be understood by business people. This was followed by a postal pilot, following which our questionnaire was finalised.[34] It was found that firms understood, and were willing to complete, a

[33] We considered asking questions of both sides to the same transaction, but it proved too difficult to pair up individual transactions (one reason was the fact that it would lead to confidentiality problems); so we asked firms to respond as either buyer or seller.

[34] The 26 pilot responses could not be used in our final analysis as the question changes were too substantial. The final questionnaire was structured in five parts: a) background details on the firm (e.g.

questionnaire that involved statements of the form We have made a substantial investment in capital equipment specifically to meet our Customer s requirements, against which they had to circle a scale of 7 to 1, labelled strongly agree to strongly disagree. Alternatively, box-ticking elicited a good response (e.g. for a series of potential contract provisions, such as price escalation formula for raw materials, respondents had to tick either no agreement or written agreement or verbal agreement). However, requests for actual numbers (e.g. value of investments) were not feasible, except for relatively simple magnitudes like employment and the value of transactions with their parner firms. In this way, we developed a thirteen page questionnaire with over 150 quantifiable questions.

A2 Representativeness of Sample

A random sample of manufacturing firms was selected from a large directory, Key British Enterprises (KBE).[35] This includes the 50,000 largest actively trading companies in the UK, about a third of which are in manufacturing. When compared with census data, it becomes clear that KBE is almost comprehensive in terms of firms employing at least 50 people, but not of the smaller firms. KBE contains information on firm names, addresses, SIC codes, sales and employees, which enabled the selection of a reasonably representative sample (except for the smallest firms), stratified by size and sector.

Having selected our sampling frame, we wrote an introductory letter, mostly at the managing director level, explaining our research motivation and independent research council funding. This was closely followed by a telephone approach. Having agreed to co-operate with the survey, the managing director of a larger firm typically

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firm size); b) the transaction (e.g. frequency and standardisation); c) reasons for buying, not making in-

passed us on to either a sales or a purchasing manager, who we also spoke to by telephone before sending them the questionnaire to complete. One further telephone reminder was made in the event of non-response, though this had little effect on our success rate. This approach methodology proved unusually successful in terms of eliciting responses to such a lengthy questionnaire. Only 4.3% refused at the initial telephone approach, and of the 367 questionnaires sent out, we received 147 reasonably complete responses - a rate of almost exactly 40%.

Of the 147 respondents, 108 answered as Suppliers and 39 as Customers. In terms of *business size*, respondents were asked how many people were employed by their firm. 27% employed fewer than 100 (but only 10% fewer than 50), 52% employed 100-499, and 21% at least 500. Furthermore, 65% were linked to a parent company; and of those that were, 54% reported that the parent group employed >2,000. There is no definitive way of measuring how representative this sample is of inter-firm transactions activity. Compared with the net output shares of these size classes in the UK Census of Production (for the similar definition of "businesses"), this over-represents medium sized firms and under-represents the largest firms (by value, but not by number). However, given the preponderance of supplier responses, and inasmuch as upstream firms tend to be smaller than downstream 'assemblers', this appears to be reasonably representative by size of firm. Information given on parent sizes reflects a similar picture of slight under-representation by output of the largest organizations.[36]

In terms of *industrial distribution*, just over half of responses were from the engineering industries. These were thus over-represented in terms of net output

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house; d) written and unwritten agreements; e) trust and personal relations.

35 Computer generated random numbers were used to select page numbers of the directory.

relative to, say, food and drink. This can probably be justified in terms of the intensity of inter-firm transactions in engineering, particularly those involving idiosyncratic requirements. Metals, chemicals and plastics each had at least nine respondents, which is roughly consistent with their share of output. Overall, it seems we have a reasonably representative sample of inter-firm transactions in UK manufacturing. Inasmuch as there is a slight 'bias' in favour of medium sized engineering firms, this probably reflects the greater intensity of inter-firm transactions in this sector.

The distribution of the *annual value of transactions* for the relationship in question was:

< £10k.	2%
£10k.- £99k	18%
£100k.-£999k.	47%
£1m.- £9.9m.	25%
£10m.-£100m.	8%

These figures seem sufficiently high to suggest that it is worthwhile for firms to think very seriously about the governance of these transactions.[37] In terms of frequency of delivery, 87% was no less frequent than monthly, so there has been some self-selection on repeat transactions.

Finally, we asked "To what extent is the good which you supply to the Customer a standardised product (i.e. a product already supplied to at least one other firm), as against a bespoke product (ie a product manufactured uniquely to the

36 Another reason why this slight under-representation should not be worrying is that larger firms tend to be more integrated (they can achieve more economies of scale and scope in-house), so they engage in relatively fewer external transactions.

37 This is one aspect of sample selection for which we had not wish to be representative – we did not want to know about paperclip procurement.

Customer's requirements?'[38] They were given three alternative boxes to tick, and the responses were as follows:

Fully standardised product	27%
Standardised product with some Customer-specific modifications	34%
Fully bespoke product	38%

Thus, we have a useful spread of financially significant, repeated transactions, including products of varying degrees of *design* specificity.

[38] Equivalently, we asked buyers: 'To what extent is the good which the Supplier supplies to you a standardised product (i.e. a product already supplied to at least one other firm), as against a bespoke product (ie a product manufactured uniquely to your requirements?'

Table 1: Specific Investments

			Supplier	*Buyer*
	Yes	*No*	*Yes*	*Yes*
Self-Investment By Supplier...				
Capital equipment	30%	43%	34	17
Capacity	10%	47%	13	0
Self or Co-operative Investment By Supplier...				
Time and effort	65%	7%		
Location	4%	90%	4	3
Self or Co-operative Investment By Buyer...				
Time and effort	35%	13%	26	60
Switching costs	30%	32%	27	37
Location	2%	98%	0	6
Co-operative Investment By Buyer...				
On-site advice	16%	55%		
Non-Specific Investment By Buyer...				
Loan of equipment	11%	85%		

Table 2: Non-Contractual Determinants of Specific Investment

	Totspec	***Selspec***	***Buyspec***	***Selloc***	***Buyloc***	***Buyloan***
Constant	-0.54 (0.14)	-3.71 (1.54)	3.17 (1.38)	0.97 (1.07)	1.39 (2.59)**	-0.09 (0.05)
Value	0.71 (2.61)**	0.46 (2.43)**	0.25 (2.03)*	-0.00 (0.06)	0.00 (0.04)	-0.13 (0.05)
Product specificity	2.30 (3.79)**	1.55 (3.65)**	0.75 (2.16)*	-0.03 (0.21)	0.03 (0.34)	1.85 (5.14)**
Technical change	0.68 (3.59)**	0.43 (3.41)**	0.25 (2.16)*	0.18 (3.23)**	0.03 (0.78)	0.17 (1.37)+
Ucost	-0.96 (3.34)**	-0.48 (2.39)**	-0.48 (2.49)**	-0.08 (1.15)	0.08 (1.25)	0.02 (0.10)
Uquantity	-0.02 (0.05)	0.07 (0.35)	-0.09 (0.46)	-0.01 (0.11)	-0.10 (1.78)*	-0.35 (2.17)*
Uspecification	-0.08 (0.35)	0.08 (0.43)	-0.15 (1.02)	-0.03 (0.29)	0.03 (1.01)	0.00 (0.01)
Frequency	1.54 (2.64)**	0.92 (2.23)*	0.62 (1.68)*	0.19 (1.20)	-0.18 (0.99)	0.31 (0.66)
Future trade	0.63 (1.87)*	0.54 (2.54)**	0.05 (0.20)	-0.08 (0.94)	0.01 (0.12)	0.32 (1.47)+
R^2 [Rbar^2]	0.471 [0.434]	0.423 [0.383]	0.247 [0.195]	0.112 [0.051]	0.061 [-0.004]	0.228 [0.175]
N	*125*	*125*	*125*	*125*	*125*	*125*

Table 3: Attitudes to Renegotiation

	Yes	*No*	*Supplier Yes*	*Buyer Yes*
Renegotiate if...				
Mutually beneficial	76	3	70	91
Future trade:				
Supplier flexible	64	3	63	66
Buyer flexible	47	6	48	43
Hardship:				
Supplier flexible	35	16	30	49
Buyer flexible	23	19	16	40
Agreements are legally binding if...				
Written	54	9	51	62
Unwritten	15	23	14	18
Role of written agreements is...				
Force of law	44	15	47	37
Clearer record	81	2	80	83
Confidence in the law of contract...				
	32	11	31	34

Note: percentage of 127 contracts with delivery at least monthly. Allowing for missed answers, actual number of contracts varies between 119 and 125.

Table 4: Renegotiation and Specific Investment

Renegotiate if...		
Mutually beneficial	*Buyer time (+2.18) On-site advice (+1.70) (-1.76)*	*Equipment loan R^2= 0.12*
Hardship on other party:		
Supplier flexible	*Supplier capital equipment (+2.18)*	*R^2= 0.07*
Buyer flexible	*Buyer switching costs (+1.65) Buyer time (+2.22)*	*R^2= 0.13*
Future trade:		
Supplier flexible	*Supplier capital equipment (+1.56)*	*R^2= 0.04*
Buyer flexible	*Buyer time (+4.93)*	*R^2= 0.22*

Signs and t-statistics are reported in brackets.

Note: This table reports the statistically significant variables from least squares regressions with the Table 1 investments, measured as scale variables, as independent variables (t-statistics have been adjusted for heteroscedasticity). Supplier time and effort has been excluded because it has little variance but still causes multicollinearity.

Table 5 Contract Clauses, Specific Investment and Uncertainty

	%	***'Significant' Variables***	
Duration ≥ 12 mths	53	*Buyer switching costs (+2.67)*	$R^2 = 0.12$
Annual Quantity	17	*Buyer switching costs (+1.61) Uncertain specification (-1.69) Uncertain quantity (-1.61)*	$R^2 = 0.13$
Quantity Next Month	50	*Equipment loan (+3.00) Uncertain quantity (-2.10)*	$R^2 = 0.17$
Unit Price Only	34	*Buyer time (+1.88) Equipment loan (-2.46) Seller location (-1.68) Uncertain quantity (+1.68)*	$R^2 = 0.18$
NonLlinear Price	48	*Supplier capital equipment (-1.84) Equipment loan (+3.22) Seller location (+1.67) Uncertain quantity (-1.78)*	$R^2 = 0.20$
Option (Annual)	10	*Equipment loan (+1.66)*	$R^2 = 0.07$
Escalation Clause	25	*Buyer time (-1.77) Uncertain costs (-1.69)*	$R^2 = 0.09$
Compensation Δ Spec.	30	*Equipment loan (+2.59) Seller location (+1.76) Buyer location (-1.89)*	$R^2 = 0.19$

The following Probit estimates also include a dummy for duration:

Penalties on Seller	30	*Equipment loan (+1.67) Uncertain quantity (-2.64) Duration ≥ 12 mths (+4.20)*	$R^2 = 0.29$
Penalties on Buyer	25	*Seller capacity (-3.15) Buyer location (+2.41) Uncertain quantity (-1.86) Uncertain specification (-2.46) Duration ≥ 12 mths (+2.27)*	$R^2 = 0.29$
Arbitration	26	*Buyer location (1.83) Uncertain quantity (-1.93) Duration ≥ 12 mths (+3.13)*	$R^2 = 0.20$

Note: This table reports the statistically significant variables from least squares regressions with the Table 1 investments and three measures of uncertainty, each measured as scale variables, as independent variables (t-statistics have been adjusted for heteroscedasticity). Supplier time and effort has been excluded because it has little variance but still causes multicollinearity. Estimation is by Probit. R^2 is from the equivalent least squares regression, and is for guidance only. 122 observations.