On Partial Contracting

Philippe Aghion, Mathias Dewatripont and Patrick Rey[1]

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[1]Respectively Harvard University, University College London and CEPR, ECARES (Universite Libre de Bruxelles) and CEPR, and GREMAQ and IDEI (Universite des Sciences Sociales, Toulouse) and CEPR.

Abstract

This paper investigates contracting situations where giving away some control rights enhances both the donor's *and* the receiver's incentives to *cooperate in the future.* We define a *partial contracting* framework with *non-verifiable actions* for which either control is contractible (*contractible control* actions) or the right to transfer control expost to another party is contractible (*transferable control* actions). Under incomplete information, when control over particular actions is transferable but not contractible, it can be optimal to give one party the right to transfer control over a particular action to the other party, in order for that party to build a reputation regarding her willingness to cooperate in the future.

1 Motivation and Framework

An important feature of the Grossman-Hart (1986) model of Vertical and Lateral Integration is that distributing ownership rights to one party typically increases the incentives to invest of that party whilst it *reduces* the investment incentives of the other party. In this paper, we investigate a contracting situation where giving away some control rights enhances both, the donor's *and* the receiver's incentives to *cooperate in the future*, that is to invest more in the joint undertaking. We also have a second, more methodological objective: in our setup, we are led to define the concept of *partial contracting*, which refers to a situation where formal contracts, rather than determining the entire relation between the contracting parties, can only influence –that is, be superimposed upon– the *underlying game* between them. To be more specific, consider the following polar cases:

(i) at one extreme, a world with fully contractible actions, both ex ante and ex post: in such a world, the relationship between the contracting parties is fully determined by the initial contract or mechanism; this case encompasses the *"-classical" implementation literature* à la Maskin (1999) or Moore-Repullo (1988), where one can contract on entire extensive forms; in this case, the contracting parties can limit themselves to sending (possibly sequential) messages to a "planner" who then takes or dictates all relevant actions;

(ii) at the other extreme, a world with only noncontractible and pre-assigned actions: then, the game between the parties involved is hardly affected by the

initial contract; this case encompasses *standard game-theoretic models*, where there is no room for contracting at all, but also *moral hazard models* (à la Mirrlees (1999), Holmström (1979, 1982), ...), where actions are noncontractible and pre-assigned.

In this paper, we are interested in the intermediate, "partial" contracting case where some actions are nonverifiable ex post and therefore not contractible, so that those actions cannot be delegated to –or dictated by– a social planner, and yet *control* over such actions may be (partly) contractible. We feel that this intermediate case is much richer than has been recognized so far by contract-theoretic models[1], which have focused a lot on the distinction between "complete"and "incomplete" contracts, and on the proper foundations of the latter. By considering a dynamic, incomplete information context, we illustrate the richness of these situations of partial contracting, which furthermore provide both proper and simple foundations: Introducing ex post nonverifiability of actions reduces the power of message games and thus restores a role for ownership and control allocations, as noticed by several papers in the literature.

Ex-post unverifiability of actions means that ex-post efficiency is a serious problem, in contrast with the Grossman-Hart (1986) model and in the Williamsonian underinvestment models that are in the same tradition. In those models, ex-post efficiency is easy to achieve, and the focus is mainly on ex-ante efficiency, that is, investment efficiency. Here, several ex-post unverifiable actions have to be taken

[1]See the end of the paper for references.

sequentially, and the objective of the contract is to ensure that both parties behave "cooperatively". In these cases, dividing control between the two parties can be a "win-win" arrangement. Interestingly, the optimality of such a control arrangement depends on the exact extent to which control can be dynamically allocated, as we explain below.

We emphasize the distinction between *contractible* and *transferable* control. *Contractible control actions* are defined as actions that cannot be contracted upon, but for which a contract can specify who is allowed to undertake them, that is, who is *in control. Transferable control actions* are defined as actions that cannot be contracted upon and for which decision rights cannot be contractually allocated at the outset, but where control over such actions can be given (transferred) later on to one or the other party. In that case, the initial contract cannot specify who has control over a given action, but still it can specify which party decides about who has ultimate control over the action.

In our model, one party optimally decides to give some control at the start to the other party in order to learn about her trustworthiness and her wilingness to cooperate in the future. This story is consistent with the widespread practice of writing initial short-term contracts in order to "test" one's contracting partner, before going for a more sustained relationship. Banerjee and Duflo's (1999) study of the Indian customized software industry provides an illustration of such two-step contracting process: when a big US computer firm starts contracting with a

small Indian software firm without reputation, it signs a contract which allows the small firm to start building a reputation, while nonetheless imposing a significant share of the risk on the small firm. Once previous contracting relationships have led to enhance the reputation of the small firm, the parties then move to contracts where the big firm takes more of the risk.

2 Control transfer as a reputation-building device

Consider the following two-stage strategic relationship:

- in stage 1, one of the two parties (A and B) has to take an action for which only control may be contractible.
- in stage 2, both parties have to simultaneously take a noncontractible action, over which control is pre-assigned.

In each stage a party can choose to cooperate (action c) or not (action a for A and b for B); however, whilst only one party acts in the first stage, both parties must act in the second stage.

For simplicity, consider a pure (time-additive) private benefit payoff structure[2]: the actions generate nonverifiable private benefits and the parties are not responsive to monetary incentives. Contracting is thus necessarily partial: it may determine who takes the action in stage 1 but leaves no scope to "buy", "sell"

[2]See Aghion et al. (2000) for an extension to the case of payoffs responsive to monetary benefits.

or "auction-off" control rights; moreover, there is no scope either for message games once the first action is chosen since, control for the actions undertaken in the second stage being pre-assigned, there is then nothing to "offer" (neither monetary transfers nor control rights) in exchange for information revelation.

We first describe the payoffs and the continuation equilibria of the game, starting from stage 1, when the actual decision-maker must decide upon his or her course of action. Assume that cooperation is more attractive to "good types" than to "bad types", so that the party in charge in stage 1 may decide to cooperate to "signal" his or her type. To keep the analysis simple, assume that only B can be of a bad type, with ex-ante probability μ.

In the first stage, payoffs are as follows:

Action	A's payoff	B's payoff (good type)	B's payoff (bad type)
c	1	1	0
a	a	0	0
b	0	b	π^*

with $a, b, \pi^* > 1$, so that each party would gain by playing noncooperatively in the game composed of only that stage.

In the second stage, if party B is of a "good type" the payoffs are given by:

		B	
		c	b
A	c	π^c, π^c	$\widehat{\pi}, \widetilde{\pi}$
	a	$\widetilde{\pi}, \widehat{\pi}$	$0, 0$

where, as before, $\pi^c > 0 > \hat{\pi}$ and $\pi^c > \widetilde{\pi}$. Under complete information this game has therefore two pure-strategy Nash equilibria: a good one where both players cooperate, and a bad one where neither player cooperates.

If party B is instead of a "bad type", the second-stage payoff matrix becomes:

		B	
		c	b
A	c	π^c, π^c	$\widehat{\pi}, \widetilde{\pi} + \Delta$
	a	$\widetilde{\pi}, \widehat{\pi}$	$0, 0$

with $\widetilde{\pi} + \Delta > \pi^c$. In this case, there is only one Nash equilibrium under complete information, which involves no cooperation.

If the game consisted only of stage 2 and only player B knew her type, it is easy to see that we would have at most two pure-strategy Bayesian equilibria: (i) a "bad" equilibrium (which always exists) where nobody cooperates and thus both parties get 0; (ii) a "good" equilibrium, where A cooperates and where B cooperates whenever she is of good type, which yields a positive expected payoff

to all parties. This equilibrium exists if $\mu \leq \mu^* \equiv \frac{\pi^c - \widetilde{\pi}}{\pi^c - \widetilde{\pi} - \widehat{\pi}} < 1$. The good equilibrium Pareto-dominates the bad one whenever it exists[3]. We shall thus assume that, whenever the good equilibrium exists, it is automatically played by the parties (technically, this amounts to assuming "Pareto-perfection").

Two problems may therefore arise due to incomplete information, that is, whenever $\mu > 0$: first, when μ is too large, the good equilibrium disappears and the unique equilibrium outcome is that nobody cooperates; second, even in the good equilibrium, when B is of bad type, A obtains a negative payoff (namely, $\widehat{\pi}$) by playing the cooperative action alone.

We now explore alternative means whereby these two problems can be solved. To fix ideas, assume that, initially, A has control over stage 1 (e.g., stage 1 is part of a bigger project over which A has been allocated *global control rights* at a preliminary stage 0) and study, from A's perspective, the optimal use of that control right.

2.1 Contractible control

Assume first that, while the stage-1 action is itself not contractible, one can contract over who has control over it. Then, A can use a mechanism asking B to reveal her type and then assign control accordingly so as to induce truthful

[3]Indeed, player B, whatever her type, prefers player A to cooperate, and player A is also better off in the good equilibrium, since he obtains a positive expected payoff instead of zero in the bad equilibrium.

revelation. Taking into account B's incentive and participation constraints, the following mechanism maximizes A's expected benefit (see Aghion et al. (2000)):

- ask B to report her type;
- then, if B reports:
  - a good type, then A keeps control;
  - a bad type, then A allocates control to B with probability $\frac{\widetilde{\pi}+\Delta}{\pi^*}$.

In the game generated by this mechanism, there exists an equilibrium in which: (i) B indeed reports her type truthfully and chooses b whenever she is control (that is, B does not signal her type through her stage 1 decision, but before- and directly- through her report); (ii) A chooses a whenever he is in control. In this equilibrium, A's expected payoff is equal to:

$$\left(1-\mu\frac{\widetilde{\pi}+\Delta}{\pi^*}\right)a+(1-\mu)\,\pi^c.$$

This revelation mechanism thus addresses the two problems mentioned above, since the revelation of B's type allows A to cooperate in stage 2 when -and only when- it is desirable to do so; however, this revelation has a cost: A must "reward" a bad type B for telling the truth, namely by granting control to that type in stage 1.

2.2 Transferable control

Whilst the above contract illustrates how control allocation can be used to induce truth-telling in an otherwise standard revelation game context, this contract suffers from obvious credibility problems: A has no incentives to transfer any control right to B once he knows B's type. It is thus worth exploring the case where A cannot commit to transfer control ex ante at the contracting stage, but can still choose to do so ex post at stage 1. This corresponds to the *(noncontractible-but-)transferable-control* case, in which one party, say A, has been initially put in charge of the stage-1 project, but yet can decide, at the beginning of stage 1, to transfer control over stage 1 action to B.

An example of this situation is the following: assume that undertaking the stage 1 action requires the acquisition of *skills and knowledge*, and party A is initially in charge of deciding who receives the required training, A or B; if the needed skills and knowledge are not easily verifiable, outside parties may be unable to assess who has received the required training, and A is in a position to decide who receives this training without being able to commit himself ex ante on that subject.

Transferable control is particularly relevant when the project involves many tasks and control can be contracted only "globally". It might then be inefficient to abandon all control rights to B at the contracting stage 0; for example, B might then behave in a "crazy" way for some aspects of the project, thereby

jeopardizing its overall return; yet, transferring control of the specific stage-1 *action* described above is potentially fine: even though it involves some stage-1 cost, such (partial) transfer of control may be worthwhile insofar as it allows A to acquire information about B that can be useful in stage 2 of the relationship. We shall thus assume that A is initially in control of stage 1 but can decide, at a previous stage 0, to transfer, *noncontractually but irreversibly*, control of the stage-1 action to B.

What will be the optimal contract under these assumptions ? Not surprisingly, there is little scope for message games in this transferable-control context. However, A may find it optimal to transfer control of the stage-1 action to B, in order to allow B to build a reputation, that is to signal her willingness to cooperate in the future. This however requires (see Aghion et al. (2000)):

- first, that B finds it in her interest to signal her type, that is, cooperate in stage 1 if and only if she is "good". This requires the gain from inducing A to cooperate in stage-2 to outweigh the cost of stage-1 cooperation by B if and only if B is good, that is, $\pi^c \geq b - 1$ and $\pi^* \geq \widetilde{\pi} + \Delta$.

- second, that the probability of a bad type, μ, is far enough from 0 and from 1, so that the gain for A from learning B's type is not too low.

Note that transferring control to B is less efficient for A than the revelation mechanisms that he could use if control of the stage 1 action were contractible: while A achieves the same payoff in stage 2 in both cases, he only obtains an

expected stage-1 payoff of $(1-\mu)$ in the transferable control case, while in the contractible control case, he obtains in stage 1:

$$\left(1-\mu\frac{\widetilde{\pi}+\Delta}{\pi^*}\right)a>1-\mu.$$

Therefore, if A could credibly commit to give away control, he would rather use a revelation mechanism and give control to B if and only if she accepts to reveal her bad type; it is only when control is noncontractible but transferable that the more intuitive reputation-building mechanism - of the form "give B a try, to see how she behaves" - becomes optimal.

3 Links with the literature

3.1 Reputation building

Our incomplete information story is related to game-theoretic models of reputation building, starting with the work of Kreps et al. (1982). Sobel (1985) and, more recently, Watson (1999), consider how varying the stakes of the relationship changes the evolution of reputation. However, these papers do not consider explicit contracts, or the link with contractual control rights and reputation.

Also related to our work is the argument of Boot et al. (1993) , who stress that "loan commitment contracts" that allow banks to unilaterally renege on their commitments imply that the bank's reputation for "fairness" is enhanced when they do not actually renege. Their paper however focuses on a specific

contractual device instead of looking at the issue of optimal contract design and the allocation of control rights in general.

3.2 Complete versus incomplete contracting

This paper is also related to the theory of incomplete contracts (see Grossman-Hart (1986), Hart-Moore (1990) or Hart (1995)). While this theory is widely adopted as a simple and natural framework to think about firms and organizations, its foundations have been debated. The debate has recently been spurred by Maskin and Tirole (1999a), who show that the ex ante non-describability of actions and states of nature assumed in the theory has no bite on the best implementable outcomes when: (i) message games can be fully relied upon, and (ii) *ex post* actions and payoffs are verifiable[4]. In response to this criticism, several papers (see Segal (1999), Hart-Moore (1999a), and Maskin-Tirole (1999b)) have taken the approach of assuming both, *ex post and ex ante contractibility* of actions[5], whilst at the same time introducing complexity and renegotiation constraints that limit the power of complete contracts to little more than what can be obtained without any contract or by simply allocating ownership.

In this paper, we do not rely on any difference between ex ante and ex post contractibility either. But we explore situations where actions are ex ante and

[4]See also Tirole (1999) and Maskin (2002) for examples of this result.

[5]Of course, this concerns "ex-post actions", that is, trade levels, not "ex-ante actions", that is, investment levels, which are assumed not to be contractible.

ex post *noncontractible*, and yet where control over these actions is contractible or transferable. In this partial contracting context, we can capture some of the main insights of incomplete contracts models, in particular the notion of governance structure, in a simple and well-founded way (allowing in particular for unrestricted message games)[6].

According to Hart-Moore (1999a), a key distinction between complete and incomplete contracting is the ability or inability to commit not to renegotiate the initial contract; our partial contracting approach restates this view in a more general fashion as a contrast between *a world where contracts can determine the entire relation between the parties* and *a world where contracts can only try and influence an existing underlying game between them.* This definition encompasses both classical moral hazard models and the various papers that focus on contract renegotiation, such as Hart-Moore (1988), Chung (1991), Aghion et al. (1994), Noldeke-Schmidt (1995) or Maskin-Moore (1999). In contrast to our paper, these papers do not feature the contractible control or transferable control actions of our typology.

Finally, our analysis departs from Dewatripont-Tirole (1994), Aghion-Tirole (1997), Aghion-Rey (1999), Legros-Newman (1999) and Hart-Moore (1999b) which also feature contractible control actions. However, in these papers, actions come at the end of the game and therefore cannot be used to influence further interaction. Moreover, these papers do not consider the concept of transferable control,

[6] On this issue, see also Dewatripont (2001).

an innovation which is shown here to be necessary to see the emergence of control allocation as a reputation-building device.

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