Incomplete Contracts and Renegotiation

RENEGOTIATION AND THE DYNAMICS OF CONTRACT DESIGN

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1. Introduction

Besides sunk costs and reputation, long-term contracts are an important form of commitment. In fact, in the imaginary world of Arrow–Debreu there is no room for other forms of commitment than the fully contingent long-term contract. At the risk of oversimplification, one could describe a large part of the theoretical research effort of the past three decades as a systematic attempt at understanding the implications of gradually limiting the set of feasible long-term contracts further and further away from the set of fully contingent Arrow–Debreu contracts. Thus, the theory of incentives was born in the 1960s when information constraints were introduced. Later, other constraints relating to the difficulties of describing and verifying contractual performance have been imposed thus leading towards the first formal foundations of a theory of property rights and ownership.

More recently, the role of renegotiation in limiting the commitment power of contracts has become the focus of attention. Basically, the possibility of renegotiation amounts to the addition of another constraint on the set of feasible contracts: now contracts must be not only 'incentive compatible' but also 'renegotiation-proof'. (When parties can commit not to renegotiate they have a choice of when to allow for renegotiation and when not. If this commitment possibility is withdrawn they are forced to renegotiate whenever there are ex-post gains from renegotiation. Since the outcome of this renegotiation is perfectly predictable they might as well write renegotiation-proof contracts).

The fact that renegotiation may drastically reduce the commitment possibilities of the contracting parties has already been recognized by

Schelling (1960) in his classic essay on bargaining and deterrence (see for instance his discussion on pages 24–25) but formal treatments of the constraints imposed by renegotiation have been developed only much later. A precursory paper by Hellwig (1977) looked at the implications of renegotiation for debt contracts, but the recent proliferation of papers has been mainly sparked off by the papers of Hart–Moore (1988) and Dewatripont (1986).

It turns out that the role of and issues raised by renegotiation are somewhat different when the contracting problem is set in an environment of asymmetric information as opposed to an environment of symmetric but unverifiable information. The next two papers in this session deal with each case in turn. In this introduction I shall discuss the basic ideas about renegotiation and briefly illustrate how these considerations are relevant to long-term debt.

2. General principles and results

All contracting problems, whether under asymmetric information or complete but unverifiable information share the feature that in order to achieve ex-ante efficiency one generally needs to specify ex-post outcomes that are Pareto-inefficient. This naturally creates the possibility of ex-post renegotiation, for once the contracting parties reach the point where an inefficient outcome is suggested by the contract, they can always tear up the initial contract and write a new Pareto-improving contract. As a result, when the contracting parties are unable to commit not to renegotiate they will have to abandon these contracts designed to be executed without renegotiation.

The main distinguishing feature of contracting under asymmetric information with renegotiation, as opposed to contracting under symmetric but unverifiable information is that in the former case some ex-post inefficiency can be maintained by delaying the revelation of private information so as to renegotiate under asymmetric information, while in the latter case ex-post bargaining under symmetric information is always efficient.

2.1. Renegotiation under asymmetric information

2.1.1. Bilateral contracting
All three classic cases of contracting under asymmetric information (adverse selection with screening; adverse selection with signalling and moral hazard) have been extended to incorporate the possibility of ex-post renegotiation; The general method for deriving the optimal contract is the same in all three cases. One appeals to the well known *revelation-principle* and to the *renegotiation-proofness principle*. The latter says that one can without loss of generality restrict the set of possible contracts to the class of contracts which

are not renegotiated. Given any non-renegotiation-proof contract, the parties can anticipate exactly how this contract will be renegotiated in each state; thus, they can simply include this renegotiation into the initial contract. Consequently, the possibility of renegotiation simply introduces an additional constraint on the set of ex-ante feasible contracts, namely *renegotiation proofness*.

What are the effects of this constraint? In particular, is this constraint ever binding? And if it is does renegotiation-proofness eliminate the commitment value of long-term contracts altogether? These are the important questions posed in the literature. Some reasonably straightforward answers to these questions can be given in the framework of contracting with adverse selection and screening: basically, the possibility of *renegotiation slows down the speed of information revelation* [see Dewatripont (1986), Hart–Tirole (1988) and Laffont–Tirole (1987, 1988)].

As an illustration, consider the contracting problem where an uninformed seller faces a buyer who may purchase goods repeatedly over time from that seller. The optimal contract under full commitment would reduce everything to a single one shot transaction. It would specify inefficiently low purchases for a consumer with low willingness to pay so that consumers with a higher willingness to pay receive a lower informational rent. This allocation is no longer feasible in the presence of renegotiation, for once the buyer has revealed that she has a low willingness to pay, the contract will be renegotiated. To keep the contract from being renegotiated after the first purchases, the seller must then either eliminate distortions in future consumption (this would generally not be profit-maximising for the seller) or the seller must structure the contract so that he does not learn the buyer's type perfectly after the first purchases. In the latter case, the presence of renegotiation slows down the speed of information revelation.

Note that the same effect obtains when the seller is not allowed to write any long-term contract at all. If the buyer and seller can only make spot-transactions then the former will not reveal her willingness to pay early on for fear that the seller will use this information to charge higher prices in the future (this is the classic *ratchet effect* [see Weitzman (1976) and Freixas–Guesnerie–Tirole (1985)]. One may therefore naturally ask whether a renegotiation-proof contract has any commitment value at all?

The answer to this question is not obvious. In some situations a sequence of short-term contracts yields the same outcome as a renegotiation-proof long-term contract, in others one does strictly better by writing a renegotiation-proof long-term contract [see Hart–Tirole (1988)]. The latter contracts tend to generate outcomes that dominate allocations obtained with a succession of spot transactions whenever the parties improve efficiency through intertemporal transfers. These are feasible with long-term renegotiation-proof contracts but not with a sequence of spot transactions.

The general ideas discussed so far also apply to situations where the informed party makes the offers at the various negotiation stages. Renegotiation by informed principals has been studied by Maskin–Tirole (1988) and Gale–Hellwig (1989). The fundamental new feature that is introduced in this setting is the multiplicity of equilibria inherent to all signalling games. This multiplicity creates a problem: which equilibrium in the renegotiation game will the parties predict when designing the initial contract? Maskin–Tirole deal with this difficulty by defining two notions of renegotiation-proofness:

(1) a contract is *weakly renegotiation-proof* if there exists one equilibrium of the renegotiation game where the parties agree to stick to the initial contract.

(2) a contract is *strongly renegotiation-proof* if there exists no equilibrium of the renegotiation game in which the contract is renegotiated.

Maskin–Tirole show that if one insists on strong renegotiation-proofness the set of ex-ante implementable allocations is the same whether the informed or uniformed party makes the offers. However, it is not clear why the parties should insist on strong-renegotiation proofness. Moreoever, such contracts do not always exist. With weak renegotiation-proofness interesting issues of *forward induction* arise: how does the form of the initial contract indicate which equilibrium in the renegotiation game will be played? This question is one aspect of the more general problem of renegotiation-design [see Gale–Hellwig (1989) for a thought-provoking discussion on these issues].

The effects of renegotiation in the standard Principal-Agent problem with moral hazard are slightly different. Fudenberg–Tirole (1988) have looked at the following set-up. After the initial contract is written, the risk-averse agent takes a hidden action. Some time elapses before the outcome of that action is known, so that after the action is taken the risk-neutral Principal can offer to renegotiate the contract. If the principal could perfectly infer what action the agent has chosen he would want to renegotiate the initial imperfect insurance contract to a perfect insurance contract. But if the agent anticipates this renegotiation, he would shirk and an inefficient outcome obtains. Thus the optimal renegotiation proof contract is such that the agent randomises over his choice of action so as to keep the Principal guessing in the renegotiation stage and thus eliminating some of the gains from renegotiation. The result is that renegotiation induces *undersupply of effort* relative to the full commitment solution and sometimes the agent gets a positive rent from the contract. Incidentally, this theory may possibly serve as a justification for efficiency wages even when workers are able to post bonds.

2.1.2. Contracts with third parties and renegotiation

There are many situations where agents could improve their bargaining power and firms protect their monopoly rents by writing binding contracts with third parties. Thus an incumbent firm could protect its monopoly rent from potential competition by writing a contract with the managers of the

firm inducing them to be extremely aggressive towards entrants. Foreseeing the aggressive response potential entrants would then decide not to enter. Such contracts seem implausible and perhaps the very reason why they are not convincing is that they can easily be renegotiated.

There are two levels at which renegotiation reduces the commitment power of such contracts. First, in the above example if entry occurs the owners of the incumbent firm and its managers may have an incentive to renegotiate the contract so as to accommodate entry. The initial contract then has no effect on entry, unless this renegotiation takes place under asymmetric information [see Dewatripont (1988) on this point]. Secondly, even if the contract with the third party is ex post efficient when entry occurs, its commitment value may be undermined if there are gains to secret renegotiation prior to the entry decision [see Katz (1987) and Bolton–Scharfstein (1989)]. Basically, secret renegotiation eliminates to a large extent the incumbent's first-mover advantage in writing contracts with third parties (in effect, contracts become non-observable). The entrant and the incumbent then end up playing a simultaneous-move game where the incumbent's strategies are contracts and the entrant's strategies are enter or stay out. Whether the renegotiation-proof contracts still have a strategic effect depends largely on whether they are used to mitigate agency problems or not.

There is now a growing literature in industrial organisation exploring the implications of competition between managerial firms. More often than not, misleading results are obtained because of the assumed excessive commitment value of agency contracts between managers and shareholders. I believe that if one takes into account the possibility of renegotiation of these agency contracts one would end up with a more satisfactory theory of competition between managerial firms.

2.2. Renegotiation under symmetric but verifiable information

The basic framework analysed by the literature is as follows: consider a contract on future trade between a buyer and a seller. Neither knows in advances the net value of trade. This becomes observable ex-post but remains unverifiable to a third party. Thus the ex-ante contract cannot be made directly contingent on the net value of trade. The parties may wish to make the terms of trade contingent on the realisation of the state of nature either for risk-sharing reasons or to induce correct ex-ante investment by the buyer and seller. In the absence of any contract on future trade, there will be efficient ex-post bargaining; so that, trade only takes place if the net value of trade is positive. But the resulting division of surplus across states may not be ex-ante optimal.

An obvious but nevertheless fundamental point made by Hart–Moore (1988) is that quite generally even renegotiation proof contracts dominate the outcome under ex-post bargaining. The reason is that the ex-ante contract

can be constructed in such a way that it can shift the bargaining power of the agents away from the no contract bargaining position either in favour of the buyer or the seller; and only by accident would the no contract bargaining position produce the right ex-post bargaining outcome from an ex-ante perspective. Thus, by writing a long-term contract the agents could move closer to the first-best outcome. The difficult problem in this set up is determining the extent to which the ex-ante contract can manipulate the ex-post bargaining outcome by 'redesigning the ex-post renegotiation process' so as to move closer to first-best efficiency.

For instance, if the problem is one of inducing the right amount of ex-ante investment, then the set of final allocations that is implementable depends in a crucial way on the underlying trade technology:

– Hart–Moore suppose that a unanimous agreement by the buyer and the seller is required for trade to take place. That is, neither the buyer nor the seller can unilaterally enforce trade at the price specified in the ex-ante contract. This is a reasonable assumption, for example, when the underlying good to be traded is not describable ex-ante but becomes describable ex-post [see Grossman–Hart (1986) for a discussion of this point]. Under these conditions, and within a specific bargaining game (where deadlines play a crucial role) Hart–Moore establish that optimal renegotiation proof contracts induce ex-ante underinvestment. In other words, renegotiation is a sufficiently severe constraint in this case to prevent the implementation of the first-best allocation. [Green–Laffont (1988) obtain a similar result in a different setting where there are no deadlines in bargaining and where consequently there is no final period where if no agreement is reached the parties implement the inefficient initial contract]. This is a striking conclusion; it is the first formal derivation of Williamson's underinvestment result in an explicit model of incomplete contracting with renegotiation. Unfortunately, this strong prediction is somewhat undermined by two recent papers by respectively Maskin–Moore (1988) and Aghion–Dewatripont–Rey (1989) (ADR). In the latter paper it is shown that the underinvestment result of Hart–Moore goes away in environments where trade can be imposed unilaterally by either party at the price prespecified in the initial contract. Simple use of outside options in the renegotiation game generates the correct marginal incentives to invest for both parties (see the last paper in this session). *One concludes that the underinvestment result has less to do with the nonverifiability of the state of nature than with the inability to describe the transaction ex-ante.* A more general novel aspect of the paper by ADR is the idea that the initial contract can be used to specify the rules as well as the starting point of renegotiation. It is in this sense that the initial contract truly designs renegotiation.

Finally, the paper by Maskin–Moore warns us that with more than two players renegotiation proofness is a very weak constraint on the set of ex-

post implementable outcomes. Recall that the main constraint imposed by renegotiation is that Pareto inefficient 'punishments' are no longer feasible. Maskin–Moore point out that, roughly speaking, with more than two agents the majority of players can effectively impose Pareto efficient punishments on the minority and they show that these punishments can (under weak conditions on the bargaining solution) be as effective as Pareto inefficient punishments.

3. Debt and renegotiation

There is now a wide literature on debt-forgiveness and rescheduling. Most of this literature is only concerned with third-world debt and almost exclusively analyses the ex-post situation when a debtor country is in a situation of default. I shall briefly discuss how the theory of optimal contracts with renegotiation can provide insights into this problem. An immediate general lesson that can be drawn from this literature is that ex-post renegotiation hurts ex-ante efficiency. If the creditor cannot commit to cutting funds to inefficient projects in the future there may be both too little overall investment in good projects and too much investment in bad projects. The reason why the creditor may be unable to commit to stop funding is that in the future it may become optimal to continue funding a project that has a negative ex-ante net present value.

Perhaps a more interesting and less obvious point that emerges from the literature on debt and renegotiation is that even allowing for renegotiation under symmetric information, optimal debt contracts may involve inefficient ex-post liquidation. This problem arises partly because the debtor cannot commit to repaying the creditor when the project generates positive revenues and partly because the private costs of liquidation of the borrower are ignored by the creditor [see Aghion–Bolton (1988), Hart–Moore (1989) and Bolton–Scharfstein (1989)].

A third aspect concerns the issue of long-term versus short-term debt. Very roughly, a sequence of short-term debt involves a lot of renegotiation, allows the creditor(s) to be often involved in the decision making process of the firm (or country) and thus creates a potential for excessively early liquidation. While long-term debt (with correspondingly lower early repayments) can minimise the likelihood of early liquidation at the cost for the creditor of greater difficulties at inducing repayment of the debt [see Hart–Moore].

These are three important insights emerging from the literature on dynamic contracting with renegotiation. However, many issues (concerning in particular long term debt contracts) remain ill understood. I shall just mention two. First, it is not clear to what extent one can restrict oneself to renegotiation-proof contracts, particularly when the initial contract is incomplete. In practice we observe a lot of renegotiation, yet the theory tells us

that we should not observe any. Does this mean that the contracting parties fail to foresee certain contingencies or that they find the contracting costs of writing down renegotiation-proof contracts prohibitive? [see Hart–Moore on this latter point]. Second, when more than one creditor is involved, to what extent can one reduce the contracting problem to a bilateral problem where all the creditors are bunched together?

References

Aghion, Philippe and Patrick Bolton, 1988, An incomplete contract approach to bankruptcy and the financial structure of the firm, Technical report no. 536 (IMSSS, Stanford University).

Aghion, Philippe, Mathias Dewatripont and Patrick Rey, 1989, Renegotiation design under symmetric information, Mimeo. (MIT).

Bolton, Patrick and David Scharfstein, 1989, A theory of predation based on agency problems in financial contracting, American Economic Review (forthcoming).

Dewatripont, Mathias, 1986, Renegotiation and information revelation over time in optimal labour contracts, in: On the theory of commitment with applications to the labor market (Ph.D. thesis, Harvard).

Dewatripont Mathias, 1988, Commitment through renegotiation-proof contracts with third parties, The Review of Economic Studies 55, no. 183.

Freixas, Xavier, Roger Guesnerie and Jean Tirole, 1985, Planning under incomplete information and the ratchet effect, The Review of Economic Studies 52, no. 169.

Fudenberg, Drew and Jean Tirole, 1988, Moral hazard and renegotiation in agency contracts, Mimeo. (MIT).

Gale, Douglas and Martin Hellwig, 1989, Repudiation and renegotiation: The case of sovereign debt, International Economic Review 30, no. 1.

Green, Jerry and Jean-Jacques Laffont, 1988, Contract renegotiation and the underinvestment effect, Mimeo. (Harvard).

Grossman, Sandy and Oliver Hart, 1986, The costs and benefits of ownership: A theory of vertical and lateral integration, Journal of Political Economy 94, no. 4.

Hart, Oliver and John Moore, 1988, Incomplete contracts and renegotiation, Econometrica 50.

Hart, Oliver and John Moore, 1989, Default and renegotiation: A dynamic model of debt, Mimeo. (MIT).

Hart, Oliver and Jean Tirole, 1988, Contract renegotiation and Coasian dynamics, The Review of Economic Studies 55, no. 184.

Hellwig, Martin, 1977, A model of borrowing and lending with bankruptcy, Econometrica 45, no. 8.

Katz, Michael, Game-playing agents: Contracts as precommitments, Mimeo. (Berkeley).

Laffont, Jean-Jaques and Jean Tirole, 1987, Comparative statics of the optimal dynamic incentive contract, European Economic Review 31.

Laffont, Jean-Jacques and Jean Tirole, 1988, Adverse selection and renegotiation in procurement, Mimeo. (MIT).

Maskin, Eric and John Moore, 1988, Implementation and renegotiation, Mimeo. (Harvard).

Maskin, Eric and Jean Tirole, 1988, The Principal-agent relationship with an informed principal, II: Common values, Mimeo. (Harvard University Press, Cambridge, MA).

Schelling, Thomas, 1960, The strategy of conflict (Harvard University Press, Cambridge, MA).

Weitzman, Martin, 1976, The new Soviet incentive model, Bell Journal of Economics 7.