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Political Treaties as Incomplete Contracts

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The Government As a Firm

What is a firm? This was the opening question in the seminal paper by Grossman and Hart (1986), but their answer and analysis have had implications far beyond the initial question. Incomplete contracts and hold-up problems are now familiar concepts also in the field of political economy. This may not be very surprising, since a leading candidate to the initial question is "a governance structure." The firm is a governing institution, and as such it shares many features with public and political governments. The issue of "how to organize the firm" has the analogous "how to organize political institutions."

Personally, I learned this analogy the hard way. I was a visiting student at Harvard, and Oliver Hart had kindly agreed to be my host. I guess this made him feel that he had to chat with me from time to time, even though I kept on talking about politics and political institutions rather than Oliver's theory of the firm. Our somewhat different interests required some tactic. To catch his attention, it did not suffice to depart from existing theory and intuition and apply them in another area. Nor was it sufficient to depart from the particular details of political institutions and let this guide new extensions. Either one of these approaches were unlikely draw more attention than Oliver's window or ceiling. Instead, the solution was to show how political lessons could illuminate aspects that were important but overlooked in the traditional theory of the firm. This chapter surveys some of the (preliminary) fruits of my (ongoing) effort to impress Oliver.

To satisfy space constraints, I do not formally present any model. Instead, the claims that follow should be interpreted as possibilities which hold under certain assumptions. The details of sufficient assumptions and proofs can be found in the papers I draw on (Harstad 2005, 2012, 2015).

The next section starts by allowing for many agents (you may call them districts or countries). It then studies how a voting rule affects the hold-up problem and the incentives to invest in collective projects. The main message of this section is that the hold-up problem can be solved by carefully selecting the voting rule. The following section permits dynamics and an infinite time horizon. This allows us to analyze how the hold-up problem is influenced by the duration and the terms of the contract and also discuss how these aspects of the contract should be designed to reduce the cost of the hold-up problem. I also discuss renegotiation design (and how this can implement the first-best outcome) before I conclude.

Multiple Agents and Majority Requirements

Most papers on the hold-up problem assume that there are two agents (an exception is Hart and Moore 1990). In legislatures or international politics, however, there are typically many more than two agents. Furthermore, they may take decisions by voting rather than simply bargaining. This changes the hold-up problems in several ways.

Consider a setting where a number of districts first invest in a public project. An example can be liberalization of agricultural policies within the European Union. The more a country invests (by modernizing its sector), the more it benefits (and the more competitive it will be) if the public project is implemented. After the countries have invested, preference shocks may distort the country-specific as well as the aggregate value of the public project. Once the realized values can be observed, the countries determine whether to implement the public project or instead stick to the status quo.

At the bargaining stage, it is both transparent and useful to separate two processes. First, the coalition is formed. One may assume that one of the representatives are randomly drawn to propose a coalition: with a continuum of agents, the outcome is the unique core at this stage of the game. Second, the coalition members negotiate two aspects of the policy: whether to implement the final decision and a set of side transfers among all the countries. Assume that the bargaining outcome at this stage is characterized by the Nash bargaining solution. This ensures that every coalition member receives the same utility relative to the status quo. This assumption can be relaxed and replaced by noncooperative bargaining if unanimity is required within the coalition (in particular, one could assume that a randomly drawn coalition member can make a take-it-or-leave-it offer to the other members). Finally, the countries vote. The negotiated proposal passes if it is approved by the required majority. In addition, one may require that no country should prefer to exit the union, that is, one cannot

transfer an unlimited amount of side payments from other countries, even if they do not belong in the majority coalition.

In equilibrium, the countries that are not in the coalition will be taxed up to the point where their participation constraints bind. Therefore, the majority coalition is able to extract the entire surplus when contemplating to implement the public project. The coalition will thus implement the public project if and only if it raises total surplus: the Coase theorem holds and the voting rule is irrelevant.

Proposition 1. The project is implemented if and only if it increases total surplus, regardless of what the majority requirement is.

This result is in stark contrast to the traditional view (as in Grossman and Hart 1988; Aghion and Bolton 2003), where transaction costs ensure that the voting rule will affect the selection of projects.

Although the coalition will make the decision that maximizes social surplus, the distribution of side transfers within the coalition is not necessarily even. Instead, transfers will go from those countries inside the coalition which have a high value of the project to those countries that benefit less. We may say that countries with low valuation has more bargaining power. This is the standard hold-up problem.

Since we are solving the game by backward induction, consider next the coalition formation stage. The size of the coalition will, in equilibrium, be equal to the majority requirement. That is, this model predicts a minimum winning coalition, as did Riker (1962). More interesting is to study the identity of the coalition members: in equilibrium, the coalition will consist of those countries that value the project the most. These countries do not need to be compensated to vote in favor of the project, and instead they are ready to compensate others. Thus, a country has more political power, in the sense that it is more likely a member of the majority coalition, if it has invested a lot in the public project.

Proposition 2. A country that values the project more has less bargaining power but more political power.

At the investment stage, the countries anticipate all this, and they know that more investments will reduce their bargaining power but raise their chances of being included in the majority coalition. But what is the value of political power? Well, that depends on the majority requirement. If the majority requirement is large, perhaps close to unanimity, then political power has a low value: most countries will, in any case, be a member of the coalition, and few can be

exploited and taxed. In equilibrium, countries will invest little since the concern for their future bargaining power is more important than the value of gaining political power. If, instead, the majority requirement is small, then political power has a much larger value: a large minority can then be taxed and the total surplus is distributed on relatively few coalition members. In this situation, a country will be motivated to invest a lot since that raises the chance of gaining political power. The concern for bargaining power will play a less important role.

Proposition 3. If the majority requirement is large, the hold-up problem dominates and countries invest little. If the majority requirement is small, the concern for political power is more important and countries may invest more than is socially optimal.

To summarize, the majority requirement is not affecting the collective decision, given the realized valuations of the project, but it does affect how much a country is willing to invest and raise their expected value of the project. Hence, one should select the majority requirement such that the incentives to invest are just right.

Proposition 4. When the voting rule is optimally chosen, the concern for political power cancel with the hold-up problem and investments are first-best.

In Harstad (2005), I show how the optimal majority requirement can be derived as a function of the other parameters in the model: the expected value of the project, the heterogeneity among the countries, and the variance of the preference shocks. The paper further argues that the predictions regarding the optimal voting rules are consistent with the actual voting rules of the European Union.

Although the model above is motivated by political decision making, the argument can be applied also to firms. Martinelli and Sicotte (2011) have developed such a voting model for legal cartels and empirically documented that the model can rationalize the empirical pattern of voting rules in U.S. cartels.

Dynamics and Duration

In many international settings, unanimity is always required. There is currently no hope of forcing through a climate agreement, for example, without the consent of every participating country. The climate application also reminds us that it can be important to capture the dynamic nature of the problem. Following the

Kyoto Protocol, the countries negotiated the vector of emission reductions for a five-year period (2008–12), but investments in the complementary technology (such as abatement technology or renewable energy sources) were left to each individual country to decide.

The setting above will now therefore be modified in the following ways (for details, see Harstad 2012 and 2015). There is an infinite time horizon and the stages where countries invest and the stages where they contribute to the public good are sequentially alternating. They may also negotiate and sign binding contracts/treaties or agreements—specifying every country's contribution (i.e., abatement level) to the public good. In contrast to the foregoing setting, we allow for a nonbinary public project and each country's individual contribution is up for negotiations. Again, we can let the Nash bargaining solution characterize the outcome.

Once the contributions (i.e., the emission quotas) have been negotiated, each country can top its consumption of fossil fuels by investment in renewable energy sources. Alternatively, it can reduce the cost of its emission reduction by investing in modern abatement technology. Such investments are more beneficial under (and thus complementary to) a tough and demanding treaty which allows for little emissions.

In the next bargaining round, the countries with the best technology will find it cheapest to contribute. The other countries will hold them up and require that the technology-leading countries contribute the most in the contract. This is, again, the hold-up problem, and when countries anticipate to be held up at the investment stage, they will certainly invest too little. The discouraging effect of the hold-up problem will be at the largest when the next round of negotiations is near.

Proposition 5. The shorter the duration of the contract, the lower the equilibrium investment levels.

In fact, the countries may invest less in a setting with short-term agreements than they would if there were no bargaining game coming up (this possibility was first observed by Buchholz and Konrad 1994). The explanation is that when future negotiations are anticipated, the countries do not find it necessary to take a prompt and unilateral action already today. The problem will in any case be "solved," to a certain extent, by the upcoming negotiations, and costly investments in green technology can wait. If investments are important (i.e., if they are relatively cheap such that they should have been relied on to a larger extent), then the reduced investments associated with short-term agreements can lower payoffs relative to a noncooperative situation with no agreement at all.

Proposition 6. A short-term agreement can be strictly worse than no treaty.

To avoid this hold-up problem and motivate more investments, the countries are better off negotiating a more long-lasting agreement. That is, they may contract on the contributed quantities not only for this period but for several periods ahead. This certainly reduces the hold-up problem, and investments increase. The raise in investments is particularly desirable if the hold-up problem is large, that is, when investments are sensitive to the hold-up problem or if there are technological spillovers (i.e., positive externalities) when countries invest. The cost of such a long-lasting agreement may be that it is hard to guess today on the optimal contribution levels for the future when one cannot contract on the realization of future preference shocks. That is, we do not yet know how severe the climate change problem is in 80 years. By comparing the cost and the benefit of more long-term commitments, we can conclude that the contract duration should be longer if the hold-up problem is severe.

Proposition 7. The larger the hold-up problem, the more long-lasting the agreement should be.

If the technological spillovers are large, for example, the agreement should be more long-lasting. I derive an explicit formula for the optimal duration in Harstad (2015).

Terms and Toughness

A more long-lasting agreement is not the only way of motivating investments. The "depth" of the contract will also matter. In particular, if the quantities (which each country must abate or contribute to the public good) are large, then a country will find it necessary to invest to reduce the cost of complying to the contract. That is, if a country is committed to abate a large fraction of its pollution (or if it is facing a low emission quota), then it must instead invest more in renewable energy sources so as to be able to consume a desirable amount of energy without relying on consuming fossil fuels. The larger the required abatement quantities (of public good provision), the larger the equilibrium investment levels.

Combined, this suggests that a "tough" contract (with low emission quotas or large required quantities of public good provisions) is particularly important when the duration of the contract is short, since that is when the hold-up problem would otherwise severely reduce the incentives to invest.

Proposition 8. The shorter is the duration of the contract, the tougher it should be.

Harstad (2012) lays out the assumptions and the proofs backing up these results.

One problem is that although any fixed-term contract may look like a long-term contract at the time of ratification, once the expiration date is approached, it tends to look more and more like a short-term contract—given the short time that remains before the contract expires. Once the expiration date is approached, the countries become more concerned with how their investments will deteriorate their bargaining power once a new treaty is to be negotiated. To encourage countries to invest also at this stage, the required abatement quantities must increase and the contract should thus become tougher to satisfy toward the end.

Proposition 9. The contract should be tougher to satisfy toward its end.

We can apply similar logic when countries have heterogeneous investment costs. Since equilibrium investments will be larger when the contract is tough, it is particularly important to impose tough requirements on those countries that have the largest potential to invest. That is, countries that face relatively small investment costs should face smaller emission quotas than countries with high investment costs.

Proposition 10. The contract should be tougher to satisfy for countries with low investment costs.

In Harstad (2012), I allow for heterogeneous investment costs and show that the technology leaders should and will, in equilibrium, consume less energy than countries with high investment costs. This result may at first appear counterintuitive, but the explanation is that such differentiation is necessary to give the various countries the right incentive to invest.

Renegotiation Design

The contract outlined in the previous section is not "renegotiation-proof": to ensure that countries had sufficiently large incentives to invest, the optimal contract had to be tougher than what were likely going to be optimal ex post, particularly if the contract duration were relatively short. Once the investments are sunk, this implies that the countries can gain by relaxing the initial contract and allow each other to pollute a little bit more. If such renegotiation cannot be

prevented and is anticipated, would it then be harder to design an agreement which encouraged the countries to invest?

The answer is no—quite the contrary. If renegotiation is possible, the first-best can be implemented. To understand this result, suppose the timing of the game is the following. First, the countries negotiate contribution levels for the future. Next, they noncooperatively decide how much to invest in complementary technologies. Then, before the commitments are carried out, they renegotiate the initial contract.

When the renegotiation game is without transaction costs (i.e., side transfers are permitted), then a Coasian argument suggests that the contribution levels will indeed be first-best, conditional on the existing levels of technology. The initial contract, negotiated at the beginning, does not change this fact. Instead, the initial contract will influence the incentives to invest. If the initial contract is very tough, then a country has to invest quite a lot to avoid being "desperate" when the initial contract is up for renegotiation. A country that instead invests little at this stage will be in severe trouble if the initial contract is eventually enforced. Such a country's willingness to pay to renegotiate the contract is then large and the other countries can take advantage of this.

Note that the hold-up problem is now going in the opposite direction : with no initial agreement, investing more reduces a country's bargaining power. With a tough initial agreement, instead, investing more makes the country comfortable with the status quo and it will get an upper hand in the negotiations.

Proposition 11. Renegotiation ensures that the contribution levels are ex post optimal. The initial contract only affects the incentives to invest.

By fine-tuning the initial contract, the incentives to invest can be just right. The initial contract is then ensuring that the incentives to invest are socially optimal, while the renegotiation stage ensures that the contribution levels will be optimal. Just as before, the initial contract should be relatively tough to ensure that countries are motivated to invest. That is, the contract should be tougher (by requiring larger contributions to the public good) than what is expected to be socially optimal ex post—and this difference is larger if the duration of the agreement is short.

Proposition 12. In equilibrium, the countries make ambitious promises to reduce pollution in the future, but once the future arrives, the commitments are renegotiated and relaxed. This procedure implements the first-best outcome.

The above results hold whether the initial contract lasts a single period or any (finite) number of periods. Sufficient assumptions and proofs are presented

in Harstad (2012). As many readers may recognize, the reasoning draws on the lessons from renegotiation design as analyzed by Aghion et al. (1994), Edlin and Reichelstein (1996), and Segal and Whinston (2002), among others. However, these papers consider a relatively static situation (Guriev and Kvasov 2005 is an exception) and a situation with only two agents. For political situations, it is important to know how renegotiation design can work when the situation is much more complex.

Coalition Size and the Benefits of Contract Incompleteness

When countries can decide between participating in the negotiations or opt our and free-ride, then countries have a strong incentive to free-ride and the equilibrium coalition tends to be very small. That prediction changes radically when contracts are incomplete, however: in fact, the equilibrium coalition can be much larger when contracts are incomplete, and this can make an incomplete contracting environment welfare-improving compared to a complete contracting environment. This finding may rationalize why climate agreements tend to be incomplete (by letting technology investments be unspecified).

To understand this result (proven in Battaglini and Harstad, 2016), suppose there is an equilibrium coalition size m*. Consider a country that will participate in equilibrium, but who is tempted to free-ride. By participating, the coalition of size m* will sign a long-lasting agreement to mitigate the hold-up problem. By free-riding, instead, the coalition size will be m*-1 and that remaining coalition must decide between a long-lasting agreement of size m*-1 or a short-lasting agreement, expecting the one-shot deviator to return to the coalition at the next opportunity. Unless m* is too large, the coalition will prefer the latter option. The short-term agreement, however, implies that every country will invest little as long as the deviator free-rides; this is harmful also for the deviating country. Facing this credible threat, the temptation to free ride is relatively small, and a large coalition size m* can be sustained. If the contract were complete (specifying investments, as well), then investments would not collapse if one deviation motivated a short-term agreement, and the incentive to free-ride would thus be larger (and, hence, the equilibrium coalition would be smaller).

Proposition 13. If the contract is incomplete, rather than complete, then the equilibrium coalition size is larger, and so is efficiency. The hold-up problem is a credible out-of-equilibrium threat which disciplines countries and motivates participation.

Conclusions

This chapter shows that the hold-up problem is important in politics as well as in business. Districts decide on how much to invest or prepare for federal policies and, internationally, countries decide on how much to invest in green technology before negotiating climate treaties.

The focus on politics makes it natural to permit more than two investing entities. This, in turn, makes it reasonable to consider voting instead of negotiations requiring unanimity. The majority requirement will then be crucial for the magnitude of the hold-up problem. In fact, selecting the appropriate voting rule can mitigate the hold-up problem.

The focus on international treaties makes it natural to introduce dynamics and multiple periods. It then becomes evident that the hold-up problem is particularly severe when the treaty is close to its expiration date. Short-term treaties may thus be very costly, and it is possible that no agreement is better than short-lasting ones. At the same time, investments may be encouraged by designing a tougher agreement, where each country is required to contribute more to the public good (or less to pollution). Consequently, the treaty should be tougher if it is short-lasting, close to the expiration date, or if investments are considered to be fundamentally important as a solution to the public good problem.

If countries can decide between participating in the coalition and free-riding, then free-riding may induce the remaining coalition to sign a short-term agreement while it waits for the deviator to return to the table. The short-term agreement generates a costly hold-up problem if the contract is incomplete; and the temptation to free-ride is then smaller. Hence, incomplete contracts may be beneficial since they lead to larger coalitions.

Most of the results hold no matter whether the initial contract can be renegotiated. If renegotiation is possible, the single purpose of the initial contract is to set the stage and motivate the countries to invest. Thereafter, the renegotiation stage ensures that the contribution levels will be socially optimal. Combined, a careful renegotiation design can ensure that the first-best outcome is implemented, even in a political environment that is much more complex than simpler models with only two players and two stages. This way, politics can motivate extensions that are important although overlooked in the traditional theory of the firm.

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